



**Cook Shire**  
**COUNCIL**

**Cooktown**

# **Drinking Water Quality Management Plan**

**BLIGH**  
**TANNER**

## + DOCUMENT CONTROL SHEET

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## + 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 COOKTOWN

## 1.1 Overview

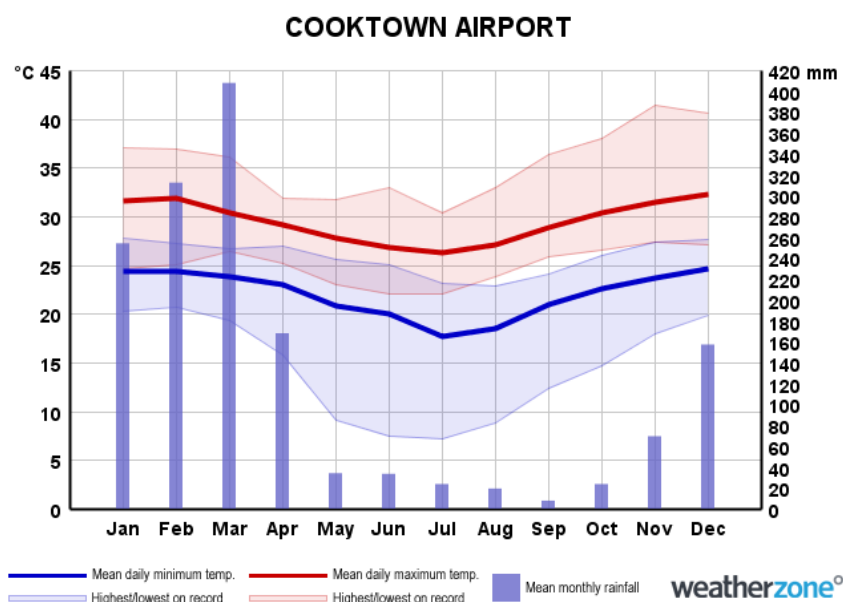
Cooktown is the largest of the drinking water schemes in Cook Shire Council. It has a population of 2200, which is projected to grow to 2850 in 10 years. This will increase demand to approximately 2ML/Day. The Annan WTP has a capacity of 3.6 ML/Day (20 hours operation), this can be supplemented by the Duckfarm Borefields that provide contingency during disasters.

## 1.2 Annan River Catchment

Cooktown's Water is sourced from the Annan Weir on the Annan River. The Annan River catchment area is approximately 37,350ha and due to the terrain has very limited human impact. The Annan River originates in rugged mountainous pristine rainforest, from the North or North western sides of Mount Misery, Poverty and Mt Romeo which is North North West of Bloomfield. It then opens up into open woodlands and grasslands. Wallaby Creek is a major tributary of the Annan River with the village of Rossville adjacent to the Wallaby.

The Annan Weir is a mass concrete weir that was built across the Annan River at the treatment plant site in the early 90's to supply the water requirements of Cooktown. The impounded waters have a capacity of approximately 400ML which is almost Cooktown's annual consumption. Normally the river has a good flow throughout the year. Since the weir was built the Annan River has stopped flowing twice, both only for a very short duration in 2 very dry years, and the trigger for water restrictions is when the weir stops overflowing. The Annan Catchment is within a high rainfall area with most of the catchment area receiving on average 3000-4000 mm pa. The Annan River experiences annual flooding with the "Wet Season". When the Annan River floods, the turbidity increases, and requires more operator vigilance to ensure that sedimentation and filtration are effective.

Figure 1 Cooktown Airport Annual Temperatures & Rainfall



## 1.3 Land Use

The Annan River Catchment, whilst not protected, has very few land uses that impact on water quality. There are large areas of the catchment that are indigenous use areas, or national parks, with only small low density residential areas, and limited grazing. There is no land use in the rainforest areas.

The Collingwood tin mine is upstream of the Annan Weir, but has not been operational for >8 years. There is no other significant industry in the area and almost nil recreational activities due to the ruggedness of the River. Bush fires don't burn through the rainforest however they do burn through the lower grasslands, almost annually. CSC conducts controlled burns around the Water Treatment Plant earlier in the year to reduce the fuel for the fires.

The Mulligan Highway crosses the Annan River above the treatment Plant; this is the main highway into & out of Cooktown.

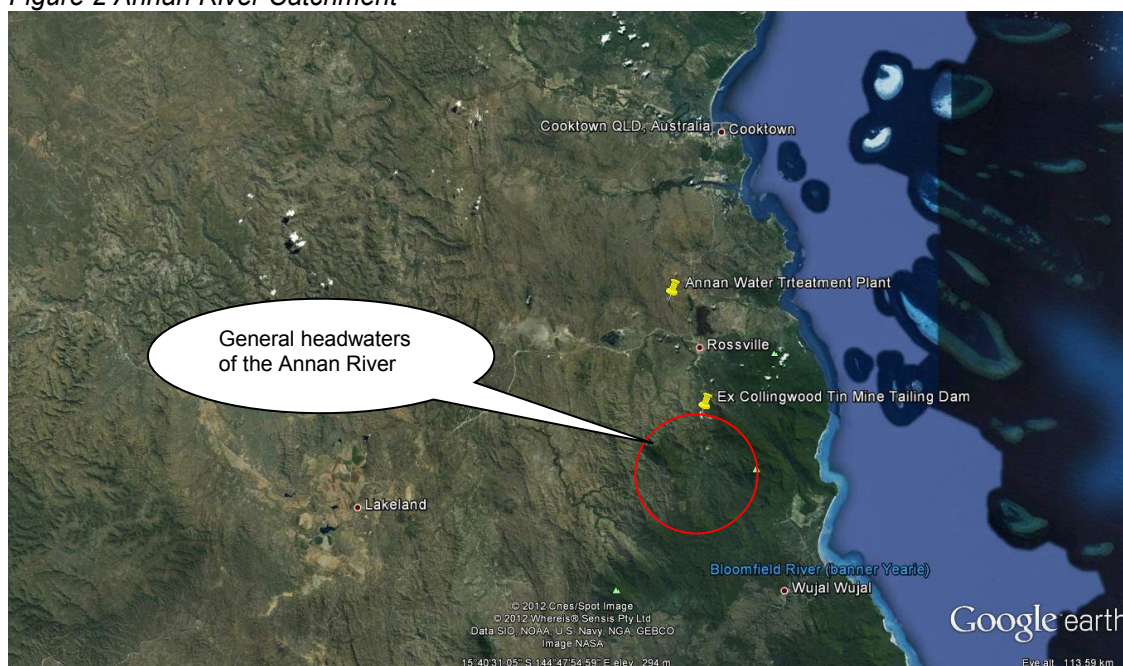
### 1.3.1 Ex-Collingwood Tin Mine

The ex-Collingwood Tin Mine poses little risk now, but the tailings dam had been considered as a potential problem in the past when the mine was operating, as the tailings dam had threatened to overflow into the Annan River.

DERM intervened with the ordering of controlled releases by Bluestone Tin from the tailings dam when the river was in flood, accompanied by a strict sampling regime (to DERM's requirements) to determine that the releases were not having a detrimental impact on the River. Analyses of the water quality (collected and analysed in a NATA Certified Lab, by Bluestone Tin) had shown at the time that Antimony & Arsenic and to a lesser degree Fluoride & Nickel were elevated in the tailings dam. Cook Shire Council was in close contact with DERM at the time as Cooktown's water was being drawn off below the discharge point and was a cause of concern. DERM confirmed with Cook Shire Council that the releases and subsequent sampling had proven that there was no threat to the Cooktown Water supply as the level of dilution had reduced the parameters in question to be negligible. The mine has not operated now for approx. 8 years, and is not considered to increase the risk of any parameter.

Below the mine, the Wallaby Creek (a major tributary) enters the Annan. There is a very small village (Rossville) that is adjacent to the Wallaby. There is no sewerage system in Rossville so the residents use septic tanks. Below the confluence, the Annan River breaks out of the rainforest and into open woodlands before making its way to the upper limits of the Annan Estuary with still limited human impact in the more accessible areas. Google Earth Map overleaf shows the location of Cooktown, the Annan Treatment Plant, the location of the ex Collingwood Tin mine, and the general Headwaters area of the Annan River

Figure 2 Annan River Catchment



## 1.4 Duckfarm Borefields

The Bore fields consist of 6 production bores and a Treatment Plant.

Table 1 Bore Details

Bore Name	Bore Depth	Bore Capacity	Pump Type
Leons Bore	48.5m	3.0 L/s	Electric Submersible
China 1 Bore	47m	2.0 L/s	Electric Submersible
Gravel Pit Bore	49m	3.0 L/s	Electric Submersible
Tully Bore	55m	4.0 L/s	Electric Submersible
Lovers Bore	52m	3.0 L/s	Electric Submersible
Sykes Bore	48m	1.5 L/s	Electric Submersible

The Cooktown bore fields have not been used as the primary source for Cooktown's water since the early nineties, and from that time were only used for a couple of weeks per year to supplement the supply from the Annan during periods of high river turbidity. (Some years depending on the season it wasn't required at all). However since the installation of the sedimentation tank at the Annan Treatment Plant in 2009 the Bore fields have not been used to supply water to Cooktown at all. Rather, the bores have been used to supply water for road making and maintenance. As they have not been consistently used for some time, the infrastructure will require some investment to bring it back to fully operational. For example, pumps, power boards and vermin proofing will need to be evaluated.

Cooktown's Duckfarm Bore fields are situated on Lot 98SP105917 approximately 4.7 km West / South West from the centre of Cooktown and to the East of Mt Tully. The Duckfarm bore fields occupies an area of approximately 5 km<sup>2</sup> and is defined by a physiographic catchment bounded by moderate ridges on the eastern, western & southern sides. The northern boundary of the bore fields is a tidal, mangrove flat associated with Four-Mile creek, which is an estuary of the Endeavour River. The terrain of the bore fields is generally undulating and moderately timbered with restricted public access. There are no forms of human development or activities within the catchment area. The Hodgkinson Formation is the main aquifer underlying the Duckfarm bore fields and acts as a semi confined aquifer. All bores are concrete sealed with the bore casing generally extending 0.6mm above surface level to prevent surface water entering the bore.

### 1.4.1 Natural recharge

Water Resources conducted extensive water level plots, and collected rainfall data over several years in the mid 80's, and calculated that rainfall events of less than 100mm's had little impact on the ground water levels, however the for the 4 months of the Wet season (Jan – April) when rainfall figures are considerably higher than the 100mm's then the majority of the recharging occurs then. An average natural recharge was calculated to be approx 275ML over the entire Borefield. The total volume of ground water in storage was calculated to be in the vicinity of 6770ML.

## 2 INFRASTRUCTURE

### 2.1 Annan WTP

Catchment to tap and treatment plant schematics for the Cooktown Scheme are provided in the following pages.

The Annan WTP is manned during working hours, and is currently required to run approx. 11 hrs daily. We like to run the plant during the day while its manned that way an operator is on hand should something malfunction.

