Cook Shire
COUNCIL

Lakeland

Drinking Water Quality Management Plan

+ DOCUMENT CONTROL SHEET

REGISTERED SERVICE PROVIDER: COOK SHIRE COUNCIL
ADDRESS: 10 FURNEAUX ST
COOKTOWN, QLD, 4895
P.O. BOX 3

CONTACT DETAILS: PHONE: 07 4069 5444
FAX: 07 4069 5423
E.MAIL MAIL@COOK.QLD.GOV.AU

SPID. 511

VERSION	AUTHOR	REVIEWED	APPROVED	DATE
V4	Dr Michael Lawrence	Robert Fenn		29 March 2016
V4.1	Dr Michael Lawrence	Robert Fenn	Robert Uebergang	15 April 2016
V4.2	Reviewed by Dr Robyn Maddalena	Les Treloar/Wal Welsh	Robert Uebergang	23 April 2018
V4.3	Reviewed by Dr Robyn Maddalena	Wal Welsh/Cath Hocking	David Klye	10 December 2019
V4.4	Reviewed by Dr Robyn Maddalena	Wal Welsh/Cath Hocking	David Klye	31 March 2020
V4.5	Reviewed by Dr Robyn Maddalena	Wal Welsh/Cath Hocking	David Klye	15 January 2021
V5	Reviewed by Dr Robyn Maddalena	Wal Welsh/Cath Hocking	Peter Tonkes	1June 2022

+ CONTENTS

LIST OF FIGURES

LIST OF TABLES

+ GLOSSARY

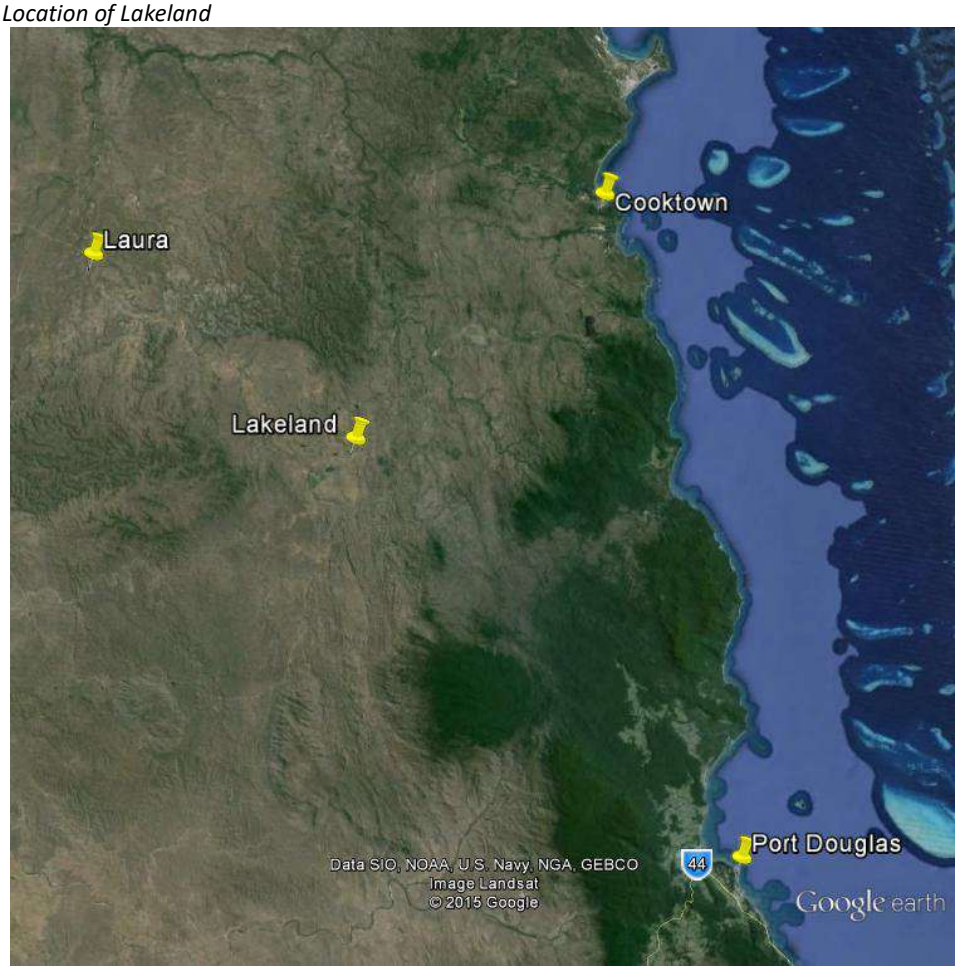
Term	Definition
ADWG	Australian Drinking Water Guidelines 2011
CSC	Cook Shire Council
DRDMW	Department of Regional Development, Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
PHR	Public Health Regulation 2005
RMIP	Risk Management Improvement Program
QH	Department of Health Queensland
WSR	Water Supply Regulation
WS(SR)A	Water Supply (Safety and Reliability) Act 2010

1 LAKELAND

1.1 Overview

Lakeland is a small community of ~115 people (43 connections) located approximately 80 km from Cooktown. The scheme is a bore scheme with 3 operational bores with chlorination as the only treatment.

Figure 1 Location of Lakeland



2 INFRASTRUCTURE –

2.1 Lakeland WTP

Lakeland scheme utilises multiple bores that are chlorinated prior to reticulation. As the surrounding region is quite flat, mains pressure is maintained by pressure pumps.

Figure 2 Location of Infrastructure

2.1.1 Bores

Lakeland has 3 operational bores, West, East and Army Bores. Each of the Bores has limited production capabilities producing approximately 1.3 L/s. The bore report cards for West and Army bores contain almost no information. These bores are all in close proximity, and are believed to tap the same aquifer – the Maclean basin. The new East bore is located in the Lakeland water compound. Army Bore is only used as a backup supply.

The three bores are chlorinated with no other treatment. The Lakeland Water Supply now is an unmanned fully automated process, connected to SCADA, which can be controlled / monitored from Cooktown. The site is visited once a week.

Army bore is located next to a property that has been placed on the contaminated land register in 2005 due to historic dumping and burial of ~200 pesticide drums prior to 1992. Whilst it was initially believed some of the drums were full, Council, with EPA has undertaken investigations to determine whether this poses a risk to the water table. As shown in the water quality data, there have been no detections of any pesticide in the Army Bore, despite a number of years of testing. We have included this in the risk assessment, and will continue to monitor. Raw water E. coli testing has commenced and Army Bore has E. coli in the raw water periodically. The bore is sealed and the source of the E. coli is not known. Army Bore is now only used as a backup supply in the event there is an issue with the operation of East or West bores.

2.1.2 Operation

The Lakeland Reservoir is a 5m high 250KL, lined panel reservoir constructed in 2017. It calls for water at 4.3 M and fills to 4.8m. When the reservoir calls for water, the 2 Bores (West Bore and East Bore) pump directly into the reservoir. Army bore is still operational but is used for a backup bore only. Council is looking at options for future bores.

