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Drinking Water Quality Management Plan

Version 6.4,
April2023

Registered Drinking Water Service Provider
Number 142

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Document History and Status

Revision	Date	Updated by	Reviewed by	Details
6.0	28/7/21	Brad Pinches	Micheal Leslie	DWQMP Updated to reflect infrastructure changes
6.1	12/10/21	Brad Pinches	Micheal Leslie	Updated to include additional information requested by WSR
6.2	28/7/22	Brad Pinches		Amendment
6.3	30/1/23	Brad Pinches		Amendment as requested by WSR
6.4	21/4/23	Brad Pinches	Michael Lee	Amendment as requested by WSR

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1. Introduction

This Drinking Water Quality Management Plan (DWQMP) documents Kowanyama Aboriginal Shire Council's (KASC) risk assessment and risk management process and provides a basis on which to maintain (and improve) the safety of the Kowanyama water supply scheme. It describes current practice and must be updated when practices change.

The DWQMP has been developed to meet the requirements of the *Water Supply (Safety and Reliability) Act 2008* (the Act). The structure and content of this plan was based on the *Queensland Drinking Water Quality Management Plan Guideline* (the Guideline) (DRDMW 2010) and the *Guidance Notes and Template for Drinking Water Service Providers Draft* (DRDMW 2011).

This plan contains or references the relevant documentation which underpins the drinking water quality management for the Kowanyama water supply scheme. The following documents make up the DWQMP:

- Main DWQMP Document (this document)
- Risk Register and Risk Management Improvement Plan (RMIP) (Excel Spreadsheet)

1.1 Kowanyama Aboriginal Shire Council

The KASC community lies 25 km from the west coast of the Gulf of Carpentaria in the South-Western region of the Cape York Peninsular, and 600 kilometers north-west of Cairns, see Figure 1.

