



Cook Shire
COUNCIL

Lakeland

Drinking Water Quality Management Plan

+ DOCUMENT CONTROL SHEET

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Lakeland Site Based DWQMP

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+ CONTENTS

1	LAKELAND.....	1
1.1	Overview.....	1
2	INFRASTRUCTURE –	1
2.1	Lakeland WTP	1
2.1.1	Bores	2
2.1.2	Operation	2
2.1.3	Disinfection	3
2.1.4	Pressure pumps.....	3
2.1.5	SCADA	3
2.1.6	Reticulation Mains	3
2.1.7	Detailed Process Steps	3
3	RISK ASSESSMENT	9
3.1	Lakeland Mitigated Risk Assessment.....	9
4	OPERATIONAL PROCEDURES	13
5	OPERATIONAL AND VERIFICATION MONITORING	15
5.1	Sampling Locations	15
6	WATER QUALITY CHARACTERISATION.....	20

LIST OF FIGURES

Figure 1	Location of Lakeland.....	1
Figure 2	Location of Infrastructure	2
Figure 3	Catchment to tap schematic – Lakeland.....	5
Figure 4	Lakeland sampling locations	16

LIST OF TABLES

Table 1	Infrastructure Details – Lakeland	7
Table 2	Operational Limits used by operators/ SCADA.....	13
Table 3	Formal documented procedures used by CSC	14
Table 4	Reticulation sample locations.....	15
Table 5	Operational monitoring	17
Table 6	Army Bore water quality details (analysed by NATA registered lab)	20
Table 7	Combined Raw water quality (Analysed by NATA lab).....	21
Table 8	Chlorinated Treated Water (to town) quality details – Lakeland Water Treatment Plant (Analysed by NATA registered lab)	22
Table 9	Summary of Treated Water quality details – Lakeland Reticulation (Analysed by NATA registered lab).....	23
Table 10	Summary of Treated Water quality details – Lakeland Reticulation (Analysed by Cook Shire Council Annan Staff)	24
Table 11	Summary of Total E. coli detected – Lakeland Reticulation (Analysed by Cook Shire Council, Verification by NATA registered Lab).....	24
Table 12	Summary of Lakeland Treatment Plant daily chlorine residual readings (Obtained daily from the Lakeland SCADA) from 01/06/2015 to 30/06/2017	24