The terrain at Lakeland is flat, so the mains pressure is via a Grundfos Hydro MPC Booster System with 3 Grundfos CRE10-06 pumps, these are controlled to maintain the pressure to the adjustable set point, with an input from a pressure sensor, as the mains pressure drops (due to consumption) then another pumps starts, if the pressure continues to fall to the next set point then the third pumps starts, alternatively as the pressure rises pumps stop as the cut out set points are reached. Lakeland is serviced with 3 phase power and all 3 pumps are fitted with variable speed drives thus decreasing the number of pump starts and pressure variations. Mains pressure can be adjusted and currently set at 330 KPA. This is the pressure that the Hydro Booster maintains. The duty pump alternates daily to distribute wear of the pumps.

During periods of "Loss of Mains Power", an auto change over switch will start the generator to provide power to the Lakeland bores and pressure pumps.

2.1.3 Disinfection

Disinfection is achieved with the dosing of sodium hypochlorite.

There are 2 chlorine pumps, 1 chlorine analyser and a recirculation system. The recirculation system recirculates water around the 250kL reservoir whilst a chlorine analyser monitors the chlorine residual. If the chlorine residual is lower than the set point, then the chlorinator starts and runs until the desired level of residual is reached. The recirculation system runs 24/7 so the reservoir water and chlorine are constantly mixed. When the Bores start, the inflow of un-chlorinated water dilutes the chlorine residual. This is measured by the analyser and starts the chlorine pump when the low set point is reached. The chlorinator has excess capacity to maintain the desired residual level.

2.1.4 Pressure pumps

A Grundfos Hydro MPC Booster System with 3 Grundfos CRE10-06 vertical multistage pumps supply the pressure for the reticulation mains, these are all controlled through the inbuilt PLC with input from a pressure sensor. One of the pumps becomes the daily duty pump, which runs continuously all day at a speed to maintain the set point pressure with the others cutting in and out as required, the duty pump is rotated daily to distribute wear & tear. This arrangement generally maintains mains pressure around 330 KPA. The pumps pump directly into the reticulation mains with a flow meter recording the instantaneous flow as well as the accumulated total volume.

2.1.5 SCADA

The SCADA was setup to monitor and operate the Lakeland plant as it's an unmanned facility.
The SCADA shows equipment status, e.g. running, off or faulted, shows levels of most tanks, mains pressure flow rates and accumulated values, shows plant voltage and amps drawn and trending is available for these parameters. Operating parameter can be altered via password protection.

2.1.6 Reticulation Mains

The reticulation mains are A.C., UPVC or Poly, with a maximum of 330KPA available this is well within the pressure rating of the pipes (1200KPA) and consequently we have few leaks or bursts, the mains have regular scouring to promote healthy mains

2.1.7 Detailed Process Steps

Water is supplied from the bores. The bores run for anywhere between 4 – 10 hrs / day depending on demand and the season. The normal flow rates for the pressure pumps are between almost zero to 1.2 L/s, with the flow rate rarely exceeding 1.5 L/s.

Water is chlorinated. Chlorine is added into the recirculation line. There is a recirculation pump that recirculates water through the reservoir. The sample point for the chlorine analyser is at the outlet of the reservoir. The water that goes through the chlorine analyser goes to waste.

As water is pumped to town, the reservoir is drawn down. When the level gets to 4.3m, the bores start to run and fill the reservoir. All bores run simultaneously when the reservoir calls for water. These bores all pump directly into the Clean Water Reservoir, which has been previously chlorinated, as the un-chlorinated water enters the reservoir this dilutes the chlorine residual, this is then subsequently detected by the chlorine analyser which then starts the chlorine dosing pump. The dosing pump continues to run until the chlorine residual reaches the upper set point of 0.8mg/L, then stops.

The pressure pumps run continuously supplying the mains pressure to the township, the duty pump runs for 24 hrs, (duty pump is rotated daily) whilst the other 2 pumps cut in / out as required these are controlled by the on board pump controller based on mains pressure i.e. If the demand suddenly increases and the pump/s currently running cannot maintain the pressure, then the mains pressure drops, this then starts the next pump in the queue, if that is still not sufficient to maintain the pressure then another will start, up till all 3 are running. Alternatively, when the demand decreases the additional pumps will stop one by one until there is only the one left. The Grundfos Hydro MPC Booster Systems work extremely well with their variable speed drive motors and the ability to ramp the motors down to extremely low motor speeds with low flows. The booster systems have the ability to cut in or cut out without causing major pressure fluctuations.

Lakeland had a high level reservoir which has been decommissioned in 2017 and replaced by a generator that is capable of running the bores, feed pumps to town, chlorination system and recirculation pumps.

The only Chemicals used for water treatment at Lakeland is Sodium Hypochlorite.