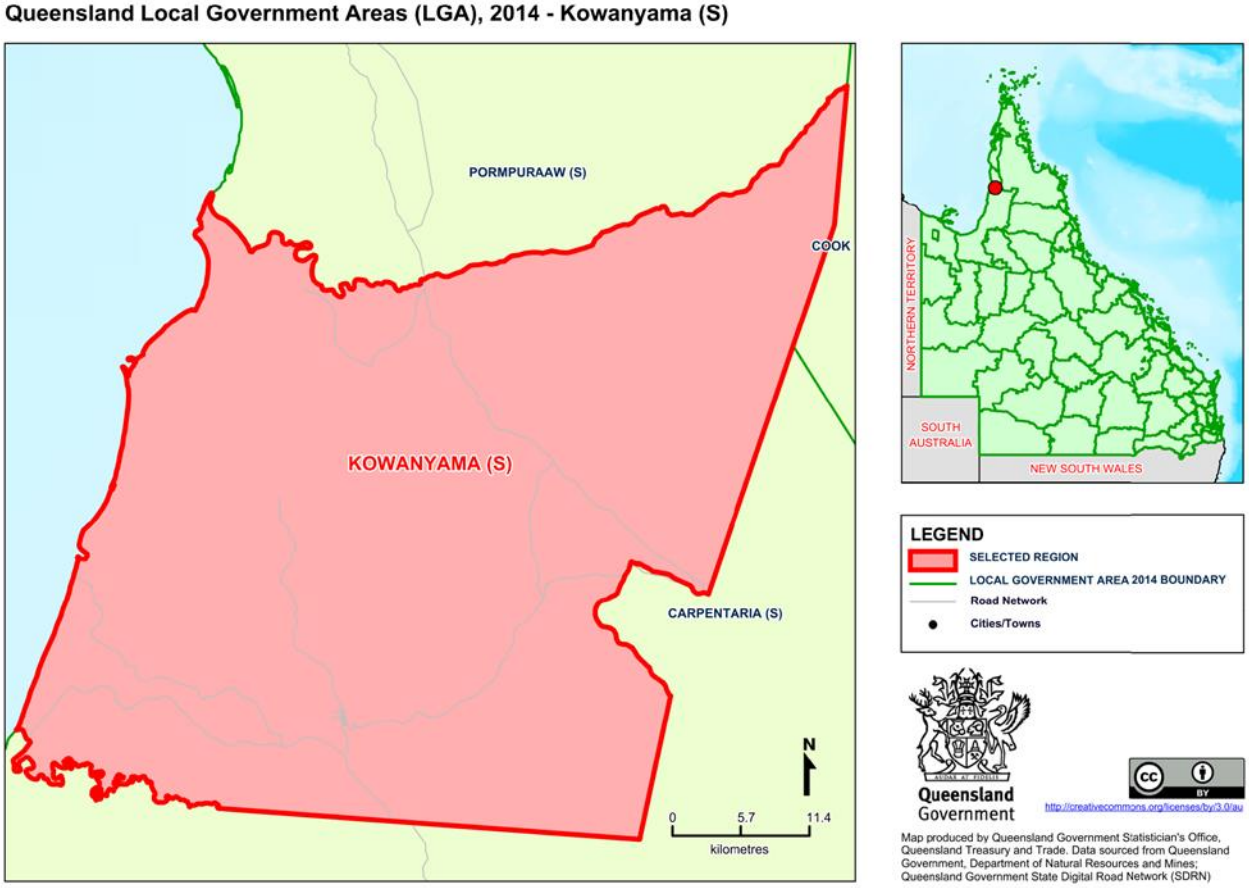

Figure 1 KASC Boundary

2. Registered Service Details

See table below for further registered service details.

Table 1 Registered Service Details

Service description	Details
Service Provider Identification Number (SPID)	142
Council Name and Contact Details	**Kowanyama Aboriginal Shire Council** 30 Chapman Road Kowanyama 4871 ABN: 86 255 216 480 Phone: 07 4083 7132 Fax: 07 4060 5124 CEO E-Mail: ceo@kowanyama.qld.gov.au Website: http://www.kowanyama.qld.gov.au/kac/
Communities serviced	Kowanyama
Current population (2020)*	1164
Current connections (2020)	340
Current demand (2020) ML/day	0.92
Projected population (2030)*	1236
Future connections (2030)	361
Future demand (2030) ML/day	0.98

*population estimates based off the 2016 Census results and population growth projections of an average annual growth rate of 0.6%, published by The State of Queensland (Queensland Treasury) 2017, *Queensland Regional Profiles* – Kowanyama (S) Local Government Area (LGA).

3. Details of Infrastructure for Providing the Service

3.1 Catchment Characteristics

Kowanyama's artesian bore water is sourced from the Bulimba Formation overlying the Carpentaria Basin. The Bulimba Formation is predominantly recharged via infiltration of rainfall in outcrop areas and via some upward leakage from underlying Great Artesian Bores (GAB) aquifers, as shown in the diagram alongside. In the Mitchell River region of the basin, recharge occurs primarily along the elevated margins of the basin on the western side of the Great Dividing Range, remote from the area of utilization.

The Bulimba formation contains artesian aquifers typically not in hydraulic connection with each other.

A study published by the Department of Natural Resources and Mines (Qld) in 2005, found that near continuous pumping for the Kowanyama community water supply had resulted in a localized depression of approximately 25 m in potentiometric head (DNRM, 2005). This drop in pressure had not been measured in bores outside the Kowanyama town area, suggesting that there was very limited connectivity between the discontinuous aquifers of the Bulimba Formation.

Pastoral production from native pastures is the most extensive land use within the region. It was reported that historically there have been scattered, relatively small-scale mining activities.

There is a strong seasonality in rainfall patterns, with most rain falling in the wet season from November to March and very high dry season evaporation.