#### Plant Startup:

The process starts when the Cooktown Reservoir either reaches the “Low Level” setpoint, or an operator overrides the setpoint to initiate a fill from the Annan, either method opens a solenoid valve in Cooktown that allow water to gravity feed from the Annan High Level Reservoir to the Cooktown High Level Reservoir.

The Cooktown solenoid valves remains open until either the Cooktown Reservoir is full or an operator overrides the full setpoint. Left to its own devices the solenoid valve in Cooktown will open and close automatically on demand, whatever time of the day or night, however we prefer to control the opening (usually early in the morning) so that the operators are working and can monitor treatment processes and perform their daily water quality tests.

With either method closing the solenoid valve, the solenoid valve then remains closed until the process starts again. The solenoid valve is PLC controlled which allows the Cooktown operators to override the start setpoint to open the solenoid valve, and they can override the full setpoint to close the solenoid valve and alternatively, the operators can lockout the solenoid valve to prevent it opening at all. The operators at the Annan T/Plant can also override the opening setpoint to open the solenoid provided it's not “Locked out”

When activated the solenoid valve opens relatively quickly allowing the water to flow but on closing, it takes approximately 10 minutes to close being controlled by a pressure sensing device to control the rate of close to prevent water hammer, which works well.

Once the Cooktown solenoid valve has opened and the water flows through to Cooktown, the level in the Annan High Level Reservoir drops until the level reaches the Treatment Plant Start-up Level which will then start the Treatment Plant. The Treatment Plant operator can also override the start signal without waiting until the Reservoir drops to this point.

The on duty clean water pump starts to pump up to the Annan High Level Reservoir; this initiates and starts the carbon dioxide injection, the chlorinator, and the fluoride process. The clean water pumps draw water from the balance tank, lowering its level until the raw water start level is reached. This starts the on duty raw water pump located in the bottom of the Intake tower. Both the clean & raw water pumps auto alternate on fault, and on time run, the operator can also select the pump to run next. As the raw water flow rate ramps up, the entire chemical dosing skid cuts in when the raw water flow reaches 40 l/s, as well as the constant head pumps selected for duty. The chemical dosing skid and the constant head pumps generally start a few seconds after the duty raw water pump starts up.



Figure 3 Catchment to tap schematic - Cooktown

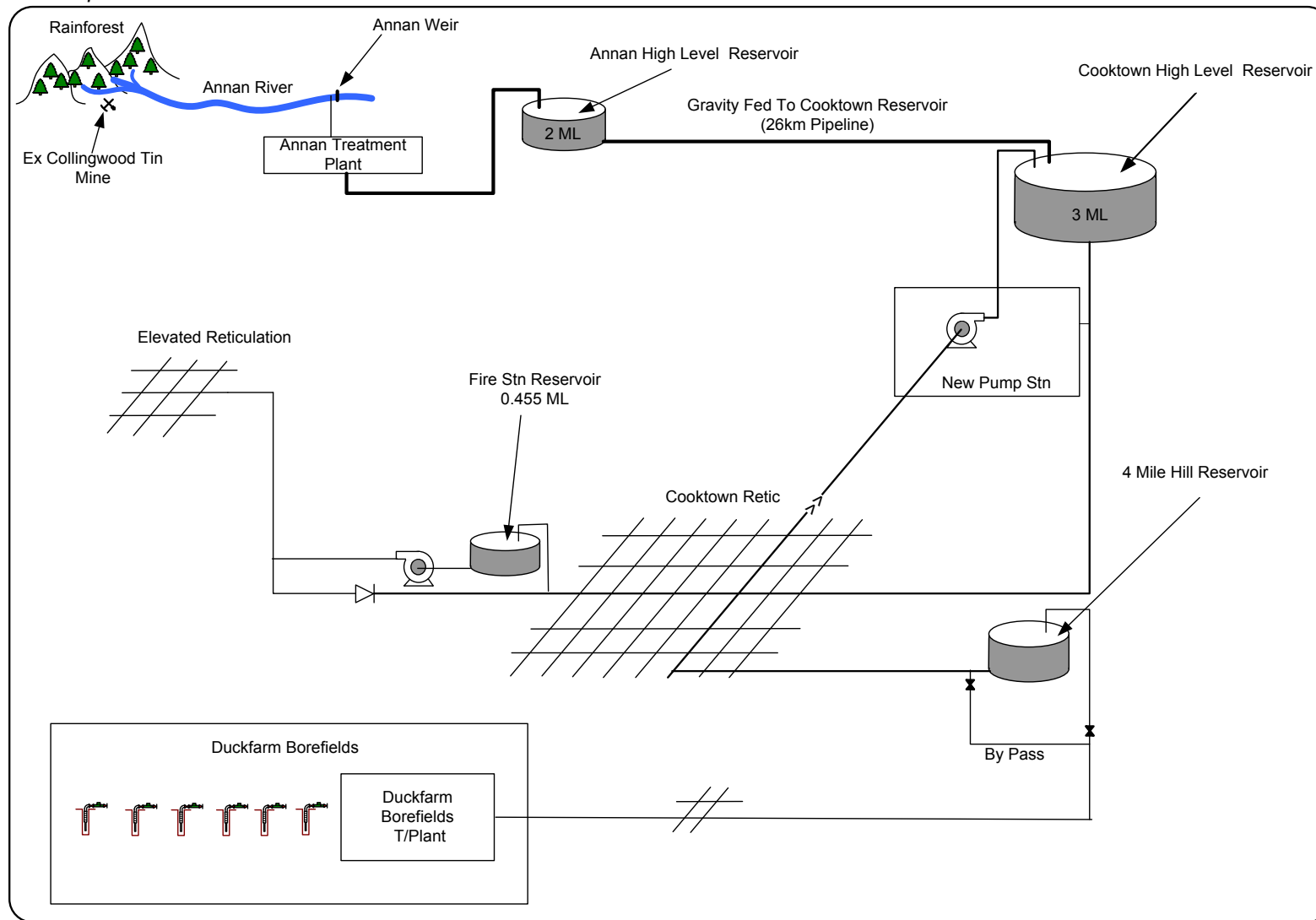


Figure 4 Annan Water Treatment Plant Schematic

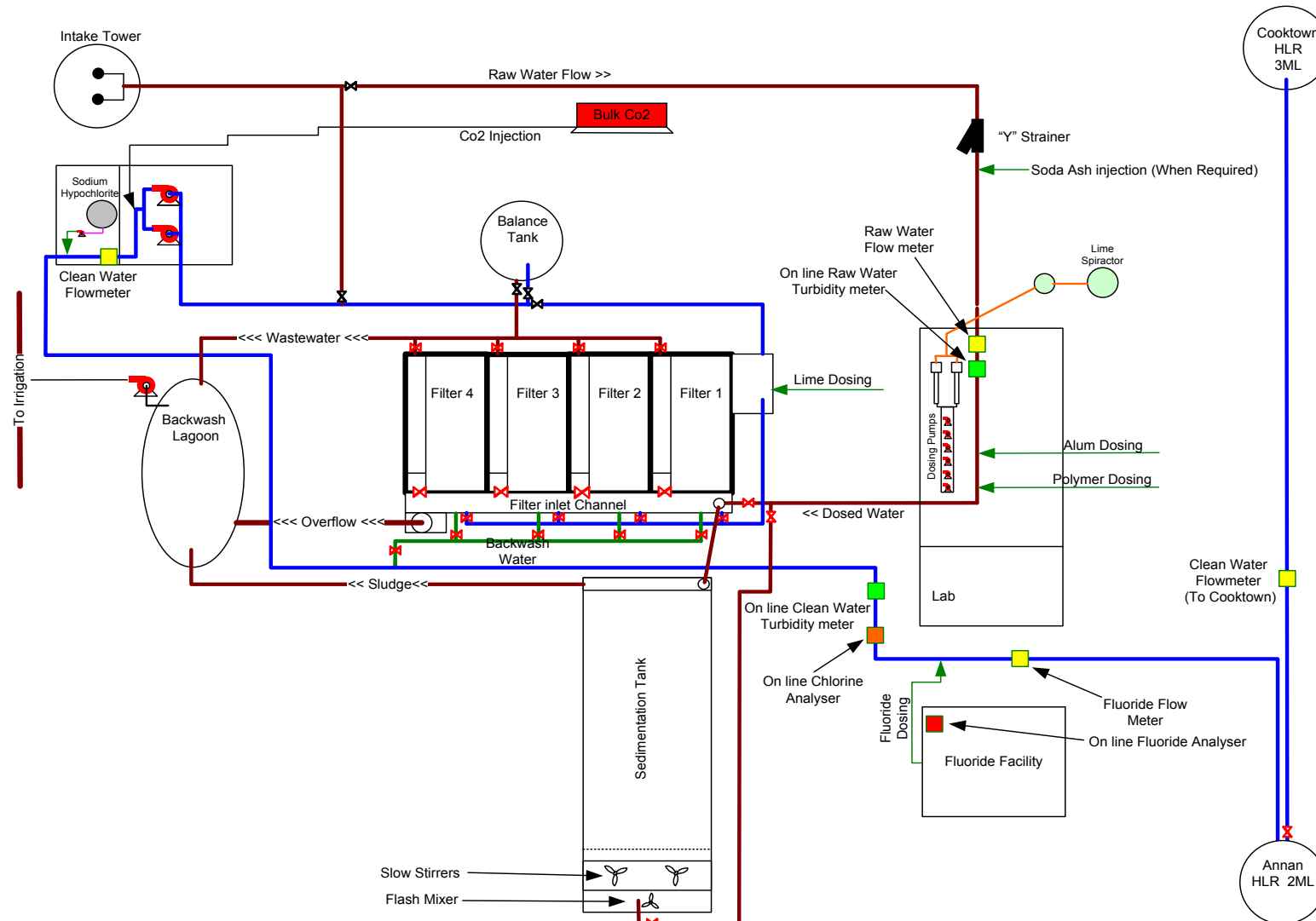


Table 2 Infrastructure Details – Annan River Source

		<b>Annan WTP</b>
Sources	Name	<i>Annan</i>
	Type	<i>Surface Water</i>
	% of supply	<i>100</i>
	Reliability	<i>Annan River stopped flowing briefly in 2002-3 during an exceptionally dry period, normally has a good flow all year</i>
	Water quality issues	<i>High Turbidity levels after storm events</i>
Sourcing Infrastructure	Annan	<i>Intake in the River upstream of a mass concrete weir with approx 400ML of impounded water</i>
Are there any sources that <b>do not</b> undergo treatment prior to supply?		<i>No</i>
Annan Treatment Plant	Process	<i>Coagulation, Flocculation, Sedimentation, Filtration Chlorination &amp; Fluoridation</i>
	Design Capacity (20 hr operation)	<i>3.6 ML/d</i>
	Daily flow range	<i>1.8 ML/d (Wet Season) – 1.9 ML/d (Dry Season)</i>
	Chemicals added	<i>Soda Ash (if required), Alum, Polymer, Lime, Carbon Dioxide, Sodium Hypochlorite and Sodium Fluoride</i>
	Standby chemical dosing facilities (Y/N)	<i>Standby dosing pumps for: Soda Ash, Alum, Polymer, Lime and Sodium Fluoride (No Standby pump for Sodium Hypochlorite)</i>
	Water sourced from and %	<i>Water is sourced 100% from the Annan River</i>
	% of average day demand provided	<i>100%</i>
	% of scheme supply Distribution area supplied	<i>100%</i>
	Bypass 1*	<i>Sedimentation can be bypassed, reverting back to Direct Filtration (This would have no impact to final water quality in the dry season)</i>
	Bypass 2 **	<i>Raw water can be pumped direct to the Reservoir, bypassing all treatment other than Chlorination and Fluoridation.</i>
Are there any sources that <b>do not</b> undergo disinfection prior to supply?		<i>No</i>
Disinfection Annan T/Plant	Location	<i>Annan Treatment Plant</i>
	Type	<i>Sodium Hypochlorite Dosing</i>
	Dose rate	<i>Unknown (Dosing to maintain target residual level)</i>
	Target residual levels	<i>1.1 mg/L</i>
	Duty/standby	<i>No</i>
	Dosing arrangements	<i>PLC controlled with feed back from free chlorine residual analyser</i>
	Alarms	<i>No, Staff on site during working hrs, shows on SCADA and is Trended</i>
	Auto shut-off arrangements	<i>Flow paced with Clean water pumps, controlled by PLC via free chlorine residual analyser with control set points, shuts down when Clean Water Pumps Stop</i>
	Trended on SCADA	<i>Yes</i>