Figure 3 Catchment to tap schematic – Lakeland

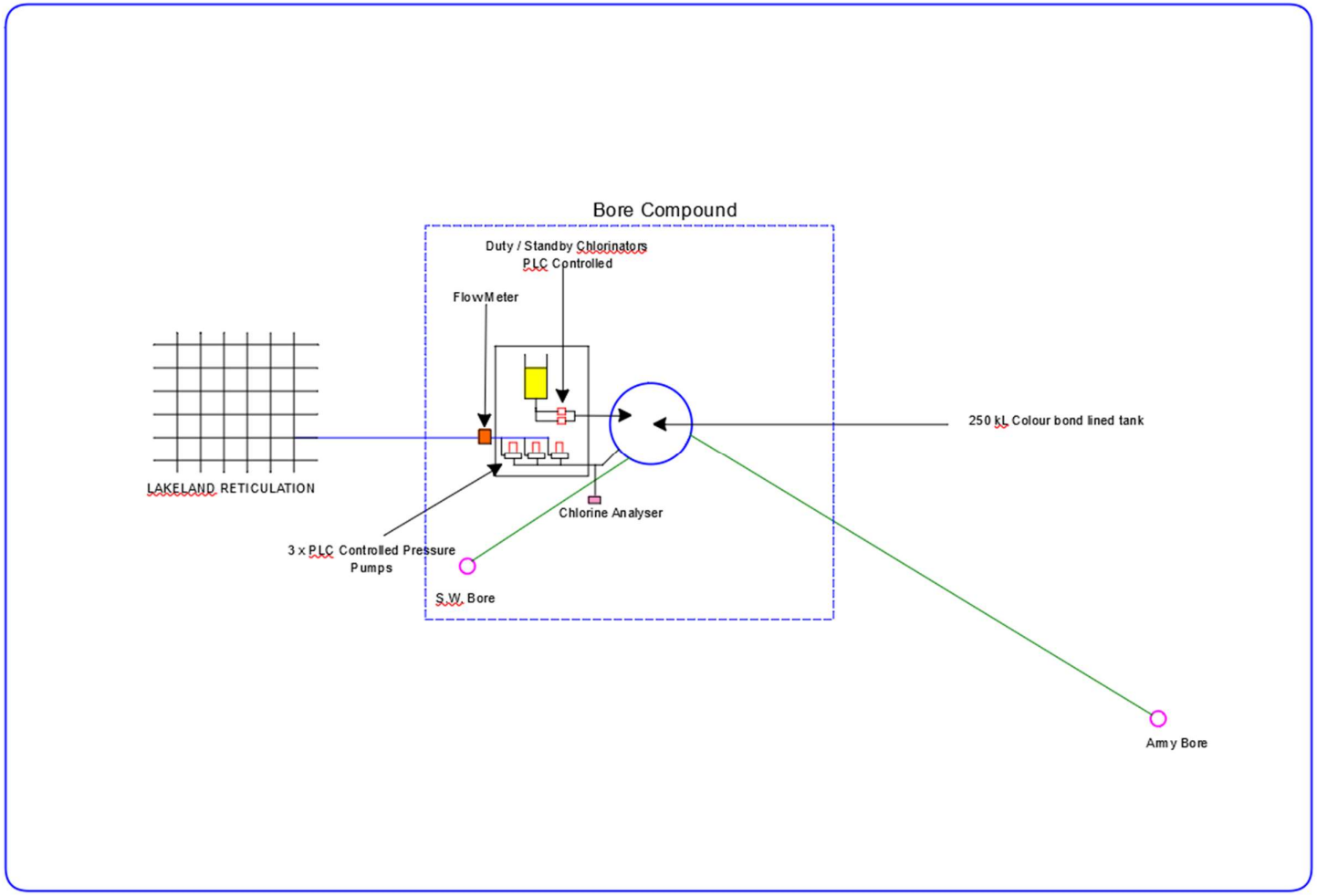


Table 1 Infrastructure Details – Lakeland

Lakeland Compound	
Source	Bore Water
Type	A network of 3 operational bores (Army bore is backup bore only)
% of supply	100
Reliability	No supply issues from these bores since 20 years of records being held
Water quality issues	These bores meet all ADWG guidelines with the exception of hardness. Old chemical drums have been buried over 30 years ago in close proximity to Army Bore. Pesticide tests are carried out yearly with no change in results
Bore head Details	
Year Bores Sunk	Army Bore – early nineties West Bore – unknown – a lot earlier East Bore - 2020
Bore Casing Size	6" /150mm
Bore Casing material	Class 12 PVC
Sealed to prevent surface water ingress	Yes, All the Bore Casings typically extend approx. 600mm above surface level
Sealed to prevent vermin (frogs / snakes etc.) from entering bore	Yes, All bores sealed to prevent vermin (frogs / snakes etc.) from entering the bore.
Sourcing Infrastructure	
Type (pumped/gravity/equipped bore/etc)	Electrical submersible pumps fitted in each Bore
Description	Bore depth are generally less than 50 metres
Are there any sources that **do not** undergo treatment prior to supply?	No
Lakeland Treatment Plant	
Process	Process comprises of chlorination only
Design Capacity (20 hr operation)	0.18 ML/d
Daily flow range	0.06 ML/d
Chemicals added	Sodium Hypochlorite
Standby chemical dosing facilities (Y/N)	Yes
Water sourced from and %	Water is sourced 100% from the network of 3 bores
% of average day demand provided	100%
% of scheme supply Distribution area supplied	100%
Bypasses / Variations	No Bypasses
Disinfection	
Location	Lakeland Treatment Plant
Type	Sodium Hypochlorite Dosing
Dose rate	Unknown (Dosed to maintain target residual between 0.5 and 0.8mg/L in reservoir)
Target residual levels	0.45 mg/L in reticulation
Duty/standby	Yes
Dosing arrangements	PLC controlled pump with feedback from free chlorine residual analyser
Alarms	No

Auto shut-off arrangements	Dosing controlled by PLC via free chlorine residual analyser with control set points Dosing pumps shut down when set point level reached
Distribution and Reticulation System	
Pipe material	A.C. UPVC & Poly
Age range	A.C. – 30 years old, UPVC – varying 1993 onwards, Poly – 1991 onwards
Approx % of total length	A.C. 10% UPVC 30% Poly 60%
Areas where potential long detention periods could be expected	Poly to school and roadhouse at varying times of the year due to wet season
Areas where low water pressure (e.g. < 12 m) could be expected during peak or other demand periods)	No areas of low water pressure at peak demand or any other time under normal conditions, the town is supplied by pressure pumps. Mains power failure will cause loss of mains pressure. Supply is then from overhead tanks to approximately 10 metres head
Lakeland Reservoir	
Name	Lakeland Reservoir
Capacity (ML)	0.250ML
Roofed (Y/N)	Yes
Vermin-proof (Y/N)	Yes
Runoff directed off roof (Y/N)	Yes

3 RISK ASSESSMENT

3.1 Lakeland Mitigated Risk Assessment

Following the hazard identification and unmitigated risk assessment detailed in the overarching plan, the Cooktown Scheme risk assessment was undertaken, following the same methodology. Individual process failures were considered, and the mitigated risks calculated. The risk assessment is presented below.

Table 2 Lakeland Risk Assessment for Risk Management Improvement Plan

Lakeland Water													
Process Step	**Hazardous Event**	**Hazards managed by same barriers**	**Unmitigated Risk**	**Primary preventive measure**	**Other Preventive Measures**	**Mitigated**			**Uncertainty**	**Comments**	**Risk Management Improvements**		
						Consequence	**Likelihood**	**Risk**			**2022/2023**	**2023/2024**	**2024/2025**
Bores	Ingress into bore	bacteria and virus	High 16	disinfection	bore head sealed and inspection program 6 monthly	Major	Rare	Medium 6	Reliable	E.coli detected in Army Bore only.			
Bores	Ingress into bore	protozoa	High 16	Bore head sealed	bore head sealed and inspection program 6 monthly	Major	Rare	Medium 5	Confident				
Bores	Septic contamination of aquifer	bacteria and virus	High 12	disinfection	Raw water E. coli sampling	Major	Unlikely	Medium 8	Certain				
Bores	Bore pump failure	Failure of supply	Medium 6	More than one bore	Restrictions	Minor	Rare	Low 2	Confident	2 active bores			