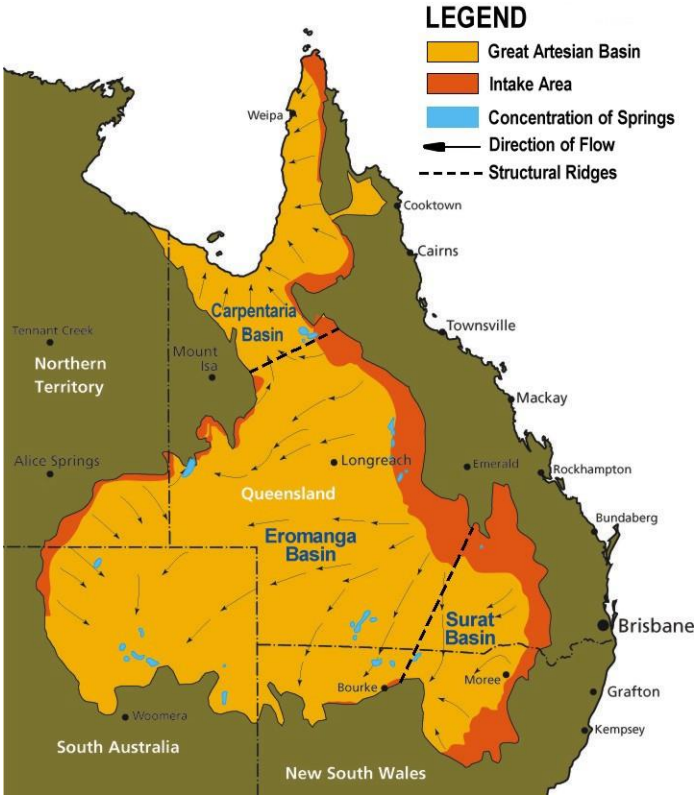

Figure 2 Overview of Great Artesian Basin

Table 2 Local Area Characteristics of Bores

Characteristics	Details
Topography	Flat. Not normally able to flood the bores, however water draining off the town may cause temporary flooding within town areas.
Soil type	Aquifer is not thought to recharge rapidly due to its depth. Clay soil.
Monthly rainfall (min, max, average)	1263mm annually. Most rain occurs in the wet season Nov – Mar
Incidence of flooding and bushfires	The bores are situated in and reasonably close to town and so are unlikely to be affected by bushfires. No incidences in recent years.
Land use	Residential, pastoral
Agriculture, industry, mining	Low intensity grazing occurs near the township and bores.
Potential sources of microbial and chemical contamination in the catchment	Cattle have access to areas near bores.

3.2 Catchment Categorisation

An assessment of the catchment categorisation has been undertaken to determine a level of catchment protection and to categorise the level.

An assessment was undertaken with the assistance of the Water Supply Regulator (WSR) at a meeting dated 30 March 2023. The meeting included representatives from WSR, the Council Essential Service Manager and Council's Project Engineer.

The process used was a methodology described for groundwater in section 4.2.2 of the *WSAA Report 2015-Manual for the application of Health-Based Targets for Drinking Water Safety*.

The outcome of the assessment was based on the best available knowledge at the time and resulted in the catchment being categorised as "**Category 1 Source (Well Protected)**".

The assessment is included in Appendix D - *Catchment Categorisation – Kowanyama Bores Assessment.*

Bore water quality will continue to be monitored as per the verification monitoring program to confirm assessment conclusion and the results will be revisited during the next DWQMP review.

3.3 Source

Water is sourced from three bores to supply the Kowanyama Water Supply Scheme, as seen in Figure 3. All bores have raised bore heads complete with operational valves and flowmeters. All bores are fenced and locked. With the introduction of Bore 3 in 2019, Council now has increased security of supply and is now able to meet future demand for the longer term. See Table 3 for further source water information.

Table 3 Bore Information

	Bore 1	**Bore 2**	**Bore 3**
Location	Adjacent to Council Offices eastern side of town Long 141.747404, Lat- 15.472237 NRW bore no. 45019	North-West of township. Adjacent to old slaughter house which is no longer operational Long 141.738764, Lat - 15.471058 NRW bore no. 45020	Within the Water Treatment Plant compound Long 141.74693, Lat -15.47587 DRDMW Bore No TBA
Operation	Generally flows under artesian pressure to the ground level reservoirs. Pumps through a 150 mm diameter PVC main to both ground level storage reservoirs. Bore screen chemically cleaned 2019 and bore pumps replaced with submersibles to avoid cavitation issues with existing surface pumps	Generally flows under artesian pressure to the ground level reservoirs. Bore screen chemically cleaned 2019 and bore pumps replaced with submersibles to avoid cavitation issues with .existing surface pumps	Generally flows under artesian pressure to ground level. Drilled in 2012 and equipped 2019 to provide Community with additional delivery options to supplement existing bores. Alternates operation with Bores 1 and 2 through SCADA
Aquifer type	Artesian Bulimba formation	Artesian Bulimba formation	Artesian Bulimba formation
% of supply	Bore one pumps water in sequence with bores two and three, they pump water constantly to reservoirs to meet demand until reservoir level is met then turns off, bore	Bore two pumps water in sequence with bores one and three, they pump water constantly to reservoirs to meet demand until reservoir level is met then turn off, bore one	Bore three pumps water in sequence with bores one and two. Currently, two bores operate together when reservoir level demands fill. Sequencing is controlled via