+ GLOSSARY

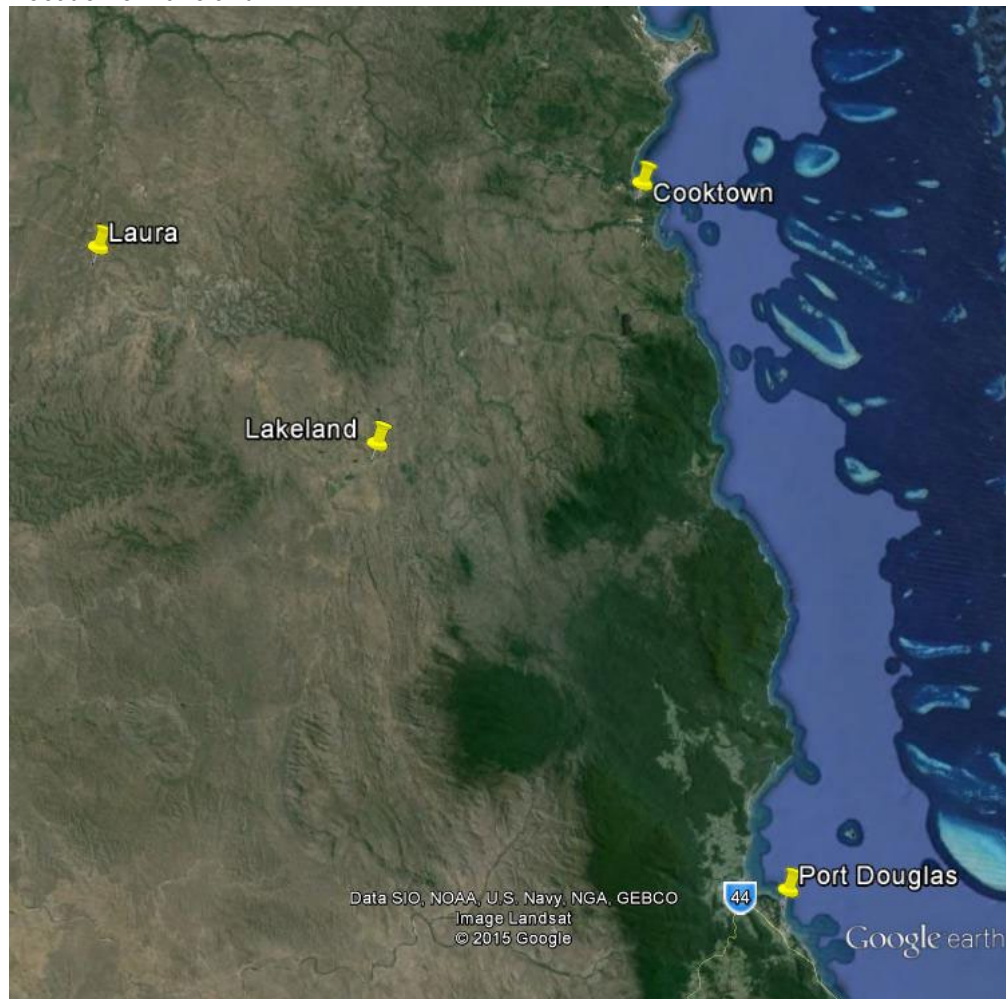
Term	Definition
ADWG	Australian Drinking Water Guidelines 2011
CSC	Cook Shire Council
DERM	Former Department of Environment and Resource Management
DWQMP	Drinking Water Quality Management Plan
PHR	Public Health Regulation 2005
RMIP	Risk Management Improvement Program
QH	Department of Health Queensland
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, with an overhead water tank providing contingency if power failures occur.

Figure 2 Location of Infrastructure



2.1.1 Bores

Lakeland has 2 operational bores, South West and Army. Each of the Bores has limited production capabilities with S.W. producing approximately 1.3 L/s and Army bore producing 1.3 L/s. The bore report cards for these bores contain almost no information. These bores are all in close proximity, and are believed to tap the same aquifer – the Maclean basin.

The two 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.

Note: 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.

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 (South West Bore and Army Bore) pump directly into the reservoir. North East bore is not operational at present. 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. Lakeland has 43 Water Connections with a population of around 116.

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 pumps water from the clean water reservoir, past the chlorine analyser and back into the reservoir. The water that goes through the chlorine analyser goes to waste.