		<b>Annan WTP</b>
<b>Fluoridation</b> Annan T/Plant	Location	<i>Annan Treatment Plant</i>
	Chemical Type	<i>Sodium Fluoride (Granular)</i>
	Dose rate	<i>Variable - Flow Paced with Clean Water Pumps</i>
	Target Dose	<i>0.7 mg/L</i>
	Duty/standby	<i>Yes</i>
	Dosing arrangements	<i>PLC controlled with feedback from on line fluoride analyser</i>
	Alarms	<i>Operators alerted via the SCADA or touch screens in Fluoridation building of any Fluoridation related Alarms or Warnings</i>
	Status Display	<i>Both rooms of the fluoride building have a touch screen which has both display and control of the fluoridation equipment, includes all tank levels, valve positions (open/closed), dosing pump flow rates, main water line flow rate, which day tank on duty, which dose pump on duty, the actual dose rate (of Fluoride) Various warnings and prompts are displayed, and require an operator to acknowledge i.e. the operator is alerted when say Day tank 1 has only 25% left in it, it will auto alternate duty to Day tank 2 only if Day tank 2 level is greater than the shut down level. It will alert the operator when the Day tanks have been alternated and require an operator to acknowledge, the operator can then refill the empty Day tank. All the above information is also available on the plant SCADA screen, however there is no control from the SCADA screen</i>
	Auto shut-off arrangements	<i>Flow paced with Clean water pumps, controlled by PLC via on line fluoride analyser with control set points, shuts down if fluoride dose reaches a second High / Low set point, shuts down if main water line flow drops below 20 L/s, during a filter backwash, also when Clean Water Pumps Stop Fluoride shuts down if both day tanks are empty, or both dosing pumps fail</i>
	Fluoride Dose drift Alarm set points	<i>Low – 0.55 mg/L      High – 0.85 mg/L</i>
<b>Disinfection</b> New Pump Station	Fluoride Dosing Shutdown set points	<i>Low – 0.45 mg/L      High – 1.10mg/L</i>
	Trended on SCADA	<i>Yes</i>
	Location	<i>New Pump Stn Chlorinator Room</i>
	Type	<i>Sodium Hypochlorite Dosing</i>
	Dose rate	<i>Unknown (Dosing to maintain target residual level)</i>
	Target residual levels	<i>0.9 mg/L</i>
	Duty/standby	<i>Yes</i>
	Dosing arrangements	<i>Flow paced with Flow meter, PLC Controlled</i>
<b>Disinfection</b> Fire Stn Reservoir	Alarms	<i>No, Staff on site at least daily</i>
	Auto shut-off arrangements	<i>Shuts off if zero flow</i>
	Location	<i>Fire Stn Reservoir Pump Room</i>
	Type	<i>Sodium Hypochlorite Dosing</i>
	Dose rate	<i>Unknown (Dosing to maintain target residual level)</i>
	Target residual levels	<i>0.6 mg/L</i>
	Duty/standby	<i>Yes</i>



		<b>Annan WTP</b>
	Dosing arrangements	<i>Reservoir recirculated, sampled and analysed by chlorine residual analyser Dosing pumps controlled by PLC to maintain set points, Adjustable set points</i>
	Alarms	<i>No, Staff on site at least daily.</i>
	Auto shut-off arrangements	<i>Dosing pumps shut off when target Chlorine Residual level reached</i>
Distribution and Reticulation System	Pipe material	<i>A.C. D.I., UPVC &amp; Poly</i>
	Age range	<i>A.C. up to 40 Y.O. All new Water mains installed since 1990 have been UPVC with a few small Poly lines Oldest D.I. is 22 Y.O.</i>
	Approx % of total length	<i>A.C. 38.8% D.I. 31.2% UPVC 18.5% Poly 11.5%</i>
	Areas where potential long detention periods could be expected	<i>1 Area along Webber Esplanade has the potential for long detention periods</i>
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	<i>No areas of low water pressure</i>
Reservoir A	Name	<i>Annan Clean Water Reservoir</i>
	Capacity (ML)	<i>2 ML</i>
	Roofed (Y/N)	<i>Yes</i>
	Vermin-proof (Y/N)	<i>Yes</i>
	Runoff directed off roof (Y/N)	<i>Yes</i>
Reservoir B	Name	<i>Cooktown High Level Reservoir</i>
	Capacity (ML)	<i>3 ML</i>
	Roofed (Y/N)	<i>Yes</i>
	Vermin-proof (Y/N)	<i>Yes</i>
	Runoff directed off roof (Y/N)	<i>Yes</i>
Reservoir C	Name	<i>4 Mile Hill Reservoir</i>
	Capacity (ML)	<i>0.120 ML</i>
	Roofed (Y/N)	<i>Yes</i>
	Vermin-proof (Y/N)	<i>Yes</i>
	Runoff directed off roof (Y/N)	<i>Yes</i>
Reservoir D	Name	<i>Fire Station Reservoir</i>
	Capacity (ML)	<i>0.455 ML</i>
	Roofed (Y/N)	<i>Yes</i>
	Vermin-proof (Y/N)	<i>Yes</i>
	Runoff directed off roof (Y/N)	<i>Yes</i>
Water quality responsibility changes	Upstream location	<i>NA</i>
	Downstream location	<i>NA</i>

Raw water intake:

A circular concrete intake tower was built in the river bed, and was fitted with 4 intakes (at 4 different levels) on the downstream side of the tower, however only the top intake has been used as that's where the best water quality is, this intake has a stainless steel Johnson screen complete with air backwash. There are 2 x 50 L/s Submersible Flygt Pumps in the tower, these pumps auto alternate if one faults, and also auto alternates between duty & standby.

Soda Ash Dosing:

Soda Ash is used intermittently; it may be used for 3 or 6 months then not required for 12 months or 2 years depending on the seasons. Soda ash is used when the raw water pH is low and needs to be raised to optimise the alum dose, soda ash also slightly raises the alkalinity of the raw water. There are 2 (duty / standby) soda ash dosing pumps which auto alternate on fault, and time, and the operator can also select the pump to run next. Soda ash is made into an 8% solution from 25 kg bags, and made up in a 2500 litre tank, this generally lasts for several weeks.

#### Coagulation/Sedimentation:

An on line turbidity meter monitors the raw water turbidity, but this is not used for process control. There are 4 alum dosing pumps 2 of 0.25 L/m capacity and 2 of 1.7 L/m capacity, these dose at a point about 15m further along than the soda ash dosing. Liquid alum is used as the primary coagulant. The coagulation process can be operated in either of 2 modes “High Turbidity Mode” or “Low Turbidity Mode”. “High Turbidity Mode” is generally used when the raw water turbidity is greater than 150 NTU, usually encountered when the Annan River is in flood during the wet season. “High Turbidity Mode” auto selects the “On duty” of the larger size pumps which are capable of delivering the larger doses required with the high turbidity.

For the most part, the “Low Turbidity Mode” is used as the raw water turbidity generally is less than 10 NTU. Some seasons do not require the use of the “High Turbidity Mode” at all. There are duty / standby alum dosing pumps which auto alternate on fault, and time, and the operator can also select the pump to run next in each of the 2 modes. Liquid alum is purchased and supplied in 24 tonne lots as a 47% solution, this is transferred to the alum dosing tank and is diluted 50/50 with water to produce a 23.5% alum solution.

#### Polymer:

There are 2 duty / standby 0.25 L/m capacity polymer dosing pumps. Polymer is used as a filter aid and is used continuously. The polymer dosing pumps auto alternate on fault, and time, and the operator can also select the pump to run next. Polymer is made into a 0.2% solution from 25 kg bags, and made up in a 1000 litre tank, this generally lasts for several weeks. Polymer has the option of being injected where it currently is (in the dosing pit) or at the end of the sedimentation tank, prior to filtration. However during commissioning of the sedimentation tank the best results were obtained by dosing polymer at its current location. Several different polymers were trialled at the commissioning, however the one we have been using for years was still the optimum product.

The dosed water passes through static mixers then on to the sedimentation tank. The sedimentation tank is fitted with a flash mixer however to date hasn't been required, the 2 slow stirrers gently agitate the water to strengthen the floc, the water then travels on through the tank where the heavy floc drops out before reaching the end. Sludge is removed from the floor of the sedimentation tank via an MRI Low Profile Hoseless Sludge Collector. The sludge is sent to the backwash lagoon and supernatant is not recycled.

Bypass 1\* (See Table 2) The sedimentation tank can be bypassed. The trigger to initiate the use of this bypass would be a catastrophic failure of the sedimentation tank, normal cleaning and maintenance of the sedimentation tank does not require the use of this bypass. The use of this bypass returns the plant back to its original design (a direct filtration plant) and limits the raw water quality that can be treated to less than 25 NTU.

#### Filtration:

Water leaves the sedimentation tank and enters the bank of 4 filters along the filter inlet channel then through the individual filter inlet boxes. Filters are a dual media (Sand and Anthracite). The filtration process along with most of the processes are fully automated and controlled by a PLC.

At the Annan Treatment plant filter backwashes can be initiated by:

- Operator initiated
- Filter run time, (Operator can set this time)
- Head loss across the filter

Granular media filtration performance can be monitored by sampling the effluent from the filters and checking the turbidity. At the Annan treatment plant we have 4 filter cells all of which have a

continuous sample line plumbed to the lab so it's very easy to obtain a grab sample from each / any of the filter cells. Monitoring and trending of the head loss on the SCADA is a valuable tool for the operators as shows how the filters have been running historically and also indicates when a backwash is imminent.