Lakeland Water

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Risk Management Improvements		
						Consequence	Likelihood	Risk			2022/2023	2023/2024	2024/2025
Bores	Aquifer contamination from buried chemical drums	Pesticides	High 12	Annual Monitoring		Major	Rare	Medium 5	Estimate	Known source, buried pre 2005. Annual monitoring has detected no contamination.	continue to monitor	continue to monitor	continue to monitor
Disinfection	overdose	Chlorine	Medium 8	Target 0.6-1.8 mg/L critical at 2 mg/L	SCADA, Alarms and auto dialler	Minor	Unlikely	Medium 6	Confident	Recirculation pumps in reservoir			
Disinfection	insufficient dose	bacteria/virus	Extreme 16	Target 0.6-1.8 mg/L critical at 2 mg/L	SCADA, Alarms and auto dialler	Catastrophic	Rare	Medium 6	Confident	Source water is bore water.			
Disinfection	ineffective disinfection due to turbidity	bacteria	High 10	Bore water has low turbidity	disinfection	Moderate	Rare	Low 3	Confident				
Disinfection	chemical breakdown	chlorate	High 12			Moderate	Possible	Medium 9	Estimate	THM sampling quarterly	Work with QH and WSR to find solutions		
Treated water storage/ Reservoirs	Ingress into reservoirs	Protozoa	Extreme 16	Brand New reservoir	Reservoir inspection program every six months	Catastrophic	Rare	Medium 6	Reliable				
Treated water storage/ Reservoirs	ingress of amoeba	amoeba	High 12	disinfection	Brand new reservoir	Major	Rare	Medium 5	Reliable	Disinfection maintained in reticulation.			
Reticulation	ingress of contaminated water	Bacteria virus	Extreme 20	network pressure,	mains break procedure WS 0002;	Major	Unlikely	Medium 8	Reliable	Weekly chlorine and E.coli sampling			

Lakeland Water

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Risk Management Improvements		
						Consequence	Likelihood	Risk			2022/2023	2023/2024	2024/2025
				residual disinfection	Low chlorine flushing procedure WS006					Monthly reticulation phys/ chem monitoring			
Reticulation	ingress of contaminated water	protozoa	Extreme 20	network pressure	mains break procedure WS 0002; Low chlorine flushing procedure WS006	Major	Unlikely	Medium 8	Reliable				
Reticulation	biofilm growth	opportunistic pathogens	High 15	flushing program		Moderate	Rare	Low 3	Estimate	disinfection maintained			
Reticulation	Power failure	Failure of supply	High 15	Generator		Moderate	Unlikely	Medium 6	Confident	3 phase power and generator back up			
Reticulation	backflow	protozoa	Extreme 20	system integrity, backflow prevention		Major	Rare	Medium 6	Estimate				
Reticulation	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6	Disinfection residual	Reservoir low level alarm Multiple days storage in reservoir	Insignificant	Possible	Low 3	Confident				
System Wide	WTP Fire	Failure of supply	High 10	DMP		Catastrophic	Rare	Medium 6	Reliable				
System wide	Cyclone	Failure of supply	High 10	DMP	Cyclone preparation procedure WS0032	Catastrophic	Rare	Medium 6	Reliable				
System wide	operator error	any	Extreme 25	training, experience, mentoring	Cert III in water operations trained ongoing.	Major	Unlikely	Medium 8	Estimate	Checklists in place for operations at plant.			

Lakeland Water													
Process Step	**Hazardous Event**	**Hazards managed by same barriers**	**Unmitigated Risk**	**Primary preventive measure**	**Other Preventive Measures**	**Mitigated**			**Uncertainty**	**Comments**	**Risk Management Improvements**		
						Consequence	**Likelihood**	**Risk**			**2022/2023**	**2023/2024**	**2024/2025**
System Wide	Cybersecurity	Cyber Attack	High 12	Gateway software	Anti-virus and threat detection software	Major	Unlikely	Medium 8	Estimate				

3.2 Lakeland Risk Management Improvement Plan

Table 3 Lakeland Risk Management Improvement Plan

Process Step	Hazard	Risk Management Improvements	Priority	Responsible Person	Year
Disinfection	Pesticides	• Continue monitoring pesticides.	Low (in place)	Manager Water and Wastewater	On-going
Disinfection	Chlorate	• Continue monitoring chlorates in reticulation system	Low (in place)	Manager Water and Wastewater	On-going

3.3 Cybersecurity

The Cook Shire Council's network is set up to detect cybersecurity breaches. The breach is identified through the internal network security monitoring tools which includes gateways and anti-virus threat detection.

In the instance of a cybersecurity attack that gets through, the Council IT department would try to detect its origin, look at removing the computer from the network, restore information from backups.

To date, there have been no detectable cyber-attacks on our SCADA systems in Council

Issues that needs to be addressed in the cyber security space include: separate log in for individual employees when logging onto the SCADA system and the end of support for Windows 7 which will force Council to migrate SCADA control software to Windows 10 operating system.

All cyber security incidents/breaches are reported to the QGCIO. The details for the QGCIO are:
Queensland Government Information Security Virtual Response Team (QGISVRT).
Phone: 07 3215 3951
Email: qgisvrt@qld.gov.au
Website: www.qgcio.qld.gov.au

3.4 Outcome of recent incidents

Recent incidents for the Lakeland Water Scheme from 01 January 2020 to 31 March 2022.

Table 4 Recent water quality incidents

Date	Place	Parameter	Concentration	Action Plan
01 February 2021	Lakeland SES Shed	Chlorate	2.51	This is believed to have been caused by using old chlorine in spray bottles to sterilize taps before sampling.

3.5 Chlorate Management Plan

The chlorate management plan below is based on the qldwater Chlorate Fact Sheet – Managing Chlorate Residuals.

Table 5 Chlorate Management Plan

Potential mitigation action	Action	Future Action
Reduce age of chlorine		
Bulk chlorine is delivered to the Annan WTP	Annan operators perform a chlorine strength and a pH test on the delivered chlorine.	Continue
Work with supplier to reduce chlorate in source material	Cooktown does not have high chlorate levels, therefore, it is assumed that the bulk supply does not have high levels of chlorate.	No action

Work with supplier to minimise the time from manufacture to delivery and use	Lakeland is a remote community in Cape York. This would be difficult to achieve.	No action
Increase turn-over/delivery of hypochlorite	Lakeland is a remote community in Cape York. This would be difficult to achieve. Population is 115.	No action
Replace oversized tanks	Smaller tanks cannot be procured due to the remoteness of the site. Staff visit site once a week. One 60L tank is on-site.	No action
Reduce rate of chlorate formation prior to use		
Dilute stock concentrations	Chlorine is diluted 50:50 with water.	Action complete
Store solution in cool area and out of direct sunlight	Lakeland chlorination shed needs to be rebuilt. It will be rebuilt as a besser block shed with insulation in the roof, similar to Laura. The shed will have big vents that take up most of the wall space on two opposing sides of the shed.	Dependant on funding
Control the pH of stored hypochlorite solutions at pH 11-13, even after dilution	Action: This option will be investigated.	Investigate
Rinse sodium hypochlorite storage tanks between refills	Sodium Hypochlorite is transferred from the bulk solution to the Lakeland WTP. When the chlorine tank requires filling, the hypochlorite remaining in the tank is pumped into a 20L container. 60L of hypo lasts approximately 2 weeks. Water staff clean out the tank as close to monthly as possible when the chlorine level is low enough.	Continue
Ensure processes and maintenance are optimized		
Optimise the chlorination process to avoid high doses of chlorine	Set points for Chlorine disinfection levels in Lakeland are between 0.5 mg/L and 0.8 mg/L. This cannot be lower and still maintain disinfection to the end of the mains.	No action
Optimize the coagulation, flocculation, sedimentation, filtration processes to reduce chlorine demand	Lakeland is a groundwater source. Water is pumped into a tank, chlorinated and sent to town. There is no optimization that can be done with the current system.	No action
Reduce chlorine demand of reservoirs and networks caused by biofilm and sediment	Lakeland reservoir is cleaned every two years. Water mains are flushed once a year. The water team does not have the capacity to increase the frequency of these options.	No action
Explore alternative disinfection options		
Converting to disinfection using chlorine gas	This option is considered too dangerous. Lakeland WTP is operated remotely by SCADA and visited once a week. The WTP is situated in the middle of town. Qldwater Disinfection Options for Water Service Providers Guidance Paper lists chlorine gas as high risk for very small remote places.	No action
Convert to onsite generation of chlorine	Lakeland has only had one exceedance for chlorates and it is believed that this was due to old chlorine being used to sterilize the tap.	No action
Additional Council Actions		