	Bore 1	Bore 2	Bore 3
	one delivers water at higher flow (litres per second) than bore two, demand much higher in the dry season.	delivers water at higher flow (litres per second) than bore two, demand much higher in the dry season.	SCADA on a 10 hour fill cycle. System has capacity to operate all three bores simultaneously if demand requires.
Reliability	Historically impacted during droughts. Artesian head drops during dry season, initiating the pump via telemetry. Currently reliable supply with no estimated depletion date. No rapid recharge from rain. Constructed around 1982	Historically impacted during droughts. Artesian head drops during dry season, initiating pump via telemetry. Currently reliable supply no estimated depletion date. No rapid recharge from rain. Constructed around 1982	Historically impacted during droughts, however additional bore has reduced requirement for restrictions. Artesian head drops during dry season. Currently reliable supply no estimated depletion date. No rapid recharge from rain. Constructed 2012 and equipped 2019
Pump type	Grundfos 3 phase submersible pump set at 40m depth. Backup power supply via genset and automated under SCADA	Grundfos 3 phase submersible pump set at 40m depth. Backup power supply via genset and automated under SCADA	Grundfos 3 phase submersible pump set at 40m depth. Backup power supply via genset and automated under SCADA
Capacity	10 L/s pumped, 5-6L/s natural flow	10 L/s pumped, 2-4 L/s natural flow	12 L/s pumped, 2-4 L/s natural flow
Bore depth (m)	220 including final 10m of screen.	220 including final 10m of screen.	220 including final 10m of screen
Bore head details	Submersible pumps, standard raised head pipework including fittings and flowmeters .	Submersible pumps, standard raised head pipework including fittings and flowmeters	Submersible pumps, standard raised head ;/pipework including fittings and flowmeters
Diameter, casing and material	150 mm, cased, cast iron with PVC	150 mm, cased, cast iron with PVC	200mm, cased, PVC, steel collar to surface, raised concrete surround to prevent flood water ingress
Water quality issues	Naturally elevated fluoride and iron levels.	Naturally elevated fluoride and iron levels.	Naturally elevated fluoride and iron levels

3.4 Supply Infrastructure Details

The Kowanyama water supply scheme currently consists of three bores, a filtration unit, two reservoirs and the reticulation. Along with appropriate dosing, pumps and monitoring. See Figure 3 for a supply system overview process flow diagram.

3.4.1 Treatment and Storage

Filtration

A 72m^3 deep bed AFM glass media filtration package was installed in 2019 to service the new Bore 3. Historically, Bore 3 produced highly turbid water when first tested. The filtration unit was installed in anticipation of potential turbidity issues. Although the bore started producing water with low turbidity after a period of extensive testing and flushing and is now continuously producing water of low turbidity, the unit remains in operation to ensure that it is available should a high turbidity incident occur.

The filtration unit consists of 4 glass media filters, a final 200 micron cartridge check filter and an automatic pneumatic control system. Water passes through the filters under bore pressure and the glass filters are backwashed on a pre-set timed basis. Currently, turbidity levels in the system are monitored by SCADA via an output from the packaged filtration unit and the level data sent to the SCADA system for monitoring. However as this represents an operational signal from this plant only and generally for Bore 3 only, it is not considered reflective of the turbidity levels of the whole water supply. Consequently it has not been set up to trigger an automatic alarm. To rectify this, Council is currently in the process of installing

a dedicated online turbidity monitor to be installed in the combined flow stream of all running bores before the chlorination point and monitored by SCADA (Refer Flowchart in Figure 3)
In 2020, pipework was modified in the Water Treatment Plant compound to allow for the mechanical diversion of water from Bores 1 and 2 to pass through the filtration unit if required. The system has the capacity to filter two bores operating together but does not have the capacity to treat all three bores simultaneously.
In 2019 an Aluminium Activated Calcium Hydroxyapatite Filtering System was installed to reduce flouride levels This system was not commissioned. There had been some discussion on the appropriateness of the plant and whether the consequences of potential failure of the system outweighed the health benefits of lowering the fluoride level in the water. In particular, Council raised concern of the remote possibility of equipment failure allowing the back wash solution containing sodium hydroxide by-products to enter the system.
As a result, Council decided to isolate the filtration bank from the system and remove the back wash dosing system. Council has no plans to use the system for flouride reduction in the future Council is investigating the possibility of repurposing the filter infrastructure as a standard media filtration unit to supplement the existing smaller AFM unit.

Disinfection

The bores are protected from potential surface water microbiological contamination. Disinfection is used as a protective measure against potential reticulation contamination.
The treatment system is limited to disinfection with liquid sodium hypochlorite before entering the reservoir storages. Chlorine dosage is controlled according to flow rate into the reservoirs. Adequate dosage is easily maintained during peak water usage and dose rate is also well controlled during low flow trickle into the reservoirs. By-passing chlorination is not possible. Power failures trigger an alarm on SCADA.
Kowanyama has historically used 10% liquid sodium chlorite injection system for disinfection via 200 litre drums A noted issue with this system was the difficulty and frequency of hypochlorite 200 litre drum deliveries. During the wet season, hypochlorite deliveries are not possible. Additionally, stock held by the vendor may not be fresh, and hypochlorite must sometimes be used at an age of up to 7 months. To reduce the reliance on “Hypo 10” delivery, Council installed an onsite salt water electrolysis chlorine generation plant to produce sodium hypochlorite. The unit was installed in 2019 and commissioned in 2020. The commissioning of the system demonstrated that it has sufficient capacity to produce enough chlorine to continually disinfect the town’s water supply, however Council has kept the Hypo10 system in place to act as a 100% backup to the salt water system. Council is currently upgrading the SCADA system to dose via the electrolysis system and to automatically changeover to the convention Hypo 10 system should the electrolysis unit fail or require supplementing.
Table 4 further details the treatment process.