All Filter valves are PLC controlled, pneumatically driven. During a filter cell backwash the Clean water flow from the filters is reduced by  $\frac{1}{4}$  (because 1 cell is off-line (backwashing) to create uniform flows through the plant, the raw water flow is reduced to  $\frac{3}{4}$  of the flow rate immediately prior to the backwash, all chemical dosing pumps are reduced proportionally as well. This method maintains the same hydraulic load on the remaining filter cells during a backwash. Only 1 filter cell can backwash at a time, if a second or third requires backwashing then they queue until the previous cell has completed the backwash cycle

Bypass 2\*\* Filter Bypass. The trigger to initiate the use of this bypass would be a catastrophic failure of the filters, and it would have to apply to all the filter cells, as there is the ability to shut down an individual filter cell for maintenance / repairs. This bypass was used initially in stage 1, prior to the construction of the filters. Since the commissioning of the filters, this bypass has never been used. Both bypasses are more a result of future subsequent works rather than designed bypasses.

#### Lime and CO<sub>2</sub> dosing:

Immediately after the water is filtered the lime solution is added in a chamber that creates turbulence, thus mixing the lime solution well. There are 2 helical rotor lime dosing pumps dosing a saturated lime solution into the filtered water.

Lime is batched by making a lime slurry in the lime slurry tank from 25kg bags. The slurry is transferred to the lime spiractor in operator adjustable increments of both frequency and duration. The lime spiractor is a cone shaped tank, water is added to the slurry from the bottom, at a tangent, to create a swirling motion with the slurry as the water level rises the cone diameter increases and the upward velocity of the solution decreases creating a saturated lime solution, this solution over flows into the saturated solution tank. This tank supplies the solution for the lime dosing pumps, as the tank is depleted a solenoid valve opens to allow more water into the spiractor thus replenishing the saturated solution tank.

The pipeline that exits the filters leads directly to the clean water pumps with a tee off to the balance tank. So if the clean water pumps are stopped then the water simply fills the balance tank until full then shuts down the raw water pumps, alternatively if the clean water pumps are running then the pumps take what is required, this either slowly fills the balance tank, or slowly depletes it. The pumps, raw and clean water, have been sized to produce the same flow rate, however there has been some minor throttling to fine tune the flows. The balance tank level now remaining fairly constant over a pumping cycle. A level sensor on the balance tank controls the starting and stopping of both the raw and clean water pumps.

Immediately after the clean water pumps is the injection point for CO<sub>2</sub>, this is injected directly into the main through a diffuser, the CO<sub>2</sub> is pressure regulated and a flow rotameter is fitted to show the rate of flow. Carbon dioxide is stored in a 4 tonne cylinder which has to be refrigerated, CO<sub>2</sub> gas is injected prior to the disinfection but after the lime. Lime & CO<sub>2</sub> dosing can be turned off as a whole, selecting this option stops both lime & CO<sub>2</sub>.

Lime with the addition of carbon dioxide forms a calcium carbonate lining on the inside of all the concrete reservoirs and the cement lined pipeline to Cooktown, forming a barrier to the otherwise aggressive nature of the water. After the commencement of using water from the Annan River in the early nineties and prior to lime & carbon dioxide dosing, evidence was clearly visible with the degradation of the internal walls of the concrete reservoirs, both at the Annan and in Cooktown. Lime and carbon dioxide dosing has proven to reverse the destruction of the concrete fixtures. Over the years the Annan pipeline has been cut for various reasons and the calcium carbonate lining has been clearly visible.

#### Disinfection:

Approximately 20 m downstream of the lime the water is disinfected with sodium hypochlorite. Dual duty/standby dosing pumps provides the chlorine dose, which is controlled by a PLC and a chlorine analyser, the chlorine is maintained at the set point level of 1.1 mg/l, with feedback from a chlorine analyser. Since we don't have dual dosing pumps a spare is always kept at the plant. The chlorine dosing pump is interlocked to run only when either of the clean water pumps are running, and shuts down with the clean water pumps

#### Fluoridation:

A further 60m along the pipeline Fluoride is injected, being a brand new purpose built facility it complies with all requirement in the Water Fluoridation "Code of Practice" Revision Sept 2010 and the "Water Fluoridation Regulation 2008", Qld Health's audit team have performed 3 audits on the facility, all audits found the facility to be "Fully Compliant". Fluoride dosing is maintained as required by QH at 0.7 mg/L with auto shutdowns at 0.45 and 1.1 mg/L.

#### Reticulation:

Treated water is pumped to the Annan High Level Reservoir (at the WTP) from where it water gravity feeds via the 26 km 300 mm DICL pipeline to the Cooktown High Level Reservoir at 50 L/s, in Cooktown, as required via telemetry signals. There are 12 residences connected to the main between the Annan Reservoir and the High Level reservoir. These residences experience daily pressure fluctuations, lower pressure as the Reservoir fills, and higher pressure when the Reservoir is filled. Cook Shire has not received any water pressure complaints from those residences.

The Cooktown Reservoir directly supplies water to the reticulation after being re-chlorinated at the New Pump Stn. Dual chlorine dosing pumps, are controlled by a PLC and inject a flow paced set dose, the dosing pumps auto alternate on fault, as well as Duty / Standby.

The Fire Stn. Reservoir is filled from a major water main in the reticulation, and is now only used as the suction storage for the booster pumps which boost the pressure to the elevated reticulation. A non-return valve allows water to pass through to the elevated sites during periods of "Loss of Mains Power".

The Fire Stn Reservoir is equipped with dual recirculation pumps and dual chlorine dosing pumps, all controlled by a PLC and a chlorine analyser. The chlorine residual level is maintained at the set point level. The recirculation and chlorine dosing pumps auto alternate on fault, as well as time.

## **2.2 Duckfarm Borefields**

The Duckfarm Bore fields can supply water directly to the 4 Mile Hill Reservoir, supplying a handful of residents on the way. The 4 Mile Hill Reservoir is directly connected to the reticulation, water can be pumped from the 4 Mile Hill Reservoir to the High Level Reservoir through the reticulation, and via the pumps at the New Pump Stn. The Bore fields have now become a backup supply in the event of a major supply issue from the Annan. At present the borefields are unusable. Council is investigating the refurbishment of the aeration system, sand filter, pumps and switchboards. The water will be used for roads to ensure that the system is used on a regular basis.

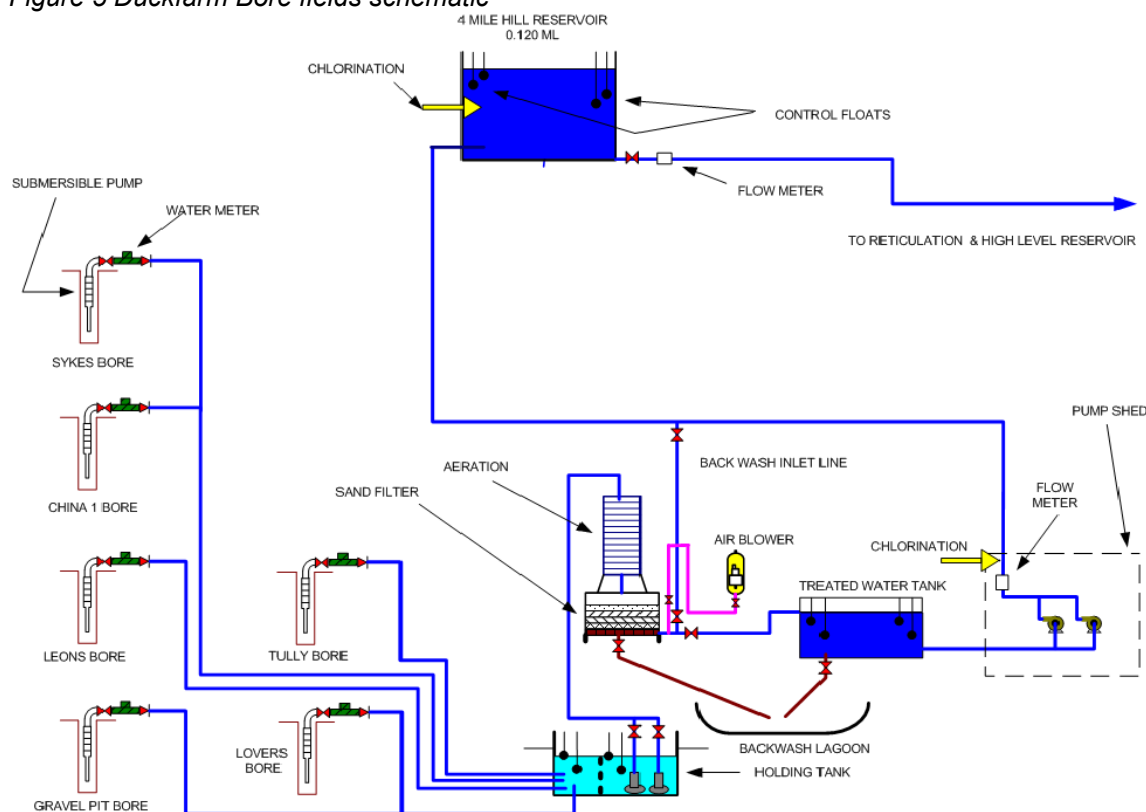
When operational, control floats in the 4 Mile Hill Reservoir initiate a start for the Bore fields at reaching the pre-set level, this starts all the Bores simultaneously, which fill up the below ground holding tank, upon reaching the required "Start level" the "On duty" submersible pump starts to pump the water to the top of the aeration tower, the water cascades through the aeration tower and is collected and funnelled into the top of the sand filter.

The sand filter utilises multiple layers of graded sands through to rather coarse gravel, a backwash is required daily if operated for a full day. The backwashes are a fully manual operation, with no automation at all. After filtration the water flows to the treated water tank, upon reaching the required "Start level" the "On duty" centrifugal lift pump starts to pump the water to the 4 Mile Hill Reservoir until the "Stop Level" is reached.



The single hypochlorite dosing pump is interlocked with the centrifugal lift pumps, so that when either of the lift pumps run so does the dosing pump. The centrifugal lift pumps pump at a fixed rate that doesn't vary, as does the dosing pump to produce a downstream chlorine residual of 0.6 mg/l

Figure 5 Duckfarm Bore fields schematic



Upon reaching the "Stop Level" in the 4 Mile Hill Reservoir a signal is transmitted via telemetry to the bore field which stops all the bores simultaneously, everything else continues to run, as the below ground holding tank becomes depleted of water, the "Stop Level" is reached, stopping the submersible pumps, this in turn then depletes the water level in the treated Water tank as the centrifugal lift pump continues pumping but only until the "Stop Level" is reached in the treated water Tank. With the centrifugal lift pumps stopped the bore fields remain idle until the next Start signal is received. A manual start signal can also initiate a bore fields start up.

The bore fields uses reverse logic (by leaving the process tanks empty until the next start) compared to everything else in the Shire.

Water can be pumped from the 4 Mile Hill Reservoir to the Cooktown High Level Reservoir through the Reticulation mains, as there is no dedicated trunk main from the 4 Mile Hill Reservoir to the New Pump Station. Centrifugal pumps at the "New Pump Stn" (Still named "New Pump Stn" even though it's nearly 30 years old) lift the water from the reticulation mains to the High Level Reservoir with a level sensor at the 4 Mile Hill Reservoir controlling the Stop / Start functions of the centrifugal pumps at the "New Pump Stn".