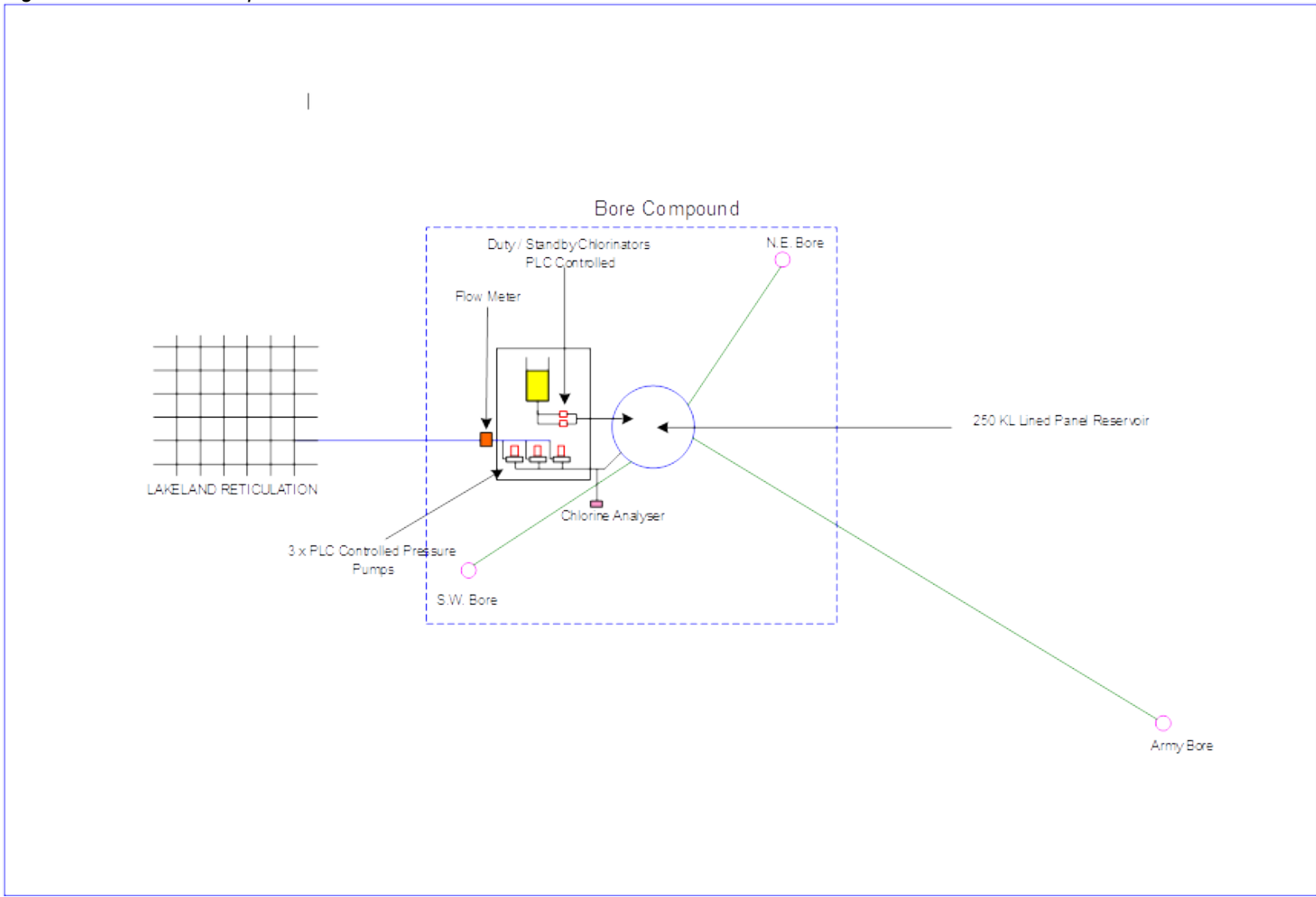
As water is pumped to town, the reservoir is drawn down. When the level gets to 4.3m, the bores start to run and fill the reservoir. All bores run simultaneously when the reservoir calls for water. These bores all pump directly into the Clean Water Reservoir, which has been previously chlorinated, as 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



Note: North East Bore is not currently operational.