Table 4 Treatment details

Location	Immediately after the supply flow meter prior to entering the storage reservoirs at the Water Compound/Depot Shed. Feed from bores 1,2 and 3 combine before disinfection. .
Disinfection Type	1. Sodium hypochlorite injection with 0.5% solution from salt water electrolysis plant (Prominent Chlorinsutu II) 2. Backup Sodium hypochlorite injection with 10% solution from liquid Hypo 10 drums
Chlorine dose rate	Varies according to inflow rate.
Free chlorine target residual level	Aim is for a routine residual of 0.2mg/L free chlorine in the reticulation network at 5 monitoring sites around town.
Duty / standby	Two dosing pumps alternate automatically. Back-up generator available with auto start.
Dosing arrangement	Flow paced based on flow into storage reservoirs
Alarms	Alarms set according to SCADA
Chemicals added, storage and turnover	1. Salt for generation plant stored in 20kg bags stored in storage shed 2. Sodium hypochlorite from 200L drums stored in a purpose-built storage shed meeting Australian Standards for safety, decanted into 1,000L tank.
Inspection schedule	Daily visual operational monitoring and visual inspection of equipment

Storage

All three bores combine to supply water to the reservoirs simultaneously. Reservoirs are configured in series, and water from the 0.8 ML reservoir feeds into a common main which feeds the reticulation.
Table 5 details both reservoirs.

Table 5 Reservoir details

Capacity	0.8ML	1ML
Location	At the Water Compound/Depot Shed, Long 141.746935, Lat -15.475666 Constructed around 1997/1998	Same location. Constructed around 2007
Type	19.1 m diameter A-Betong concrete ground level. Epoxy coated inside.	Concrete, ground level. Epoxy coated inside.
Roofed	Yes	Yes
Vermin-proof	Yes	Yes
Runoff from roof	Sloping roof directs run-off onto the ground	Sloping roof directs run-off onto the ground
Cleaning schedule	Approximately 5 yearly based on sediment accumulation. Last cleaned July 2020.	
Filling	Water flows to reservoir one and fills up until required level has been reached and shuts off bore flow. Water runs into the 0.8 ML reservoir [once a certain depletion water level has been reached] via an actuating valve and fills up again to required height has been reached. Water from the 0.8 ML reservoir is pumped out into the reticulation network.	