Chlorate samples taken every three months	Sampling includes E. coli and therefore the tap is sterilized before samples are taken. Staff have two options. Option 1 is the use of alcohol wipes to sterilize the tap. Samples can then be taken (including chlorate) or Option 2 is to take the chlorate sample, then sterilize the tap with liquid chlorine and then take the E. coli sample last.	Continue
Chlorate detected	If chlorate is detected, the regulator and QH will be notified	Continue
Chlorate detected in two consecutive samples	If chlorate is detected in two consecutive samples then a "do not consume" notice will be discussed with QH. This is considered a long-term exceedance.	Continue

4 OPERATIONAL PROCEDURES

The documented procedures are listed in Table 3. The critical control point for the Lakeland Treatment system is free chlorine residual as this is the only treatment the water receives. The following table forms the basis of more comprehensive operational procedures that will be developed over time.

Table 6 Operational Limits used by operators/ SCADA.

Process Step	Parameter	Operational Monitoring	Target Range	Monitoring Frequency	Operator Intervention Range	Report to Supervisor Range	Corrective Actions/ Comments
Final Treated water	Free Chlorine Residual	Y	 <0.4 and >3mg/L 0.4 – 0.6 and >2 mg/L 0.6 -1.8 mg/L	Daily online analyser. Weekly hand held free chlorine meter	<0.6 and >2 mg/L	<0.4 and >3 mg/L	• If chlorine is above 2 mg/L - Check operation of Chlorine dosing equipment. Check chlorine analyser is reading accurately using hand held analyser. Decrease chlorine dose as chlorine may have been added without dilution. • If chlorine is below 0.4mg/L - Check operation of chlorine dosing equipment, ensure no air bubbles in chlorine line. Check chlorine tank levels to ensure sufficiently chlorine. Check chlorine analyser using hand held unit. Increase chlorine dose.
Final Treated water	Turbidity	Y	 <2 NTU 1 – 2 NTU <1 NTU	Monthly samples. Verified quarterly.	>1 NTU	>2 NTU	• There is no filtration at the Lakeland Compound. The bore water is chlorinated only. • If turbidity is over <1 NTU, then contact supervisor and resample immediately. • If still above <1 NTU, sample bores separately to work out if turbidity is coming from a particular bore.

Documented procedures, as listed below.

Table 7 Formal documented procedures used by CSC

Number	Documented Procedure Name	Date of last revision	Area
WS 0001	Safe Handling of Sodium Hypochlorite	2021	All
WS 0002	Water Main Repairs	2021	Reticulation
WS 0003	DWQMP Annual Report Creation	2021	Admin
WS 0004	SWIM Annual Report Creation	2021	Admin
WS 0005	E. Coli Detection Reporting	2021	Admin
WS 0006	Water Mains Flushing and flushing for Low reticulation free chlorine residual	2021	Reticulation
WS 0007	Water Reservoir Cleaning	2021	Reticulation
WS 0008	Water Sampling	2021	Reticulation
WS 0009	Water Testing Coliforms & E.coli Analysis	2021	Annan Lab
WS 0010	Water Service - New Installation	2021	Reticulation
WS 0011	Water Mains - New Installation	2021	Reticulation
WS 0012	CIP Procedure Laura	2021	Treatment
WS 0013	Water Service Repairs	2021	Reticulation
WS 0014	Operation Procedure for Lakeland WTP	2021	Reticulation
WS 0015	Chlorine Analysers Maintenance Procedure	2021	Treatment
WS 0016	Jar Testing Procedure	2021	Treatment
WS 0017	Incident Notification	2021	Admin
WS 0018	Coagulation & Flocculation	2021	Treatment
WS 0019	Flow meter Calibration	2021	Admin
WS 0020	Working around sewage	2021	Sewage
WS 0021	High Pressure Sewer Cleaning	2021	Sewage
WS 0022	Troubleshooting DAF Plant Coen	2021	Treatment
WS 0023	Running the Coen Bore field	2021	Treatment

WS 0024	Recharging the Coen Bores	2021	Treatment
WS 0025	Using Hydrochloric Acid (Splash Park)	2021	Reticulation
WS 0026	Wastewater Sampling at the Coen STP (NATA lab)	2021	Sewage
WS 0027	Cleaning Baskets	2021	Sewage
WS 0028	Dealing with high flow at the Cooktown STP	2021	Sewage
WS 0029	Lakeland WTP Generator	2021	Treatment
WS 0030	Cooktown STP Generator	2021	Sewage
WS 0031	Detection of a chemical parameter above ADWG	2021	Admin
WS 0032	Splash Park Procedure	2021	Reticulation
WS 0033	Cyclone Preparation procedure - Lakeland, Laura and Cooktown (Using bore fields)	2021	Reticulation/Treatment
WS 0034	Cyclone Preparation procedure - Lakeland, Laura and Cooktown (not using the bore fields)	2021	Reticulation/Treatment
WS 0035	Cyclone Preparation procedure - Coen	2021	Reticulation/Treatment
WS 0036	Procedure in the event of environmental Incident	2021	Sewage
WS 0037	Boiled water alert (Media coordinator)	2021	Media liaison
WS 0038	Fire Service configuration and metering procedure	2021	Admin and Reticulation
WS 0039	E. coli analysis using Idexx	2021	Annan and Coen WTPs
WS 0040	High Level new chlorine analyser maintenance at the High Level Reservoir	2021	Reticulation
WS 0041	Power Outage at the Cooktown STP	2021	Cooktown Sewage
WS 0042	Pressure Decay Test Coen WTP	2021	Coen WTP
WS 0043	Pressure Decay Test Laura WTP	2021	Laura WTP
WS 0044	Lock out, tag out procedure	2021	All
WS 0045	Chemical Batching – Soda Ash – Annan WTP	2021	Annan WTP
WS 0046	Chemical Batching – Lime – Annan WTP	2021	Annan WTP
WS 0047	Chemical Batching – Alum – Annan WTP	2021	Annan WTP
WS 048	Running the Annan Generator	2021	Annan WTP