Table 1 Infrastructure Details – Lakeland

Component		Lakeland
Sources	Name	<i>Lakeland</i>
	Type	<i>A network of 2 operational bores</i>
	% of supply	<i>100</i>
	Reliability	<i>No supply issues from these bores since 20 years of records being held</i>
	Water quality issues	<i>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</i>
Bore head Details	Year Bores Sunk	<i>Army Bore – early nineties The rest – unknown – a lot earlier</i>
	Bore Casing Size	<i>6" /150mm</i>
	Bore Casing material	<i>Class 12 PVC</i>
	Sealed to prevent surface water ingress	<i>Yes, All the Bore Casings typically extend approx. 600mm above surface level</i>
	Sealed to prevent vermin (frogs / snakes etc.) from entering bore	<i>Yes, All bores sealed to prevent vermin (frogs / snakes etc.) from entering the bore.</i>
Sourcing Infrastructure	Type (pumped/gravity/equipped bore/etc)	<i>Electrical submersible pumps fitted in each Bore</i>
	Description	<i>Bore depth are generally less than 50 metres</i>
Are there any sources that do not undergo treatment prior to supply?	<i>No</i>	
Lakeland Treatment Plant	Process	<i>Process comprises of chlorination only</i>
	Design Capacity (20 hr operation)	<i>0.18 ML/d</i>
	Daily flow range	<i>0.06 ML/d</i>
	Chemicals added	<i>Sodium Hypochlorite</i>
	Standby chemical dosing facilities (Y/N)	<i>Yes</i>
	Water sourced from and %	<i>Water is sourced 100% from the network of 3 bores</i>
	% of average day demand provided	<i>100%</i>
	% of scheme supply	<i>100%</i>
	Distribution area supplied	<i>100%</i>
Bypasses / Variations	<i>No Bypasses</i>	
Are there any sources that do not undergo disinfection prior to supply?	<i>No</i>	
Disinfection	Location	<i>Lakeland Treatment Plant</i>
	Type	<i>Sodium Hypochlorite Dosing</i>

Component		Lakeland
	Dose rate	<i>Unknown (Dosed to maintain target residual between 0.5 and 0.8mg/L in reservoir)</i>
	Target residual levels	<i>0.45 mg/L in reticulation</i>
	Duty/standby	<i>Yes</i>
	Dosing arrangements	<i>PLC controlled pump with feedback from free chlorine residual analyser</i>
	Alarms	<i>No</i>
	Auto shut-off arrangements	<i>Dosing controlled by PLC via free chlorine residual analyser with control set points Dosing pumps shut down when set point level reached</i>
Distribution and Reticulation System	Pipe material	<i>A.C. UPVC & Poly</i>
	Age range	<i>A.C. – 30 years old, UPVC – varying 1993 onwards, Poly – 1991 onwards</i>
	Approx % of total length	<i>A.C. 10% UPVC 20% Poly 70%</i>
	Areas where potential long detention periods could be expected	<i>Poly to school and roadhouse at varying times of the year due to wet season</i>
	Areas where low water pressure (e.g. < 12 m) could be expected during peak or other demand periods)	<i>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</i>
Reservoirs A	Name	<i>Lakeland Reservoir</i>
	Capacity (ML)	<i>0.250ML</i>
	Roofed (Y/N)	<i>Yes</i>
	Vermin-proof (Y/N)	<i>Yes</i>
	Runoff directed off roof (Y/N)	<i>Yes</i>

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.

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			Immediate (17/18 FY)	2018/2019 FY	19/20 or later
Bores	Ingress into bore	bacteria and virus	High 16	disinfection	bore head sealed and inspection program	Major	Rare	Medium 5	Reliable	Bore heads sealed and disinfection will generally mitigate though.			
	Ingress into bore	protozoa	High 16	Bore head sealed	bore head sealed and inspection program	Major	Rare	Medium 5	Confident	Bore heads sealed and an inspection program implemented			
	Septic contamination of aquifer	bacteria and virus	High 12	disinfection	bore head sealed and inspection program	Major	Unlikely	Medium 8	Certain	considered as whole of treatment in absence of failure			
	Contamination of aquifer through SE bore	protozoa	Extreme 25	SE bore disconnected		Moderate	Rare	Low 3	Reliable	Investigate options for SE and NE bores for refurbishment or replacement.		Investigate new bore in the future	