3.4.2 Kowanyama Water Supply Schematic.

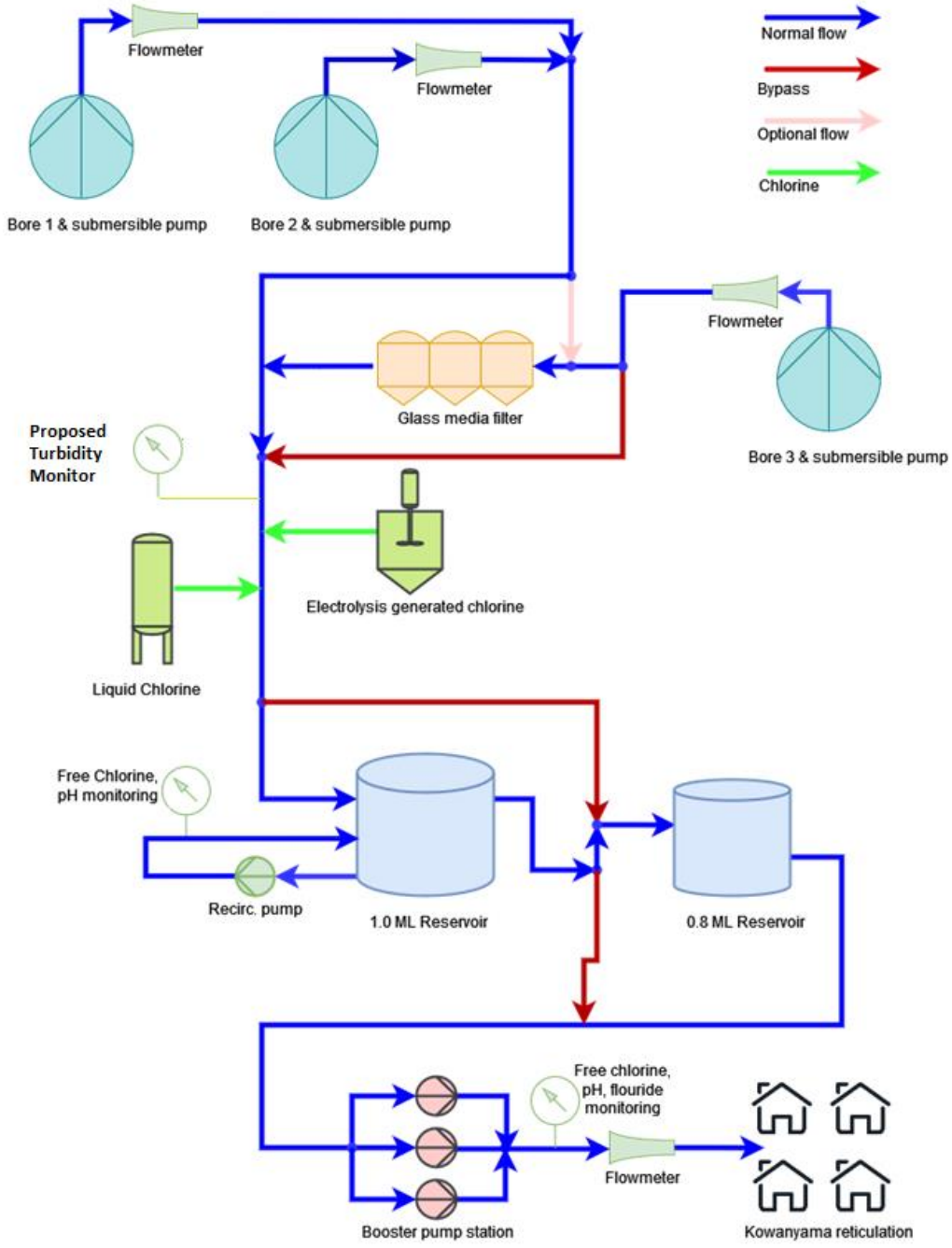

Figure 3 KASC Water Supply Overview

3.5 Distribution and Reticulation

Three pumps supply the Kowanyama community reticulation network, from the reservoirs. Table 6 and Table 7 details the pumps and the reticulation.

Table 6 Pumps supplying reticulation

Capacity	Up to 600kPa, 22 L/s at 17 m head. Grundfos CR64
Duty/standby	3 pumps (generally not all required): • auto adjust turbine speed according to demand • run independently and share the work according to flow demand. • back-up generator available with auto start.
Inspection schedule	Daily as per work schedule Alarms – low pressure, power failure

Table 7 Reticulation network details

Pipe material(s)	PVC
Age range	A large portion of the reticulation network was replaced in 2011, with some PVC services originally installed in 1989.
Length of mains	16.5 km
Issues with dead ends	No
High pressure issues	No
Low pressure issues	No
Reticulation type	Pumped
Flushing schedule	Six monthly
Other notes	Majority of reticulation was replaced in 2011.

3.6 Key Stakeholders

Table 8 details the key stakeholders of the scheme.

Table 8 KASC Key Stakeholders

Organization	Contact name and details	Relevance to management of drinking water quality	How the stakeholders is engaged in the DWQMP
Kowanyama community	Vulnerable customers listed in Incident and Emergency Response section.	Consumers	Informed of water quality issues as they arise.
Chemical suppliers	Elite Chemicals Warehouse Supervisor Phone: 4035 5699	Appropriate quality chemicals, availability and supply of stock. Larger stock of chlorine kept on site over wet season of 4-7 months.	Salt and Liquid Chlorine is ordered as needed from supplier.
Department of Regional Development, Manufacturing and Water [DRDMW]	Water Supply Regulation Incident Hotline: 1300 596 709 (24/7) Principal Regulatory Officer Ph: 07 3199 4867 e-mail: drinkingwater.reporting@rdmw.qld.gov.au GPO Box 2247 Brisbane Queensland 4001 Australia	Drinking water supply regulator	Report incidents on 1300 596 709 when detection *of Escherichia coli* (*E. coli*) and chemical parameter above health guideline value in ADWG in potable water supply; Report an event likely to affect drinking water quality in potable water supply.
Cairns Public Health Unit, Queensland Health	Manager Environmental Health Ph: 4226 5555 A/H: 0428560670 e-mail: eh.cairns@health.qld.gov.au PO Box 1103, Cairns, Qld 4870	Point of contact for assistance with public health issues related to water supply.	Provides advice during any public health incidents
CEO and Elected Council	As per Council directory	Provides overall management, budget and finance resources to deliver services	Kept up to date and informed of water operations. Submits DWQMP to WSR for approval.
Cairns Regional Council water laboratory	Laboratory Manager Ph.: 4044 8344 PO Box 359 Cairns, QLD 4870	NATA certified laboratory where water samples are sent for analysis	Scheduled water samples from the drinking water supply are collected and sent to this laboratory for analysis.