WS 0049	Activating bypass of two filters during	2021	Annan WTP
WS 0050	Sludge removal from the Annan sedimentation basin	2021	Annan WTP
WS 0051	Chemical Batching – Poly – Annan WTP	2021	Annan WTP
WS 0052	Run Annan WTP on 2 filters	2021	Annan WTP
WS 0053	Change or modify ABB drawers at Cooktown STP	2021	Cooktown STP
WS 0054	Water meter reading	2021	Reticulation/Rates
WS 0055	Sodium Hypochlorite concentration test	2021	Annan WTP
WS 0056	Annan Water Treatment Plant – Water testing procedure	2021	Annan WTP
WS 0057	Water sampling process for One Drive	2021	Reticulation and Treatment Plants
WS 0058	Clean Y strainer	2021	Annan WTP
WS 0059	Bore Flushing	2021	Bores
WS 0060	Septic waste disposal at the Cooktown STP	2021	Cooktown STP
WS0061	DAF Maintenance Procedure	2021	Coen WTP
WS 0062	Calibrate 4670 Turbidity meter	2021	Water Treatment Plants

5 OPERATIONAL AND VERIFICATION MONITORING

Operational monitoring is undertaken by CSC to ensure that the water treatment barriers are operating effectively. This monitoring provides confidence that we are producing safe water. Operational monitoring is conducted by the WTP operators and NATA registered laboratory where CSC do not have the facilities to analyse parameters. Where any value exceeds the ADWG health guideline in treated or reticulated water, the Manager Water and Wastewater is immediately informed and the regulator is informed. A procedure is available for reporting E. coli detection to the regulator. The operational monitoring undertaken by CSC includes total coliforms and E. coli, colour, dissolved oxygen, electrical conductivity, pH, total dissolved solids, total hardness, turbidity and water temperature.

Operational monitoring is also undertaken by a NATA registered laboratory. This includes physical/chemical parameters and metals in the reticulation system, raw bore water and final water leaving from the Lakeland reservoir. A pesticide scan is done on Army bore yearly. Certificates of analysis are reviewed immediately upon receipt, and if a value exceeds the ADWG Health Guideline value, the Manager Water and Wastewater is informed, and reported to the regulator.

Verification monitoring is undertaken to ensure that the analysis done by CSC is correct. *E coli* samples are taken weekly and analysed by CSC. Every three months the E. coli sample is split and sent to a NATA registered laboratory for analysis. Results are compared via the SWIM database Verification monitoring data is reported in our annual report.

5.1 Sampling Locations

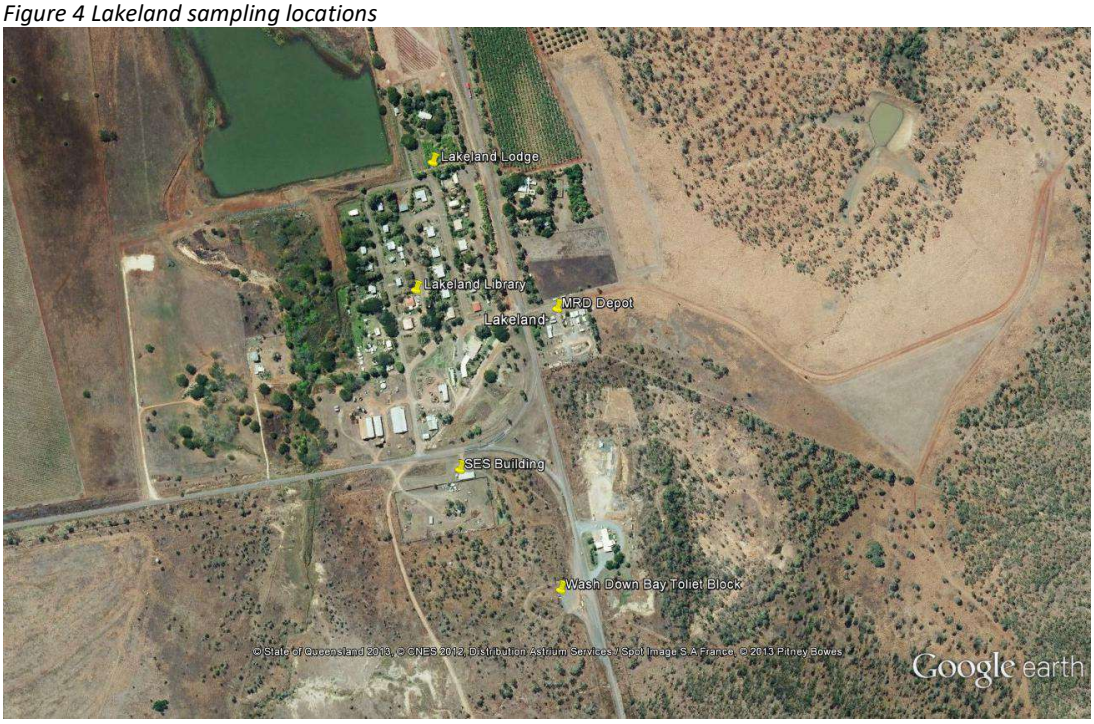
Operational monitoring occurs at a number of steps through the WTP process, and these are identified in the tables that follow.

Additionally, there are sample locations for both operational and verification monitoring that are located on the trunk main, at reservoirs, and in the reticulation network. These are detailed below.

Table 8 Reticulation sample locations

Sample Location Name	Street Name	Site Chosen Because	GPS Coordinates *
SES	Peninsular Development Rd	End of the line.	15°51'42.27"S - 144°51'21.53"E
MRD Depot	Cooktown Development Rd	Ease of access, Central	15°51'32.22"S - 144°51'27.84"E
Lakeland Library	Sesame St	Ease of access, Central	15°51'31.05"S - 144°51'18.66"E
Wash down Bay	Peninsular Development Rd	End of the line.	15°51'49.78"S - 144°51'28.11"E
Lakeland Lodge	Back St	Northern end of Town	15°51'23.10"S - 144°51'19.75"E

Figure 4 Lakeland sampling locations



The above sample locations give a good cross section of the town including the dead end areas as shown in the figure below.