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			Immediate (17/18 FY)	2018/2019 FY	19/20 or later
	Bore pump failure	Failure of supply	Medium 6	More than one bore	Restrictions	Moderate	Possible	Medium 9	Confident	3 active bores, Army bore supplies bulk of water in Lakeland.		Investigate new bore in the future if demand requires	
	Aquifer contamination from buried chemical drums	Pesticides	High 12	Annual Monitoring		Moderate	Unlikely	Medium 6	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 0.5-0.8 mg/L critical at 4 mg/L	SCADA monitoring. EDAC system will call out at 1.5mg/L. Pump can be turned off remotely via SCADA.	Moderate	Possible	Medium 9	Confident	Recirculation system gives a good indication of chlorine residual due to good mixing.			
	insufficient dose	bacteria/virus	Extreme 16	Target 0.5-0.8 mg/L	Dose not below 0.3mg/L for a number of years. SCADA monitoring and EDAC system will call out at 0.3mg/L.	Catastrophic	Rare	Medium 6	Confident	Source water is bore water which is more likely to be free of bacteria than surface water	Dual hypo pumps are currently being installed		
	ineffective disinfection due to turbidity	bacteria	High 10	disinfection		Moderate	Rare	Medium 6	Estimate	bore water low turbidity			
	chemical breakdown	chlorate	High 12			Moderate	Likely	High 12	Unreliable			Begin THM sampling of final water	If chlorate is found, investigate solutions.


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			Immediate (17/18 FY)	2018/2019 FY	19/20 or later
Treated water storage/ Reservoirs	Ingress into reservoirs	Protozoa	Extreme 16	Brand New reservoir	Reservoir inspection program every three months	Catastrophic	Rare	Medium 6	Reliable				
	ingress of amoeba	amoeba	High 12	disinfection	Brand new reservoir	Major	Unlikely	Medium 8	Reliable	Disinfection maintained in reticulation.			
Reticulation	ingress of contaminated water	Bacteria virus	Extreme 20	network pressure, residual disinfection	mains break procedure	Major	Unlikely	Medium 8	Reliable	weekly reticulation monitoring	develop procedure to flush on low chlorine		
	ingress of contaminated water	protozoa	Extreme 20	network pressure	mains break procedure	Major	Unlikely	Medium 8	Reliable		develop procedure to flush on low chlorine		
	biofilm growth	opportunistic pathogens	High 15	flushing program		Major	Rare	Medium 5	Estimate	disinfection maintained			
	Power failure	Failure of supply	High 15	Generator		Moderate	Unlikely	Medium 6	Confident	3 phase power and generator back up			
	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6			Insignificant	Possible	Low 3	Confident				
	backflow	protozoa	Extreme 20	system integrity, backflow prevention		Major	Rare	Medium 5	Estimate				Taggle meters

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			Immediate (17/18 FY)	2018/2019 FY	19/20 or later
				on new installations									
System Wide	WTP Fire	Failure of supply	High 10	DMP		Catastrophic	Rare	Medium 6	Reliable				
	Cyclone	Failure of supply	High 10	DMP		Catastrophic	Rare	Medium 6	Reliable				
	operator error	any	Extreme 25	training, experience, mentoring		Major	Unlikely	Medium 8	Estimate	All Operators have a Certificate III in water operations			
	Missing procedures	All	Extreme 25	SCADA limits partially mitigate.		Moderate	Possible	Medium 9		Need to take staff offline to write procedures to mitigate risks	Procedures currently being written		

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 2 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 >3mg/L 0.4 – 0.6 and 2 - 3mg/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	<ul style="list-style-type: none"> 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.

Documented procedures, as listed below.