4. Identify Hazards and Hazardous Events

4.1 Water Quality Information

4.1.1 Summary of Water Quality

Water quality data for both the raw water from the bores and the treated water from the reservoirs is continuously recorded. A summary of the water quality data since 2017 is discussed below. Details of the data are included the Tables 9 to 12 in this section.

Raw Water

Water quality data for the bore water supply demonstrates that the measured parameters have been consistent for the past 5 years with little variance in any of the parameters.
A comprehensive raw water analysis was undertaken in March 2023. The analysis included all metals, PFAS and radionuclides. The results for all bores are included in Appendix F.
The most noticeable and consistent observations of the bore water quality are:

- Flouride levels fluctuate around the maximum ADWG limit of 1.5 mg/L. It is not clear if the level is slowly rising. The newest bore (Bore 3) has the lowest level of flouride (around 1.3 mg/L)
- All metals are well below ADWG guidelines where applicable
- The water is very soft with a level generally below 10 mg/L CaCO3
- There has been no recordings of any manufactured chemicals (ie PFC's)
- There has been no recordings of radionuclides

Treated Water

Water quality records for the treated water supply demonstrate that the measured parameters have also been consistent for the past 5 years
In general, the data shows:

- Free chlorine levels are generally around the 0.9 mg/L mark however the levels fluctuate slightly during chlorine dosing plant maintenance procedures
- pH is stable around the 8.0 level
- Microbiological levels are very low except on the rare occasion of plant or infrastructure failure
- THM level are very low except on a single period of incorrect plant operation
- Chlorate levels are currently around the 0.6 mg/L mark and is a potential cause for concern if this keeps rising. Chlorate levels have relatively recently been included as a parameter that requires a high priority monitoring

4.1.2 Operational Monitoring

Operational monitoring is conducted regularly as per section 7.1. Operational monitoring consists of monitoring daily free chlorine, total chlorine, pH and turbidity.
Operational monitoring data is recorded on site and transferred to the SWIMLocal portal.
No issues regarding maintenance of chlorination or the presence of *E. coli* is shown in the data, although turbidity is noted as exceeding 1 NTU in some samples. The high sample readings appear to be sporadic from inspection of the data and are possibly the result of poor sampling technique or incorrectly entered data. No noticeable infrastructure failure incident shows on the data.
Measurement of chlorine, pH and turbidity are taken on site using Council's portable testing equipment. Council currently uses both Palintest and Lovibond equipment. Should readings appear to be inaccurate or not what is anticipated, Council can use alternative testing equipment for all the noted parameters. This helps to determine if any suspect results can

be attributed to equipment failure. Should any equipment appear to have failed before the calibration schedule, the equipment can be couriered to the Supplier for recalibration while Council can continue to sample using the alternative/backup equipment.
It is noticed from the data that although operational monitoring of free chlorine, pH and turbidity are regularly being undertaken, testing for total chlorine and E-Coli is currently not routine. It is understood that this is associated with current trained staff availability and plans have commenced to resume the monitoring.

Previous recorded data for the 16/17, 17/18 and 18/19 financial years are shown in Tables 9 to 11 respectively below.

Table 9 Summary of reticulation operational monitoring data interpreted from FY2016/2017 report

Parameter	Unit	Min	Max	Mean	Standard Deviation	5th %tile	95th %tile	Total Count
Free Chlorine	mg/L	>0.02	<2.0					181
Total Chlorine	mg/L		<0.5					181
pH	-	>6.5	<8.5					181
Turbidity	NTU		<0.5					181
E. coli	MPN/100mL	0	0					38

Table 10 Summary of reticulation operational monitoring data from FY2017/2018 data

Parameter	Unit	Min	Max	Mean	Standard Deviation	5th %tile	95th %tile	Total Count
Free Chlorine	mg/L	0.01	3.92	0.86	0.64	0.16	2.48	1039
Total Chlorine	mg/L	0.01	3.60	0.83	0.64	0.12	2.41	1039
pH	-	7.56	8.50	7.96	0.12	7.77	8.16	1038
Turbidity	NTU	0.01	2.05	0.34	0.17	0.10	0.61	1033
E. coli	MPN/100mL	0	0	0	0	0	0	28

Table 11 Summary of reticulation operational monitoring data interpreted from FY2018/2019 report

Parameter	Unit	Min	Max	Mean	Standard Deviation	5th %tile	95th %tile	Total Count
Free Chlorine	mg/L	0.09	1.34					1756
Total Chlorine	mg/L	0.05	1.15					1756
pH	-	7.34	8.41					1456
Turbidity	NTU							no records
E. coli	MPN/100mL	0	0	0				356

Data taken from SWIMLocal since the first entry 1 July 2019 to current (30 September 2021) is tabled below in Table 12.