Since the introduction of Fluoride into Cooktown's water we now back supply water from the 4 Mile Hill Reservoir as far as the bore fields to give all the residents fluoridated water. The bore fields supply is not fluoridated, and if used, no fluoride will be provided in the water supply. 4 Mile Hill Reservoir fills through the reticulation, and is re-chlorinated as required.

The Cooktown Reticulation Network is a mixture of A.C. (56%), uPVC (27%), and Poly (17%) The Cooktown Reticulation was initially installed in the early 70's and was entirely A.C., this was the normal practice until the early 90s when we discontinued using the A.C. and began using the uPVC pipes for all new and replacement water mains. (We are still using these today.) The water mains are scoured annually to promote "Healthy mains". We tend to have very few genuine mains bursts, we do have quite a few mains breaks which are mostly broken by mechanical equipment. Chlorine residual readings are collected from the reticulation network and stored in a database daily. To date we have not recorded any incidents involving *E.coli*.

Table 3 Borefields infrastructure details

		Duckfarm bore fields
Sourcing Infrastructure	Duckfarm Bore fields	<i>6 bores at an Av. depth of 50 metres are equipped with Electric submersible pumps. Combined water is Aerated, Sand Filtered and Chlorinated before distribution.</i>
Are there any sources that <b>do not</b> undergo treatment prior to supply?		<i>No</i>
Duckfarm Borefields	Process	<i>Aeration, Sand Filtration &amp; Chlorination</i>
	Design Capacity (20 hr operation)	<i>1.0 ML/d</i>
	Daily flow range	<i>Limited to 1 ML/d</i>
	Chemicals added	<i>Sodium Hypochlorite</i>
	Standby chemical dosing facilities (Y/N)	<i>No</i>
	Water sourced from and %	<i>Water is sourced 100% from the Borefields</i>
	% of average day demand provided	<i>0%</i>
	% of scheme supply Distribution area supplied	<i>0% (Backup Water supply)</i>
Bypasses / Variations		<i>No Bypasses</i>
Duckfarm bore fields Bore head Details	Year Bores Sunk	<i>1982</i>
	Bore Casing Size	<i>150mm</i>
	Bore Casing material	<i>Class 12 PVC</i>
	Sealed to prevent surface water ingress	<i>Yes, All the bore casings are typically 600mm above surface level &amp; encased in concrete preventing surface water ingress</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>
Are there any sources that <b>do not</b> undergo disinfection prior to supply?		<i>No</i>
Disinfection Duckfarm Borefields	Location	<i>Bore fields Pump Room</i>
	Type	<i>Sodium Hypochlorite Dosing</i>
	Dose rate	<i>Unknown (Dosing to maintain target residual level)</i>
	Target residual levels	<i>0.6 mg/L</i>
	Duty/standby	<i>No</i>
	Dosing arrangements	<i>Interlocked with Clean Water Pumps</i>
	Alarms	<i>No</i>

		Duckfarm bore fields
	Auto shut-off arrangements	<i>Shuts down when Clean Water Pumps Stop</i>
<b>Disinfection</b> 4 Mile Hill Reservoir	Location	<i>4 Mile Hill chlorinator Shed</i>
	Type	<i>Sodium Hypochlorite Dosing</i>
	Dose rate	<i>Unknown (Dosing to maintain target residual level)</i>
	Target residual levels	<i>0.6 mg/L</i>
	Duty/standby	<i>No</i>
	Dosing arrangements	<i>A small maintenance dose is added at this site to maintain the chlorine residual. The dosing pump is controlled via 24 Hr programmable timer Typically set at 15 minutes @ 8Hr intervals</i>
	Alarms	<i>No, Staff on site minimum daily, usually more frequently</i>
	Auto shut-off arrangements	<i>Shuts down when timer is off</i>
Water quality responsibility changes	Upstream location	<i>NA</i>
	Downstream location	<i>NA</i>

Water quality data is included as an appendix to this document. It is intended that over time, that this data not be updated as the Annual report summarises all verification water quality data.

### 3 RISK ASSESSMENT

#### 3.1 Cooktown 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.

Cooktown 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)	2018/19 FY	19/20 FY or later
Catchment	Animals in catchment	bacteria and virus	Extreme 20	disinfection	coagulation filtration	Catastrophic	Rare	Medium 6	Certain	considered as whole of treatment in absence of failure			
	Present in catchment - animals	protozoa	Extreme 20	filtration	coagulation	Catastrophic	Rare	Medium 6	Confident	considered as whole of treatment in absence of failure			
	Annan stops flowing, and algal bloom	taste and odour	Medium 8	coagulation/ filtration		Moderate	Rare	Low 3	Reliable	doesn't happen every year, but can then be present for weeks at a time			investigate taste and odour removal
Bores	Ingress into bore	bacteria and virus	Extreme 20	disinfection	borehead sealed	Catastrophic	Rare	Medium 6	Certain	backup supply, rarely used. Inspection program every three months.			
	Ingress into bore	protozoa	Extreme 20	borehead sealed	Inspection program every three months	Catastrophic	Rare	Medium 6	Confident	backup supply, rarely used. Inspection			



Cooktown 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)	2018/19 FY	19/20 FY or later
										program every three months.			
	Bore switchboard failure	failure of supply	High 10			Major	Unlikely	Medium 8	Reliable	backup supply, but could be required in Disaster. 6 separate bores		Investigate Reinstatement of borefields to use in emergency	
	Bore pump failure	Failure of supply	High 10	Multiple bores, would still be able to supply		Major	Rare	Medium 5	Certain				
Raw Water Feed	Raw water main break	Failure of supply	High 10	5 ML in treated water reservoirs - multiple days supply	mains break procedure	Moderate	Rare	Low 3	Confident	Crews available to fix critical issues			
	Raw water pump failure	Failure of supply	High 10	5 ML in treated water reservoirs - multiple days supply	duty standby	Major	Rare	Medium 5	Certain	routine maintenance			
Coagulation	Underdose alum	Protozoa, turbidity	Extreme 20	coagulation	Sedimentation basin monitoring, EDAC alarm on NTU over 15 from Sed basin. Filtration	Minor	Possible	Medium 6	Confident	plant run when operators on site, wet season consumption low. SCADA Alarms to operators if NTU over 15 from sedimentation basin.			

Cooktown 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)	2018/19 FY	19/20 FY or later
	Overdose alum	Aluminium	Medium 6	Sedimentation tank monitoring	EDAC alarm on NTU over 15 from Sed basin. Filtration	Minor	Possible	Medium 6	Confident	SCADA Alarms to operators if NTU over 15 from sedimentation basin.			
	poor floc due to low alkalinity	Protozoa	Extreme 20	soda ash dosing when required	Filters still pick up floc	Major	Unlikely	Medium 8		SCADA alarm for combined turbidity from filters			
	Bypass	Protozoa	Extreme 20	bypass not used in normal operations	direct filtration	Catastrophic	Rare	Medium 6		Requires manual opening of bypass valves. Wouldn't do maintenance in Wet season when risk higher			
Filtration	Filter breakthrough	Protozoa	Extreme 20	combined filtrate monitored on SCADA continuously, daily checks	Combined filtrate will ring EDAC above 1.5NTU	Major	Unlikely	Medium 8	Reliable	SCADA monitoring and alarms through autodialler. EDAC alarm on Sedimentation basin lowers the risk.			
	Filter breakthrough	turbidity	Medium 6	continuous clarifier monitoring	EDAC alarm on combined filters	Minor	Possible	Medium 6	Confident				

Cooktown 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)	2018/19 FY	19/20 FY or later
	Asset ageing	System failure	Extreme 20	Maintenance		Catastrophic	Rare	Medium 6	Estimate	Filters have been recoated internally to prevent concrete degradation			
Disinfection	Overdose	Chlorine	High 15	Daily checks at WTP and Reservoirs.	EDAC alarm in place for high chlorine over 2.5mg/L	Moderate	Rare	Low 3	Confident	SCADA monitoring, and daily monitoring at plant, 25 km of pipeline, pumps would struggle to reach 5 mg/L.			
	insufficient dose	bacteria/virus	Extreme 25	Daily checks at WTP and Reservoirs. Filters	EDAC alarm in place for low chlorine under 0.8mg/L	Major	Unlikely	Medium 8	Reliable	Duty/Stand by pumps available with automatic change over			
	ineffective disinfection due to turbidity	bacteria	High 10	disinfection, redosing at High level reservoir	Filtration. EDAC alarms.	Major	Unlikely	Medium 8	Confident	EDAC alarms on sedimentation basin and combined filters to alert operators to turbidity issues			
	chemical breakdown	chlorate	High 12			Moderate	Likely	High 12	Unreliable			Begin THM sampling of final water	If chlorate is found, investigate solutions.

Cooktown 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)	2018/19 FY	19/20 FY or later
Fluoridation	underdose fluoride	fluoride	Low 3	daily checks		Insignificant	Unlikely	Low 2	Confident	Under dose is an issue under Fluoridation Act, but not a public health issue			
	overdose fluoride	fluoride	High 12	fluoride interlocks, auto shutdown, daily monitoring		Moderate	Rare	Low 3	Reliable	interlocks, and design makes this nearly impossible			
Treated water storage/ Reservoirs	Ingress into reservoirs	bacteria/virus	Extreme 20	Integrity and sealing	residual chlorine	Catastrophic	Unlikely	High 10	Confident	Reservoirs all sealed	Seal leaks temporarily	4 mile reservoir and fire station reservoirs to be repaired/replaced. Leaking floor joints. GHD report.	Need to replace roof on High Level Res. Recoat High Level Res and Annan res.
	Ingress into reservoirs	Protozoa	Extreme 20	Integrity and sealing		Catastrophic	Unlikely	High 15	Reliable	Reservoirs all sealed	Seal leaks temporarily	4 mile reservoir and fire station reservoirs to be repaired/replaced. Leaking floor joints. GHD report.	Need to replace roof High Level Res. Recoat High Level Res and Annan res.
	ingress of amoeba	amoeba	High 12	disinfection as above items	integrity	Major	Unlikely	Medium 8	Reliable				



Cooktown 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)	2018/19 FY	19/20 FY or later
Reticulation	ingress of contaminated water / mains breaks	bacteria/virus	Extreme 20	network pressure, residual disinfection	mains break procedure	Major	Unlikely	Medium 8	Confident	daily network disinfection tests, flushing initiated if low	Mains replacement Program for 10 years. See capital program	Funding secured for main replacement program for 18/19	mains replacement program – 10 year program
	ingress of contaminated water	protozoa	Extreme 20	network pressure	mains break procedure	Major	Unlikely	Medium 8	Reliable				
	biofilm growth	opportunistic pathogens	Medium 6	Flushing program and SOP for flushing on low residual		Major	Rare	Medium 5	Reliable				
	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6	mains break procedure, pressure constant		Insignificant	Possible	Low 3	Confident				
	Failure of storage capacity	loss of supply	High 15	restrictions can be imposed to manage supply		Major	Unlikely	Medium 8	Reliable	5 ML in treated water reservoirs - multiple days supply		Investigate reinstatement of Borefield for backup supply	
	turbidity from resuspending lime in reservoir	turbidity	Medium 6	annual reservoir clean	minimum operating level	Minor	Unlikely	Low 4	Confident	ladder for access is deteriorating, needs replacement as WHS issue	replace ladder in Annan and High level Reservoir		
	long water age	DBPs	Medium 9	Coagulation to take out organics	disinfection	Moderate	Unlikely	Medium 6	Confident	high consumption in hot weather when temperature			