Table 3 Formal documented procedures used by CSC

Location	Documented procedure Name	S.O.P. No	Last Revision or Implementation	Process for implementing the procedure Activity and Frequency	Comments
Treatment	Chlorine Analyser Maintenance Procedure	WS0005	19/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Safe Handling of sodium hypochlorite	WS0001	12/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Operational Procedure for Lakeland Water Treatment Plant	WS 0014	31/01/2018	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
Reticulation	Water main new installation	WS0011	19/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water mains repairs	WS0002	18/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water service repairs	WS0013	19/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water Mains Flushing / Scouring	WS0006	23/3/2012	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water Sampling	WS0008	10/12/2012	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water Reservoirs – Cleaning	WS0007	2/10/2012	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water Service – New installation	WS0010	19/12/2017	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	Water testing for Coliforms and E.coli	WS0009	31/01/2018	Distributed to Relevant staff and training records through toolbox talks	This is a current Procedure
	E.Coli detection reporting (to regulator)	WS0015	31/01/2018	Reporting by Manager only	This is a current Procedure

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 4 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 5 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. Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	Composite bore sample	Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Metals Analysis Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn	Composite bore sample	Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Pesticides	Army Bore	Yearly	Grab Sample	Y	Analysed by NATA registered laboratory
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 (these readings are taken from the SCADA each morning), on line analyser controls dosing pumps, Trended on SCADA by CSC.
	Physical / Chemical Analysis. Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	Final Treated Water Sample Tap	Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory

	Metals Analysis Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn	Final Treated Water Sample Tap	Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Total Coliforms and <i>E. coli</i>	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 6.2A	Monthly	Grab Sample	Y	Analysed by CSC
	Temperature		Monthly	Grab Sample	N	
	Alkalinity		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. Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica		Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Metals Analysis Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn		Quarterly	Grab Sample	Y	Analysed by NATA registered laboratory
	Total Coliforms and <i>E. coli</i>		Weekly	Grab Sample	Y	Analysed by CSC at the Annan WTP using Idexx. Verified quarterly at a NATA registered lab.

Samples that are verified in a NATA registered Lab 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.

Samples that are verified in a NATA registered Lab for physical/chemical 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

Note: DWQMP reports tabulate the more recent water quality data.

Table 6 Army Bore water quality details (analysed by NATA registered lab)

Parameter	Sampling Location	Time Period	Results ug/L	LOR	Australian Drinking Water Guidelines guideline value ug/L (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
Alpha-BHC	Lakeland Army Bore	2017	<0.5	<0.5		
Aldrin – mg/L			<0.5	<0.5	0.3	0
Dieldrin – mg/L			<0.5	<0.5	0.3	0
Endosulfan			<0.5	<0.5	20	0
Endo. Sulphate			<0.5	<0.5		
Endrin			<0.5	<0.5		
Heptachlor			<0.5	<0.5	0.3	0
DDT			<0.5	<0.5	9	0
Heptachlor epoxide			<0.5	<0.5	0.3	0
Methoxychlor			<0.5	<0.5	300	0
Chlordane			<0.5	<0.5	2	0

Initial and subsequent testing has not revealed any parameter to be of concern to date, however annual sampling will continue, in the future the detection of any parameters and the concentrations will determine what action will be required

Table 7 Combined Raw water quality (Analysed by 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
				Max. Value	Avg. Value	Min. Value		
Alkalinity	Lakeland Combined Bore Water (Raw Water)	1 July 2015 to 30 June 2017	10	300.0	276.2	250		
Calcium			12	40.0	39.5	29.0		
Chloride			10	130.0	104.3	65.0	< 250 mg/L	0
Colour Apparent			10	5.0	5.0	5.0	< 15 Pt/Co	0
Electrical Conductance			10	950.0	812.9	660.0		
Fluoride			10	0.31	0.24	0.05	< 1.5 mg/L	0
Total Hardness			10	290.0	257.5	210.0	< 200 mg/L	10
Magnesium			12	46.0	40.4	32.0		
pH			10	8.0	7.83	7.7	6.5 – 8.5	0
Potassium			10	2.1	1.95	1.5		
Sodium			10	81.0	67.0	50.0	< 180 mg/L	0
Total Dissolved Solids			10	570.0	486.3	390.0	< 600 mg/L	0
Sulphate			10	4.1	3.51	3.1	< 250 mg/L	0
Turbidity			10	6.1	1.15	0.5	< 5 NTU	0
Arsenic mg/L			10	0.003	0.003	0.003	0.01 mg/L	0
Cadmium mg/L			10	0.0001	0.0001	0.0001	0.002 mg/L	0
Barium mg/L			10	0.020	0.015	0.010	2 mg/L	0
Beryllium mg/L			10	0.0001	0.0001	0.0001	0.06 mg/L	0
Chromium mg/L			10	0.0010	0.0010	0.0001	0.05 mg/L	0
Cobalt mg/L			10	0.001	0.001	0.001	0.05 mg/L	0
Copper mg/L			10	0.180	0.045	0.001	2.0 mg/L	0
Iron mg/L			10	0.007	0.005	0.005	0.3 mg/L	0
Lead mg/L			10	0.003	0.002	0.001	0.01 mg/L	0
Manganese mg/L			10	0.032	0.007	0.005	0.1 mg/L	0
Nickel mg/L			10	0.001	0.001	0.001	0.02 mg/L	0
Selenium mg/L			10	0.003	0.003	0.003	0.01 mg/L	0
Vanadium mg/L			10	0.025	0.021	0.012		
Zinc mg/L			10	0.038	0.011	0.038	3.0 mg/L	0