Table 9 Verification and Operational monitoring

Process Step / Location in System	Parameter	Sampling			Is this sample Verified by a NATA registered Lab	Operational Monitoring Comments
		Location	Frequency	Type		
Lakeland Raw Bores	**Physical / Chemical Analysis** pH, Electrical Conductivity, Total Hardness, Turbidity, Colour apparent, Salinity & Silica	Composite bore sample	Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Pesticides	Army Bore	Yearly	Grab Sample	Y	Analysed by NATA registered laboratory
	Coliforms/E. coli	Composite bore sample	Weekly	Grab Sample	N	Analysed by CSC Annan staff
Lakeland Water Treatment Plant	Free Chlorine Residual	Final Treated Water Sample Tap	Weekly	Grab Sample	Y	Analysed by Cook Shire staff using a hand held meter
	Free Chlorine Residual	On line via SCADA	Continuous	On Line	N	Recorded Daily from on-line analyser
	Total Coliforms and *E. coli*	Final Treated Water Sample Tap	Weekly	Grab Sample	Y	Analysed by CSC. Verified by NATA registered lab quarterly.
Lakeland Reticulation	pH	Systematically alternating between the sites as listed in Table 8.	Monthly	Grab Sample	Y	Analysed by CSC
	Temperature		Monthly	Grab Sample	N	
	Dissolved Oxygen		Monthly	Grab Sample	Y	
	Turbidity		Monthly	Grab Sample	Y	
	Colour		Monthly	Grab Sample	Y	
	Electrical Conductivity		Monthly	Grab Sample	Y	
	Total Dissolved Solids		Monthly	Grab Sample	Y	
	Total Hardness		Monthly	Grab Sample	Y	
	Chlorine - Residual		Monthly	Grab Sample	Y	

	Physical / Chemical Analysis pH, Electrical Conductivity, Total Hardness, Turbidity, Colour apparent, Salinity & Silica		Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Total Coliforms and *E. coli*		Weekly	Grab Sample	Y	Analysed by CSC at the Annan WTP using Idexx. Verified quarterly at a NATA registered lab.
	Trihalomethanes including Chloroform, Bromodichlormethane, Dibromochloromethane, Bromoform and Total Trihalomethanes. Oxyhalides including chlorate.		Quarterly	Grab Sample	Y	NATA registered lab

- Verification samples for *E. coli* are split in half. Half is analysed by CSC Annan Staff using IDEXX and the other half is sent to a NATA certified laboratory.

- Physical/Chemical samples are verified quarterly. Samples are split in half. Half is analysed by CSC Annan Staff and the other half is sent to a NATA certified laboratory.

- All water samples are collected by either the Reticulation staff, or the Water Treatment Plant operators all of which have had the appropriate training to collect water samples. Samples collected for verification are transported to Cairns by Air, and analysed by NATA accredited Laboratories (Cairns Regional Council Water Quality Laboratory at present).

- In the event that a parameter being analysed exceeds the ADWG health guidelines, it is reported to regulation as per procedure WS0015.

6 WATER QUALITY CHARACTERISATION

Table 10 Army Bore water quality details (NATA lab)

Parameter	Sampling Location	Time Period	Number of samples taken	Results ug/L	Australian Drinking Water Guidelines guideline value ug/L (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
alpha-BHC	Lakeland Army Bore	1 January 2017 to 30 April 2022	5	<0.5		
Hexachlorobenzene (HCB)			5	<0.5		
beta-BHC			5	<0.5		
gamma-BHC			5	<0.5		
delta-BHC			5	<0.5		
Heptachlor			5	<0.5	0.3	0
Aldrin – mg/L			5	<0.5	0.3	0
Heptachlor epoxide			5	<0.5		
trans-Chlordane			5	<0.5		
alpha-Endosulfan			5	<0.5		
cis-Chlordane			5	<0.5		
Dieldrin – mg/L			5	<0.5	0.3	0
4.4'-DDE			5	<0.5		
Endrin			5	<0.5		
beta-Endosulfan			5	<0.5	20	0
4.4'-DDD			5	<0.5		
Endrin aldehyde			5	<0.5		
Endosulfan Sulphate			5	<0.5	20	0
4.4'-DDT			5	<2.0	9	
Endrin Ketone			5	<0.5		
Methoxychlor			5	<2.0	300	0
Total Chlordane			5	<0.5	2	0

Parameter	Sampling Location	Time Period	Number of samples taken	Results ug/L	Australian Drinking Water Guidelines guideline value ug/L (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
DDT (Total)			5	<0.5	9	0
Sum of Aldrin & Dieldrin			5	<0.5	0.03	0

Table 11 Combined Raw bore water quality (NATA lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results		
				Min Value	Max Value	Avg Value
Alkalinity mg/L	Lakeland Combined Bore Water (Raw Water)	1 January 2017 to 31 March 2022	20	210.0	270.0	231.4
Calcium mg/L			20	24.0	33.0	28.0
Chloride mg/L			20	47.0	100.0	65.9
Colour Apparent Pt- Co			20	1.0	31.0	2.9
Electrical Conductance us/cm			20	555.0	770.0	653.7
Fluoride mg/L			19	0.23	0.27	0.24
Total Hardness CaCO3			20	170.0	240.0	202.9
Magnesium mg/L			20	27.0	39.0	32.3
pH			20	7.4	8.1	7.7
Potassium mg/L			20	1.6	2.3	1.8
Sodium mg/L			20	50.0	67.0	59.6
Total Dissolved Solids mg/L			20	340	460	397
Salinity mg/L			18	30.0	380	300
SAR			20	1.6	2.0	1.8
Sulphate mg/L			20	2.4	4.8	3.5
Turbidity NTU			20	0.1	19.0	1.28
Arsenic mg/L			18	0.0006	0.0016	0.0011
Barium mg/L			18	0.010	0.018	0.012
Beryllium mg/L			18	0.0001	0.001	0.0003
Cadmium mg/L			18	0.0001	0.0001	0.0001
Chromium mg/L			18	0.0002	0.001	0.006
Cobalt mg/L			18	0.0005	0.001	0.0006
Copper mg/L			18	0.005	0.034	0.015
Iron mg/L			18	0.008	0.015	0.011
Lead mg/L			18	0.0005	0.0022	0.0008
Manganese mg/L			18	0.0001	0.0190	0.0025
Mercury			18	0.00006	0.0001	0.00006
Nickel mg/L			18	0.0005	0.0053	0.0010
Selenium mg/L			18	0.002	0.005	0.003
Vanadium mg/L			18	0.0156	0.0239	0.0204

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results		
				Min Value	Max Value	Avg Value
Zinc mg/L			18	0.007	0.030	0.014