Cooktown 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)	2018/19 FY	19/20 FY or later
										e might increase			
	backflow	protozoa	Extreme 20	system integrity, backflow prevention on meters. Meters installed over past 25 years		Catastrophic	Rare	Medium 6	Estimate				replacement of meters with Taggle style automated meters
	ageing hydrants/valves	Infrastructure issues	High 15	system maintenance		Moderate	Possible	Medium 9	Reliable			hydrant and valve replacement Capital program	
System Wide	Power failure	Failure of supply	High 15	Generator at Annan can produce water, mobile generators can be put on rechlorination		Catastrophic	Rare	Medium 6	Confident				
	WTP Fire	Failure of supply	Medium 6	Activate DMP.		Catastrophic	Rare	Medium 6	Reliable				
	Drought	Failure of supply	High 10	Restrictions leading to Wet season if supply low.	Happened twice in 28 years, weir has stopped overflowing	Catastrophic	Rare	Medium 6	Reliable				
	Flood	Failure of supply	High 10	Generally only impacts raw water quality	Coagulation, flocculation, sediment basin and filtration.	Catastrophic	Rare	Medium 6	Reliable				
	Cyclone	Failure of supply	High 15	DMP		Catastrophic	Rare	Medium 6	Reliable		Need to	Need to	

Cooktown 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)	2018/19 FY	19/20 FY or later
											investigate reinstating borefield. Identifying equipment required and costings.	investigate reinstating borefield as contingency supply. Applying for funding in 2018/2019 if approved by Council.	
	operator error	any	High 12	training, experience, mentoring	All Operators have a Certificate III in water operations	Major	Unlikely	Medium 8	Estimate				
	Missing procedures	All	Extreme 25	SCADA limits partially mitigate	Staff have Cert III in water operations and are trained on the job.	Moderate	Possible	Medium 9	Reliable	Need to take staff offline to write procedures to mitigate risks	Procedures currently being written		

## 4 OPERATIONAL PROCEDURES

In general CSC has few specific documented procedures for each process step as required under the ADWG. However, the operational limits are well defined, and actions are understood by the WTP operators. The following table forms the basis of more comprehensive operational procedures that will be developed over time.

Table 4 Operational Limits used by operators/ SCADA.

Process Step / Location in System	Parameter	Operational Monitoring	Target Range	Monitoring Frequency	Operator Intervention Range	Report to Supervisor Range	Corrective Actions/ Comments
Treatment Plant Final Filtered Water	pH	Y	 <p>&lt;6.6 and &gt; 8.4 6.6 - 6.8 and 7.6 - 8.4 6.8 - 7.6</p>	Daily	6.6 – 8.4	<6.6 or >8.4	<ul style="list-style-type: none"> <li>pH above 8.4 – check lime dosing equipment and slurry levels. Check CO<sub>2</sub> dosing system as malfunction of this system will cause pH to rise.</li> <li>pH below 6.6 – check lime dosing equipment and slurry levels. Malfunction of lime system will cause the pH to decrease.</li> <li>Lime and CO<sub>2</sub> dosing can be disabled on the SCADA.</li> </ul>
	Alkalinity	Y	–	Generally Daily	–	–	<ul style="list-style-type: none"> <li>Coagulation with Alum requires 0.45 mg/L of alkalinity / mg/L of Alum. Operator to maintain this ratio with the addition of Soda Ash. Natural alkalinity is generally &lt;12mg/L</li> </ul>
	Turbidity	Y	 <p>&gt; 3 0.5 – 3 &lt;0.1 NTU</p>	Daily	0.1 – 3 NTU	>3 NTU	<ul style="list-style-type: none"> <li>If turbidity is over 0.5NTU, chemical dosing may not be correct, check alum pump, check dose rate, perform jar testing to determine correct chemical doses, reset plant to new dose, retest turbidity.</li> </ul>
	Colour	Y	 <p>&gt; 12.Hu 2 – 12 Hu &lt;2 Hu</p>	Daily	0 – 12 Hu	>12 Hu	<ul style="list-style-type: none"> <li>Chemical Dosing not correct / Coagulation pH not at optimum point (5.8-6) perform jar testing to determine correct chemical doses, reset plant to new dose, retest Colour</li> </ul>
	Total Hardness	Y	 <p>&gt;60 mg/L as CaCO<sub>3</sub> &gt;55 mg/L as CaCO<sub>3</sub> 35-55 mg/L as CaCO<sub>3</sub></p>	Generally Daily	0 – 60 mg/L as CaCO <sub>3</sub>	>60 mg/L as CaCO <sub>3</sub>	<ul style="list-style-type: none"> <li>Lime and CO<sub>2</sub> added to form calcium carbonate lining on the cement reservoir and the cement lined pipeline to town. Can be turned off completely for short periods. No additional benefit with levels above 60 mg/L as CaCO<sub>3</sub></li> </ul>




Process Step / Location in System	Parameter	Operational Monitoring	Target Range	Monitoring Frequency	Operator Intervention Range	Report to Supervisor Range	Corrective Actions/ Comments
	Chlorine - Residual	Y	 <0.4 >3mg/L 0.4 – 0.6 and 2 - 3mg/L 0.6 -1.8 mg/L	Daily in laboratory. Online analyser	<0.6 and >2.0 mg/L	<0.4 and >3 mg/L	<ul style="list-style-type: none"> <li>If chlorine is above 2.0mg/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.</li> <li>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.</li> </ul>
	Aluminium	Y	 >0.15 mg/L 0 .05 - 0.15 mg/L 0.0 -0.05 mg/L	Generally Daily	0 – 0.15 mg/L	>0.15 mg/L	<ul style="list-style-type: none"> <li>Chemical Dosing not correct / Coagulation pH not at optimum point (5.8-6) perform jar testing to determine correct chemical doses, reset plant to new dose, retest Aluminium</li> </ul>
	Fluoride*	Y	 >0.9mg/L >0.6 – 0.68 and 0.72 - 0.9 mg/L 0.68-0.72 mg/L	Daily	>0.6 – 0.68 and 0.72 - 0.9 mg/L	<0.6 and >0.9 mg/L	<ul style="list-style-type: none"> <li>Check operation of Fluoride dosing equipment</li> <li>Check Fluoride Day Tank Levels</li> <li>Check Fluoride analyser operation</li> <li>Check online analyser against benchtop analyser</li> <li>Check Fluoride Maintenance schedule</li> <li>Increase / Decrease dose rate</li> </ul>

Table 5 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	Fluoride Operations - Unloading 25Kg bags from Delivery Truck	0100F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Making up a 3% Fluoride Solution	0101F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Cleaning up Minor Fluoride Spills	0102F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Disposal of Empty Fluoride bags	0103F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Water Testing - Fluoride	0104F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Emergency Response to Overdosing Event Fluoride 1.5mg/l or Greater	0105F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Changing Fluoride Dose Rate	0106F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Regular Checks, Sampling and Recording of Fluoride Operations	0107F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Determination of Fluoride in Water	0108F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Isolation, Lockout & Tag out	0109F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Annan Water T/P Control inc Fluoridation Facility	0110F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Access to Fluoridation Facility	0111F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Adjusting Dosing Pumps Dose Rate	0112F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Fluoride Analyser Maintenance Procedure	0113F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – E.Stop Testing Procedure	0114F	28/3/2011	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Chlorine Analyser Maintenance Procedure	0115F	19/7/2011	Distributed to Relevant staff c/w Training in the method described	This is a current Procedure
	Fluoride Operations – Fluoride Equipment Maintenance Plan	-	12/2010	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Operations – Fluoride Health & Safety Plan	-	12/2010	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018



Location	Documented procedure Name	S.O.P. No	Last Revision or Implementation	Process for implementing the procedure (Activity and Frequency)	Comments
	Fluoride Operations – Emergency Evacuation Procedure	-	12/2010	Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	Fluoride Induction Handout		8/2010	All Visitors, non Fluoride Ticketed personnel entering the Fluoridation Room must read this document prior to entry	
	Fluoride Dosing – Hazard inspection Checklist			Distributed to Relevant staff c/w Training in the method described	Started dosing Fluoride August 2010 Next Revision Date - August 2018
	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
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 the monitoring 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. Where any value exceeds the ADWG health guideline in treated or reticulated water, the Manager Water and Wastewater is immediately informed – this initiates a Medium level incident.

Verification monitoring is undertaken to ensure that the water that we supplied to our customers did meet the ADWG health guideline values. *E coli* sampling is predominantly internal, and all other monitoring is undertaken externally. 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 the incident and emergency response activated (this is defined as a Medium level incident). 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 6 Trunk main and reservoir sample names and locations*

Sample Location Name	Distance from Annan Reservoir	GPS Coordinates
Fire Hydrant	.46 km	15°38'37.91"S - 145°11'40.44"E
Amos	5.47 km	15°36'50.42"S - 145°13'15.40"E
Gravel Pit	14.23	15°32'41.87"S - 145°14'26.63"E
Pre Reservoir	23.13	15°29'5.99"S - 145°14'43.74"E
Post Reservoir	As above	As above