Table 8 Chlorinated Treated Water (to town) quality details – Lakeland Water Treatment Plant (Analysed by NATA registered 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
				Max. Value	Avg. Value	Min. Value		
Alkalinity mg/L	Lakeland Water Treatment Plant	1 July 2015 – 30 June 2017	8	310.0	277	230		
Calcium mg/L			8	41.0	36.8	30.0		
Chloride mg/L			8	140.0	110	110	≤250 mg/L	0
Colour Apparent Pt- Co			8	5.0	5.0	5.0	≤15 Pt/Co	0
Electrical Conductance us/cm			8	1000.0	853.5	660.0		
Fluoride mg/L			8	0.35	0.30	0.23	≤1.5 mg/L	0
Total Hardness mg/L CaCO ₃			8	300	263.8	200	≤200 mg/L	8
Magnesium mg/L			8	47.0	41.55	31.0		
pH			8	8.1	7.96	7.8	6.5 – 8.5	0
Potassium mg/L			8	2.1	1.95	1.8		
Silica – Reactive mg/L			8	100.0	90.6	77.0		
Sodium mg/L			8	79.0	71.4	54.0	≤180 mg/L	0
Total Dissolved Solids mg/L			8	600	511	390	≤600 mg/L	0
Sulphate mg/L			8	3.2	3.1	2.4	≤250 mg/L	0
Turbidity NTU			8	1.0	0.6	0.5	≤5 NTU	0
Arsenic mg/L			4	0.003	0.003	0.003	0.01 mg/L	0
Barium mg/L			4	0.013	0.017	0.018	2 mg/L	0
Beryllium mg/L			4	0.0001	0.0001	0.0001	0.06 mg/L	0
Cadmium mg/L			4	0.0001	0.0001	0.0001	0.002mg/L	0
Chromium mg/L			4	0.0010	0.0010	0.0010	0.05 mg/L	0
Cobalt mg/L			4	0.001	0.001	0.001		
Copper mg/L			4	0.008	0.020	0.039	2.0 mg/L	0
Iron mg/L			4	0.005	0.005	0.005	0.3 mg/L	0
Lead mg/L			4	0.002	0.001	0.001	0.01 mg/L	0
Manganese mg/L			4	0.005	0.005	0.005	0.1 mg/L	0
Nickel mg/L			4	0.001	0.001	0.001	0.02 mg/L	0
Selenium mg/L			4	0.003	0.003	0.003	0.01 mg/L	0
Vanadium mg/L			4	0.018	0.025	0.025		
Zinc mg/L			4	0.006	0.006	0.005	3.0 mg/L	0