Table 12 Treated Water quality details Lakeland WTP (NATA lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Avg Value		
Alkalinity mg/L	Lakeland Water Treatment Plant	1 January 2017 to 31 March 2022	19	210.0	250.0	232.2		
Calcium mg/L			19	2.7	38.0	27.0		
Chloride mg/L			18	50.0	96.0	68.9	≤250 mg/L	0
Colour Apparent Pt- Co			19	1.0	2.2	1.1	≤15 Pt/Co	0
Electrical Conductance us/cm			19	570.0	770.0	662.5		
Fluoride mg/L			18	0.19	0.27	0.25	≤1.5 mg/L	0
Total Hardness mg/L CaCO3			19	14.0	270.0	194.9	≤200 mg/L	8
Magnesium mg/L			19	1.7	42.0	30.9		
pH			19	7.8	8.2	8.0	6.5 – 8.5	0
Potassium mg/L			19	0.82	2.0	1.7		
Salinity mg/L			17	270	380	320		
SAR			19	0.65	2.10	1.82		
Sodium mg/L			19	5.5	80.0	59.1	≤180 mg/L	0
Total Dissolved Solids mg/L			19	350.0	460.0	401.8	≤600 mg/L	0
Sulphate mg/L			18	0.19	0.27	0.25	≤250 mg/L	0
Turbidity NTU			19	0.1	0.7	0.2	≤5 NTU	0
Arsenic mg/L			18	0.0008	0.0013	0.0010	0.01 mg/L	0
Barium mg/L			18	0.010	0.016	0.0126	2 mg/L	0
Beryllium mg/L			18	0.0001	0.0130	0.0011	0.06 mg/L	0
Cadmium mg/L			18	0.0001	0.0010	0.0002	0.002mg/L	0
Chromium mg/L			18	0.0001	0.0010	0.0004	0.05 mg/L	0
Cobalt mg/L			18	0.0005	0.0010	0.0006		
Copper mg/L			18	0.001	0.017	0.007	2.0 mg/L	0
Iron mg/L			18	0.008	0.015	0.010	0.3 mg/L	0
Lead mg/L			18	0.0005	0.0050	0.0009	0.01 mg/L	0
Manganese mg/L			18	0.0002	0.0015	0.0005	0.1 mg/L	0
Mercury			18	0.00006	0.00010	0.00006	0.006 mg/L	0
Nickel mg/L			18	0.00005	0.001	0.0006	0.02 mg/L	0
Selenium mg/L			18	0.002	0.005	0.003	0.01 mg/L	0
Vanadium mg/L			18	0.0002	0.0262	0.0202		

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Avg Value		
Zinc mg/L			18	0.002	0.086	0.014	3.0 mg/L	0

Table 13 Lakeland Reticulation Water Quality (NATA lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Avg Value		
Alkalinity - mg/L CaCO3	Various Locations within the Lakeland Reticulation	1 January 2017 to 31 March 2022	15	220.0	270.0	237.3		
Calcium - mg/L			15	2.1	32.0	25.78		
Chloride - mg/L			15	50.0	81.0	65.0	≤250 mg/L	0
Colour Apparent - Pt- Co			15	1.0	3.0	1.2	≤15 Pt/Co	0
Electrical Conductance			15	570.0	810.0	653.3		
Fluoride - mg/L			15	0.21	0.28	0.25	≤1.5 mg/L	0
Total Hardness - mg/L CaCO3			15	11.0	240.0	185.9	≤200 mg/L	24
Magnesium - mg/L			15	1.3	39.0	29.5		
pH			15	7.8	8.1	7.9	6.5 – 8.5	0
Potassium - mg/L			15	0.72	2.0	1.69		
SAR			15	0.65	2.10	1.81		
Salinity mg/L			15	280	400	320		
Sodium - mg/L			15	4.9	74.0	57.2	≤180 mg/L	0
Total Dissolved Solids - mg/L			15	350.0	480.0	400.2	≤600 mg/L	0
Silicon mg/L			13	78.0	84.0	80.5		
Sulphate - mg/L			15	2.3	4.3	3.5	≤250 mg/L	0
Turbidity – NTU			15	0.1	0.7	0.2	≤5 NTU	0
Arsenic mg/L			19	0.0008	0.0013	0.0010	0.20 mg/L	0
Barium mg/L			19	0.010	0.022	0.012	0.01 mg/L	0
Beryllium mg/L			19	0.0001	0.0010	0.0003	2 mg/L	0
Cadmium mg/L			19	0.0001	0.0001	0.0001	0.06 mg/L	0
Chromium mg/L			19	0.0002	0.0010	0.0005	0.002 mg/L	0
Cobalt mg/L			19	0.0005	0.001	0.0006	0.05 mg/L	0
Copper mg/L			19	0.008	0.045	0.0234		
Iron mg/L			19	0.008	0.015	0.011	2.0 mg/L	0
Lead mg/L			19	0.0005	0.0013	0.0008	0.3 mg/L	0
Manganese mg/L			19	0.0002	0.0035	0.0008	0.01 mg/L	0
Mercury mg/L			19	0.00006	0.00010	0.00006	0.006 mg/L	0
Nickel mg/L			19	0.0005	0.0010	0.0006	0.1 mg/L	0
Selenium mg/L			19	0.002	0.005	0.003	0.02 mg/L	0

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Avg Value		
Vanadium mg/L			19	0.019	0.025	0.021	0.01	0
Zinc mg/L			19	0.0024	0.0330	0.0155		

Table 14 Lakeland Reticulation Water Quality (Cook Shire Council Annan Staff)

	pH	Electrical Conductivity uS/cm	Dissolved Oxygen Mg/L	Colour Pt/Co Units	Turbidity NTU	Total Hardness as mg/L CaCO3	Chlorine Residual mg/L
Count	56	56	55	56	57	54	56
Min	6.69	468.0	5.44	0	0.07	143.0	0.31
Max	7.59	810.0	8.28	10.0	1.28	280.0	1.40
Avg	7.19	643.6	6.87	0.70	0.22	197.1	0.57

Sampled from the various locations within the Lakeland Reticulation area from 1 January 2017 to 31 March 2022

Table 15 Total E. coli Lakeland Reticulation (Cook Shire Council, Verified by NATA Lab)

Parameter	Sampling Location	Time Period	No of samples analysed in time period	Results	Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				No of Samples where E.coli was Detected		
Escherichia coli	Various Locations within the Lakeland Reticulation	1 January 2017 to 31 March 2022	198	0	Escherichia coli should not be detected in any 100 mL sample of drinking water.	0

Table 16 Lakeland WTP daily chlorine residual readings (SCADA)

		SCADA on line Chlorine readings (mg/L)
Count	1 January 2017 to 31 March 2022	1,723
Min		0.21
Max		5.2
Average		0.68

Table 17 Reticulation Trihalomethane and Chlorate results (Analysed by NATA registered Lab)

Date Sampled – 01/10/2018 – 31/03/2022								
Parameter	Unit	No of Samples collected	Summary of Results			ADWQ Guidelines Value (2011)	No of Samples exceeding ADWG or WHO	
			Min. Value	Max. Value	Avg. Value		Health	Aesthetic
Chloroform	µg/L	13	5	5	5	<250 µg/L	0	-
Bromodichloromethane	µg/L	13	5	5	5	<250 µg/L	0	-
Dibromochloromethane	µg/L	13	5	78	10.7	< 250 mg/L	0	-
Bromoform	µg/L	13	8	16	12.0	<250 µg/L	0	-
Total Trihalomethanes	µg/L	13	8	26	12.8	<250 µg/L	0	-
Chlorate	mg/L	15	0.178	2.510	0.391	<0.8 mg/L	1	-

Table 18 Raw E. coli (Analysed by Annan Lab)

Parameter	Sampling Location	Time Period	No of samples analysed in time period	Summary of Results		
				Min. Value	Max. Value	Avg. Value
Escherichia coli	**Lakeland raw water combined bores**	1 July 2018 to 31 July 2022	180	0	145	0.2