*Figure 6 Trunk main and reservoir sampling locations*

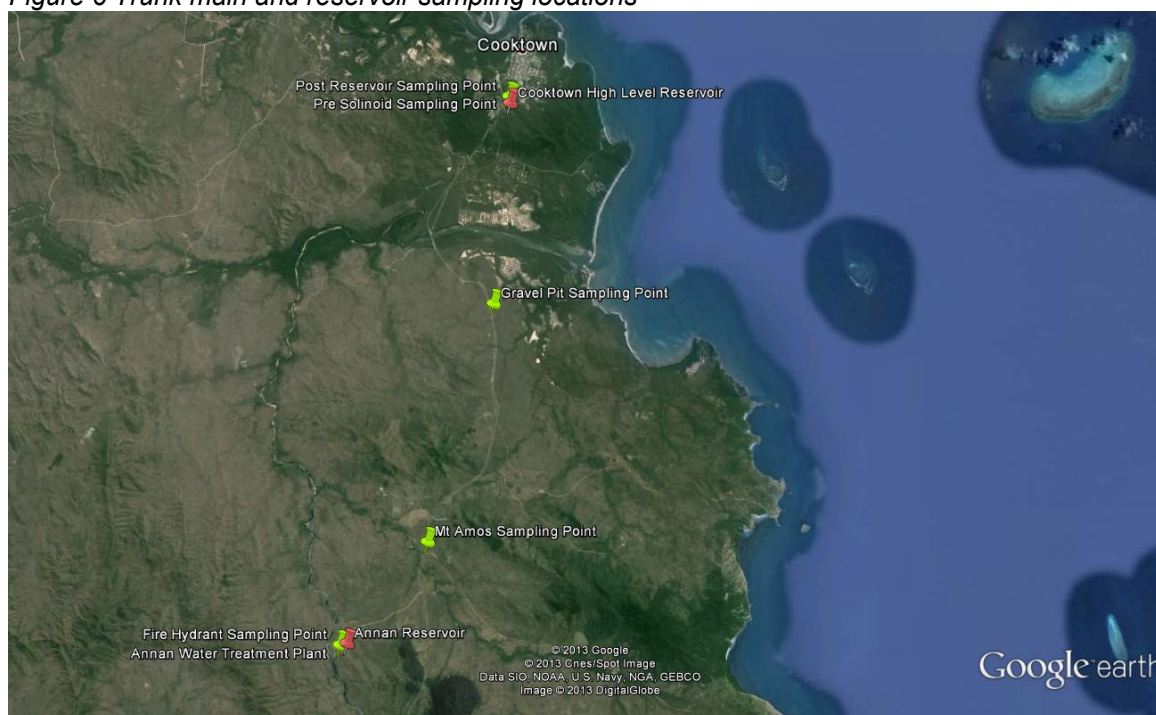


Table 7 Reticulation sample locations

Sample Location Name	Street Name	Site Chosen Because	GPS Coordinates *
Mobil Service Stn	Endeavour Valley Road	Towards the end of the line.	15°28'21.81"S - 145°13'13.98"E
Powder Magazine	Webber Esplanade	Towards the end of the line.	15°27'27.49"S - 145°15'14.33"E
Lions Park	Charlotte St	Ease of access	15°27'51.65"S - 145°15'2.91"E
Cooktown Library	Helen St	Centrally located in Residential area	15°28'16.08"S - 145°14'57.80"E
Simmo's	Furneaux St	Residential area	15°28'13.02"S - 145°15'22.46"E
Water Depot	Boundary St	Towards the end of the line.	15°28'29.80"S - 15°28'29.80"S
Cemetery	Charlotte	Ease of access	15°28'38.90"S - 145°14'30.40"E
Cooktown Hospital	Hope St	Close to Hospital & Medical Services	15°28'40.87"S - 145°14'58.82"E
Cooktown Kindergarten	Charles St	Close to Kindergarten and Schools	15°28'52.40"S - 145°15'10.27"E
Royce's Paddock	Ida St	Towards the end of the line.	15°28'51.64"S - 145°15'31.98"E
Ambrose old Service Racecourse Rd	Racecourse Rd	Centrally located in Residential area	15°28'51.85"S - 145°14'22.21"E
Peninsular Pump Station	Howard St	Towards the end of the line.	15°28'34.25"S - 145°15'26.40"E

- \* GPS co-ordinates extracted from Google Earth

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

Figure 7 Reticulation sampling locations

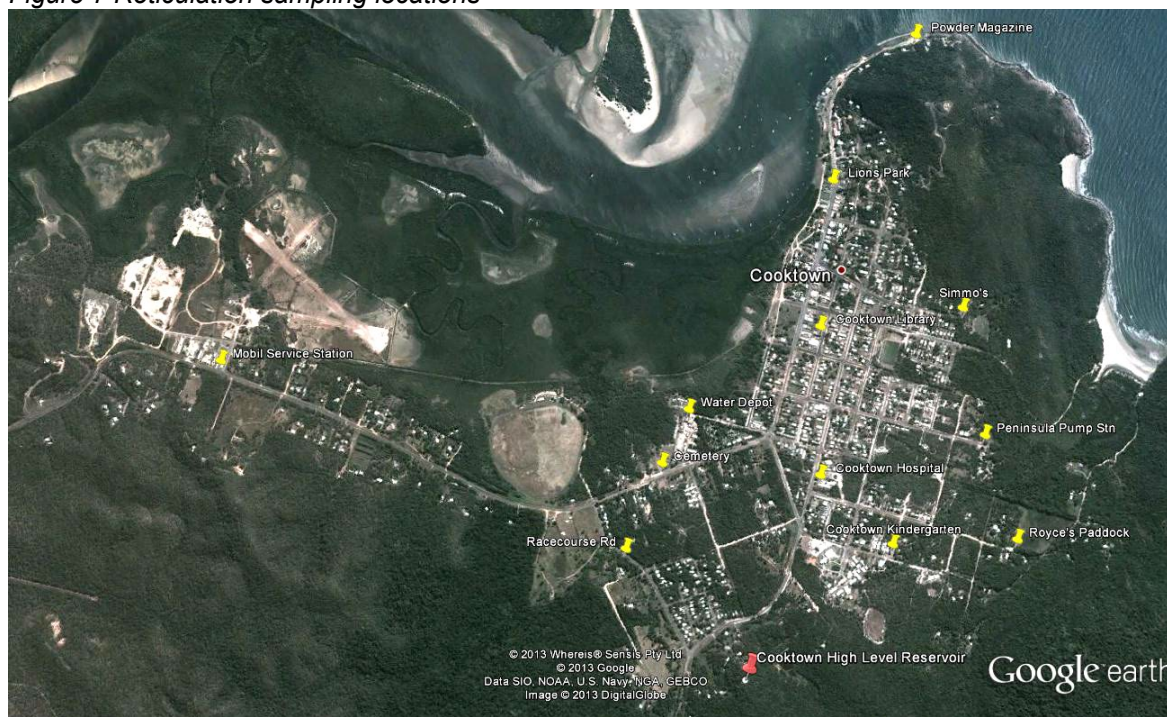


Table 8 Operational/Verification monitoring tables

Process Step / Location in System	Parameter	Sampling			Is this sample Verified by a NATA registered Lab	Operational Monitoring Comments
		Location	Frequency	Type		
Treatment Plant Raw water	pH	Annan WTP Lab	Daily	Grab	Y	Analysed by Cook Shire Council staff at the Annan WTP. Verified every two months by a NATA certified lab
	Alkalinity	Annan WTP Lab	Daily	Grab	Y	
	Turbidity	Annan WTP Lab	Daily	Grab	Y	
	Colour	Annan WTP Lab	Daily	Grab	Y	
	Electrical Conductivity	Annan WTP Lab	Daily	Grab	Y	
	Total Hardness	Annan WTP Lab	Weekdays	Grab	Y	
	Total dissolved Solids	Annan WTP Lab	Daily	Grab	Y	
	Electrical Conductivity	Annan WTP Lab	Daily	Grab	Y	Analysed by Cook Shire Council staff at the Annan WTP
	Fluoride	Annan WTP Lab	Monthly	Grab	N	
	Turbidity	Annan WTP Lab	Continuous	On-line analyser	N	
Treatment Plant Raw water	pH	Annan WTP Lab	Continuous	On-line analyser	N	
Treatment Plant Raw water	<b>Physical / Chemical Analysis.</b> Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	Annan Raw Water	Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab
	<b>Metals Analysis</b> Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn	Annan Raw Water	Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab
Borefields Raw Composite	<b>Physical / Chemical Analysis.</b> Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	Borefields Composite sample	Twice a year	Grab Sample	Y	N.A.T.A. Certified Lab
	<b>Metals Analysis</b> Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn	Borefields Composite sample	Twice a year	Grab Sample	Y	N.A.T.A. Certified Lab

WTP Dosed Water (Pre Sedimentation Basin)	pH	Annan WTP Lab	Daily	Grab Sample	N	Analysed by Cook Shire Council staff at the Annan WTP
	Alkalinity	Annan WTP Lab	Daily	Grab Sample	N	
	Turbidity	Annan WTP Lab	Daily	Grab Sample	N	
	Colour	Annan WTP Lab	Daily	Grab Sample	N	
WTP Dosed Water (Pre filtration)	pH	Annan WTP Lab	Daily	Grab Sample	N	Analysed by Cook Shire Council staff at the Annan WTP
	Alkalinity	Annan WTP Lab	Daily	Grab Sample	N	
	Turbidity	Annan WTP Lab	Daily	Grab Sample	N	
	Colour	Annan WTP Lab	Daily	Grab Sample	N	
	Turbidity	Sed. Tank Final	Continuous	On-line analyser	N	
Treatment Plant Final Filtered Water	pH	Annan WTP Lab	Daily	Grab	Verified Monthly	Analysed by Cook Shire Council staff at the Annan WTP
	Alkalinity	Annan WTP Lab	Weekly	Grab	Y	Verified monthly at a NATA certified lab.
	Turbidity	Annan WTP Lab	Daily	Grab	Y	
	Colour	Annan WTP Lab	Daily	Grab	Y	
	Electrical Conductivity	Annan WTP Lab	Weekly	Grab	Y	
	Free Chlorine Residual	Annan WTP Lab	Daily	Grab	N	
	Total Chlorine	Annan WTP Lab	Daily	Grab	N	
	Aluminium	Annan WTP Lab	Weekly	Grab	Y	
	Calcium Hardness	Annan WTP Lab	Weekdays	Grab	Y	
	Fluoride	Annan WTP Lab	Daily	Grab	Y	
	Total Hardness	Annan WTP Lab	Daily	Grab	Y	
	Total Dissolved Solids	Annan WTP Lab	Daily	Grab	N	
	Aluminium	Annan WTP Lab	Weekdays	Grab	Y	Verified twice a year at a NATA registered lab
	Free Chlorine Residual	Annan WTP Lab	On-line	Continuous	N	Chlorine residual on display on Chlorine analyser in dosing room
	Turbidity	Annan WTP Lab	On-line	Continuous	N	On-line turbidity meter
	<b>Physical / Chemical Analysis.</b> Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	Annan WTP Final Tap	Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab
	<b>Metals Analysis</b> Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn	Annan WTP Final Tap	Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab



	<b>E.Coli and Total Coliforms</b>	Annan WTP final Tap	Weekly	Grab Sample	Y	Analysed by Annan Staff using Idexx method. Verified quarterly in NATA registered lab.
<b>Cooktown Reticulation</b>	Chlorine Residual	3 sites per day	Daily	Grab Sample	N	Analysed by reticulation staff using hand held HACH meter
	pH	12 Locations in Cooktown Systematically rotated through sites in table 7. Three sites per month	Monthly	Grab Sample	Y	Analysed by Cook Shire Council staff at the Annan WTP. Verified quarterly at a NATA registered lab
	Turbidity		Monthly	Grab Sample	Y	
	Colour		Monthly	Grab Sample	Y	
	Electrical Conductivity		Monthly	Grab Sample	Y	
	Total Dissolved Solids		Monthly	Grab Sample	Y	
	Dissolved Oxygen		Monthly	Grab Sample	Y	
	Alkalinity		Monthly	Grab Sample	Y	
	Fluoride	2 sites	Weekly	Grab Sample	Y	Analysed by the Cook Shire Council Staff at the Annan WTP. Verified monthly at a N.A.T.A Certified Lab
	<b>Physical / Chemical Analysis.</b> Includes parameters: pH, Electrical Conductivity, Alkalinity, Sulphate, Chloride, Ca, Mg, Na, K, Fluoride, Total Hardness, SAR, L.I., Turbidity, Colour apparent, TDS, Salinity & Silica	12 Locations in Cooktown Systematically rotated through sites in table 7. Three sites per quarter	Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab
	<b>Metals Analysis</b> Includes parameters: As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn		Quarterly	Grab Sample	Y	N.A.T.A. Certified Lab
	<b>Total Coliforms and E. Coli</b>	12 Locations in Cooktown Systematically rotated through sites in table 7. Three sites per week	Weekly	Grab Sample	Y	Analysed at the Annan WTP using Idexx Verified at a N.A.T.A. Certified Lab quarterly.