Table 9 Summary of Treated Water quality details – Lakeland Reticulation (Analysed by NATA registered 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
				Max. Value	Avg. Value	Min. Value		
Alkalinity - mg/L CaCO ₃	Various Locations within the Lakeland Reticulation	1 July 2015 – 30 June 2018	8	300	279	220		
Calcium - mg/L			8	40.5	37.5	30.0		
Chloride - mg/L			8	130	108.7	70	≤250 mg/L	0
Colour Apparent - Pt- Co			8	5	5	5	≤15 Pt/Co	0
Electrical Conductance			8	910	825	650		
Fluoride - mg/L			8	0.39	0.28	0.23	≤1.5 mg/L	0
Total Hardness - mg/L CaCO ₃			8	310	265	205	≤200 mg/L	24
Magnesium - mg/L			8	50.0	42.0	31.0		
pH			8	8.00	7.93	7.70	6.5 – 8.5	0
Potassium - mg/L			8	2.1	2.0	1.8		
Silica – Reactive - mg/L			8	100	90.1	77.0		
Sodium - mg/L			8	82.0	71.3	54.0	≤180 mg/L	0
Total Dissolved Solids - mg/L			8	550	502	390	≤600 mg/L	0
Sulphate - mg/L			8	3.5	3.0	2.4	≤250 mg/L	0
Turbidity – NTU			8	2.5	0.9	0.5	≤5 NTU	0
Aluminium - mg/L			3	.028	0.0263	0.025	0.20 mg/L	0
Arsenic mg/L			7	0.003	0.003	0.003	0.01 mg/L	0
Barium mg/L			7	0.018	0.016	0.012	2 mg/L	0
Beryllium mg/L			7	0.001	0.0001	0.0001	0.06 mg/L	0
Cadmium mg/L			7	0.0001	0.0001	0.0001	0.002 mg/L	0
Chromium mg/L			7	0.001	0.001	0.001	0.05 mg/L	0
Cobalt mg/L			7	0.001	0.001	0.001		
Copper mg/L			7	0.026	0.0193	0.014	2.0 mg/L	0
Iron mg/L			7	0.005	0.005	0.005	0.3 mg/L	0
Lead mg/L			7	0.005	0.002	0.001	0.01 mg/L	0
Manganese mg/L			7	0.005	0.005	0.005	0.1 mg/L	0
Nickel mg/L			7	0.001	0.001	0.001	0.02 mg/L	0
Selenium mg/L			7	0.003	0.003	0.003	0.01	0
Vanadium mg/L			7	0.028	0.023	0.012		
Zinc mg/L			7	0.031	0.015	0.005	3.0 mg/L	0
Mercury mg/L			1	0.00005	0.00005	0.00005	0.001 mg/L	0

Table 10 Summary of Treated Water quality details – Lakeland Reticulation (Analysed by Cook Shire Council Annan Staff)
 Sampled from the various locations within the Lakeland Reticulation area from 01/07/2015 to 30/06/2017

	pH	Temperature °C	Electrical Conductivity uS/cm	Dissolved Oxygen Mg/L	Colour Pt/Co Units	Turbidity NTU	Total Hardness as mg/L CaCO ₃	Chlorine Residual mg/L
Count	23	23	23	23	23	23	23	22
Max	7.74	33.0	1014	7.74	11	4.10	310	1.25
Min	6.80	26.0	649	1.61	0	0.08	196	0.25
Avg	7.17	31.1	879	5.65	1.03	0.40	260	0.52

Table 11 Summary of Total E. coli detected – Lakeland Reticulation (Analysed by Cook Shire Council, Verification by NATA registered 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	01/07/2015 – 30/06/2018	119	0	Escherichia coli should not be detected in any 100 mL sample of drinking water.	0

Table 12 Summary of Lakeland Treatment Plant daily chlorine residual readings (Obtained daily from the Lakeland SCADA) from 01/06/2015 to 30/06/2017

	SCADA on line Chlorine readings (mg/L)
Count	674
Max	1.9
Min	0.24
Avg	0.63