## 6 WATER QUALITY CHARACTERISATION

Table 9 Raw water quality details (analysed by NATA registered Laboratory)

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	Annan Raw Water	1 July 2015 to 30 June 2017	12	22.0	11.3	6.0		
Calcium			12	1.6	1.1	0.8		
Chloride			12	17	14.3	13		
Colour Apparent			12	70	25.5	5.0		
Electrical Conductance			12	76.0	31.5	6.3		
Fluoride			12	0.07	0.05	0.05		
Total Hardness			12	11.0	8.6	7.0		
Magnesium			12	1.8	1.4	1.1		
Potassium			12	1.3	1.0	0.8		
pH			12	7.6	6.98	6.3		
Silica – Reactive			12	14	12.5	11		
Sodium			12	10	8.7	7.7		
Total Dissolved Solids			12	46.0	38.6	32.0		
Sulphate			12	1.8	1.5	1.1		
Turbidity			12	37.0	6.0	1.0		
Arsenic mg/L			8	0.003	0.003	0.0003	0.01 mg/L	0
Barium mg/L			8	0.010	0.005	0.006	2.0 mg/L	0
Beryllium mg/L			8	0.0001	0.0001	0.0001	0.06 mg/L	0
Cadmium mg/L			8	0.0001	0.0001	0.0001	0.002 mg/L	0
Chromium mg/L			8	0.0010	0.0010	0.0010	0.05 mg/L	0
Cobalt mg/L			8	0.001	0.001	0.001		
Copper mg/L			8	0.009	0.002	0.001	1.0 mg/L	0
Iron mg/L			8	0.210	0.142	0.006	0.3 mg/L	0
Lead mg/L			8	0.001	0.001	0.001	0.01 mg/L	0
Manganese mg/L			8	0.045	0.010	0.005	0.1 mg/L	0
Nickel mg/L			8	0.004	0.002	0.001	0.02 mg/L	0
Selenium mg/L			8	0.003	0.003	0.003	0.01 mg/L	0
Vanadium mg/L			8	0.005	0.003	0.001	0.1 mg/L	0
Zinc mg/L			8	0.018	0.006	0.005	3.0 mg/L	0

Table 10 Raw water quality - CSC Annan Lab (01/07/2015 to 30/06/2017)

	Alkalinity as mg/L CaCO <sub>3</sub>	pH	Temperature °C	Electrical Conductance uS/cm	Turbidity NTU	Colour Pt/Co Units	Total Hardness as mg/L CaCO <sub>3</sub>	Alkalinity mg/L
Count	717	717	714	713	717	709	509	717
Max	18.0	7.3	30.1	98.7	185	1092	20	18
Min	3.0	4.2	20.5	43.4	0.9	10	4	3
Avg	9.2	6.6	25.6	73.4	7.5	67	8.5	9.2

These parameters are sampled at the Annan Lab most working days.

Raw Water data shows the Annan River Raw water to be of good quality. For approximately 10 months of the year, the raw water supply is very stable & low in turbidity.

The table above shows 717 NTU as the maximum Turbidity. These high turbidity events coincide with the “Wet Season” and are usually of short duration. Raw water total hardness is low, as is the alkalinity. The soft, low alkalinity water causes corrosion to concrete reservoirs and cement lined pipelines. The addition of lime and carbon dioxide increases hardness and eliminates the corrosion problems.

Table 11 Treated water quality - Annan Final Water analysed by CRC

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 <sub>3</sub>	Annan Final Treated Water Sampling Tap	1 July 2015 to 30 June 2017	23	63.0	47.4	11.0		
Calcium - mg/L			23	19	15.0	2.8		
Chloride - mg/L			23	21.0	16.5	12.0	≤250 - mg/L	0
Colour Apparent - Pt- Co			23	5.0	5.0	5.0	≤15 - Pt/Co	0
Electrical Conductance			23	170	151.4	100		
Fluoride - mg/L			23	0.80	0.71	12.0	≤1.5 - mg/L	0
Total Hardness - mg/L CaCO <sub>3</sub>			23	53.0	43.3	14.0	≤200 - mg/L	0
Magnesium - mg/L			23	1.8	1.4	1.0		
pH			23	7.9	7.5	7.0	6.5 – 8.5	0
Potassium - mg/L			23	1.7	1.0	0.9		
Silica – Reactive - mg/L			23	13	11.2	5.9		
Sodium - mg/L			23	15	12.5	11	≤180 - mg/L	0
Total Dissolved Solids - mg/L			23	100.0	90.5	60.0	≤600 - mg/L	0
Sulphate - mg/L			23	16	8.5	4.7	≤250 - mg/L	0
Arsenic mg/L			7	0.003	0.003	0.003	0.01 - mg/L	0
Barium mg/L			7	0.007	0.006	0.005	2.0 - mg/L	0
Beryllium mg/L			7	0.0001	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	0.01 - mg/L	0
Copper mg/L			7	0.002	0.001	0.001	2.0 - mg/L	0
Iron mg/L			7	0.005	0.005	0.005	0.3 - mg/L	0
Lead mg/L			7	0.001	0.001	0.001	0.01 - mg/L	0
Manganese mg/L			7	0.019	0.08	0.005	0.1 - mg/L	1
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 - mg/L	0
Vanadium mg/L			7	0.001	0.001	0.001		
Zinc mg/L			7	0.005	0.005	0.005	3.0 - mg/L	0

*Table 12 Treated water quality - Annan Treated Water, CSC Annan Lab*

	Alkalinity as mg/L CaCO <sub>3</sub>	pH	Temperature °C	Electrical Conductance uS/cm	Turbidity NTU	Colour Pt/Co Units	Total Hardness as mg/L CaCO <sub>3</sub>
Count	725	725	721	722	719	722	502
Max	61	7.80	30.3	210.0	3.90	14	74
Min	5	6.5	20.5	64.3	0.03	0	5
Avg	40.8	6.81	26.0	161.6	0.19	0.63	40.4

These are sampled at the Annan Lab most working days, Date Range covered 01/07/2015 to 30/06/2017

A Review of the Final Treated Water data shows the Final water to be of a High Quality with no exceedances of the Australian Drinking Water Guidelines for the period stated.

Table 13 Treated water quality - Cooktown 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 <sub>3</sub>	12 Locations in Cooktown Systematically rotated through sites in Table 7.	01 July 2015 to 30 June 2017	71	70.0	48.8	5.0		
Calcium - mg/L			71	22.0	17.0	5.4		
Chloride - mg/L			71	20.0	17.0	14.0	≤250 mg/L	0
Colour Apparent - Pt- Co			70	40	5.6	5.0	≤15 Pt/Co	1
Electrical Conductance			71	180	158.3	100		
Fluoride - mg/L			71	0.81	0.70	0.54	≤1.5 mg/L	0
Total Hardness - mg/L CaCO <sub>3</sub>			71	58.0	46.0	15.0	≤200 mg/L	0
Magnesium - mg/L			71	1.3	0.9	0.4		
pH			70	8.2	7.6	6.8	6.5 8.5	0
Potassium - mg/L			71	1.6	1.1	0.8		
Silica – Reactive - mg/L			71	13.0	11.0	5.5		
Sodium - mg/L			71	18	13.3	11.0	≤180 mg/L	0
Total Dissolved Solids - mg/L			71	110.0	94.7	61.0	≤600 mg/L	0
Sulphate - mg/L			70	16.0	8.6	6.1	≤250 mg/L	0
Turbidity – NTU			70	2.6	0.6	0.5	≤5 NTU	0
Arsenic mg/L			25	0.008	0.003	0.003	0.01 mg/L	0
Barium mg/L			25	0.0001	0.0001	0.0001	<2 mg/L	0
Beryllium mg/L			25	0.0001	0.0001	0.0001	<0.06 mg/L	0
Cadmium mg/L			25	0.0001	0.0001	0.0001	0.002 mg/L	0
Chromium mg/L			25	0.001	0.001	0.001	0.05 mg/L	0
Cobalt mg/L			25	0.001	0.001	0.001	0.01 mg/L	0
Copper mg/L			25	0.056	0.008	0.001	2.0 mg/L	0
Iron mg/L			25	0.16	0.006	0.005	<0.3mg/L	0
Lead mg/L			25	0.001	0.001	0.001	0.01 mg/L	0
Manganese mg/L			25	0.005	0.005	0.005	0.5 mg/L	0
Nickel mg/L			25	0.001	0.001	0.001	0.02 mg/L	0
Selenium mg/L			25	0.003	0.003	0.003	0.01 mg/L	0
Vanadium mg/L			25	0.005	0.003	0.001		
Zinc mg/L			25	0.006	0.005	0.005	3.0 mg/L	0

A Review of the Cooktown Distribution Water data shows the Distribution water to be of a High Quality with no exceedances for the period stated except for one colour results. All parameters with a guideline value are well within the guidelines. None of the listed parameters are of any concern, other than pH as the 26km of D.I.C.L pipeline to Cooktown tends to make the pH rise by the time it gets to Cooktown. It is something that CSC is aware of, and it is monitored closely as there is no means of pH correction in Cooktown

Table 14 *E.coli* and Total Coliforms - Cooktown Reticulation combined laboratories.

Parameter	Sampling Location	Time Period	No of samples analysed in time period	Summary of 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	No of Samples where Total Coliforms were Detected		
Escherichia coli	Various Locations within the Cooktown Reticulation	01/07/2015 – 30/06/2017	333	0	-	Escherichia coli should not be detected in any 100 mL sample of drinking water.	0
Total Coliforms CFU/100ml	Various Locations within the Cooktown Reticulation	01/07/2015 – 30/06/2017	333	-	0	No guideline value has been set for total coliforms in drinking water.	

Cook Shire Council uses the IDEXX Colisure quantification test equipment and all operators have completed the subsequent training in the use of the equipment. Verification samples are done quarterly by a NATA registered laboratory.

Cook Shire Reticulation staff conducts daily chlorine residual readings from various locations in Cooktown Reticulation as well as daily monitoring of the disinfection equipment.

Table 15 Chlorine Residual in Cooktown Reticulation (01/07/2015 – 30/06/2017)

	NPS	4 Mile Hill	Fire Stn Res.	Site 1	Site 2
Count	731	727	730	451	438
Max	1.44	2.20	1.97	1.19	1.34
Min	0.38	0.29	0.30	0.3	0.3
Avg	0.85	0.73	0.71	0.72	0.71

Site 1 and Site 2 are taken at 12 Locations in Cooktown systematically rotated through sites in Table 7.