Table 12 Summary of reticulation operational monitoring data from SWIMLocal July 2019 to September 2021

Parameter	Unit	Min	Max	Mean	Standard Deviation	5th percentile	95th percentile	Total Count
Free Chlorine	mg/L	0.0	4.06	0.81	0.34	0.28	1.35	3618
Total Chlorine	mg/L	0.0	4.43	0.81	0.38	0.05	1.41	1526

pH		6.99	8.9	7.80	0.28	7.41	8.20	1808
Turbidity	NTU	0.01	3.02	0.28	0.26	0.20	0.57	3210
E-Coli	MPN/100mL	0.0	0.0	0.00	0.00	0.00	0.00	262

4.1.3 Verification Monitoring

Verification monitoring is provided for chemical parameters using water extracted from the bores, while microbial parameter verification is provided from the bores and from reticulation sites in the township.

Significant non-compliance issues occurred in March 2020 as a result of verification monitoring undertaken. This coincided with the testing of the salt water chlorine generator and the pH correction system.

Initially, two cases of *E-Coli* detection were recorded along with very high Heterotrophic Plate Count readings. Further testing indicated high trihalomethane readings being recorded throughout the treated water system. In order to maintain chloring levels, additional chlorine in the form of hypo 10 and then solid chlorine tablets were added to the system, however this resulted in further increase in trihalomethane levels

After investigation it was found that the reaction of the citric acid used for pH correction and the chlorine was producing high trihalomethanes.

As a consequence the pH correction system was taken offline and the citric acid injection system removed. The trihalomethane levels stabilised and after further testing, all parameters returned to the pre-existing levels.

Although the pH level of the average bore water is relatively high at around 8.3, there is no current plan to reintroduce pH correction.

It is noticed from the 19/20 data that a high pH reading up to 9.3 was recorded at the end of 2019 however these readings were taken after the Bores 1 and 2 were cleaned and were probably the result of the remnant chemicals/particles

A detailed quarterly water analysis of all bores revealed that all metals and physical parameters were well under the ADWG health guideline values. Some high bore turbidity readings were recorded late 2019, this was probably due to the bore cleaning process noted above .

The flouride level in Kowanyama bore water is historically high and testing indicates that the level fluctuates around the 1.5mg/L mark which is the ADWG Guideline. An activated silica flouride filtration plant was installed in 2019 to lower the flouride level however the plant has not been commissioned partly due to Council concerns about the potential consequence of plant failure (refer to 3.3 above). With the introduction of Bore 3 which has a slightly lower flouride level of 1.3mg/L, blending the water from Bores 1 and 2 with Bore 3 results in the average flouride level of water leaving the storage being slightly below the 1.5mg/L mark. The scheme has access to the online flouride level on SCADA. Council now possesses a flouride testing kit to ensure that the online sensor reads flouride levels accurately. It is further proposed to routinely monitor the flouride level to measure the periods where the fluoride level approaches the ADWG guideline limit.

Some historical issues are noted regarding the collection and storage of verification data. Council has recently implemented SWIMLocal to improve capture and analysis of verification data.

Summary of recent water quality data from the previous 2018 DWQMP is shown below in Table 11

Table 13 Summary of Water Quality Analysis Results, 2014-2018

Parameter	Unit	No. Samples	Min	Max	Mean	ADWG Health Guideline Value
Microbial Parameters (Treated Water)						
E. *coli*	CFU/ 100mL	83	0.5	0.5	0.5	ND
Heterotrophic Plate Count	CFU/mL	67	5	100	12.5	-
Total Coliforms	CFU/ 100mL	80	ND	ND	ND	-
Chemical Parameters (Raw Water)						
Aluminium	mg/L	11	0.0025	0.106	0.0171	-
Antimony	mg/L	2	ND	ND	ND	0.003
Arsenic	mg/L	11	0.0005	0.001	0.0006	0.01
Barium	mg/L	2	0.057	0.058	0.0575	2
Beryllium	mg/L	2	ND	ND	ND	0.06
Boron	mg/L	2	0.416	0.422	0.419	4
Cadmium	mg/L	11	ND	ND	ND	0.002
Calcium	mg/L	11	0.6	4.3	1.30	-
Chloride	mg/L	11	55	71	64.5	-
Chromium	mg/L	2	ND	ND	ND	0.05
Cobalt	mg/L	2	ND	ND	ND	-
Copper	mg/L	11	0.0005	0.028	0.00368	2
Electrical conductivity	µS/cm	11	580	640	617	-
Fluoride	mg/L	25	1.3	1.6	1.46	1.5
Iron	mg/L	11	0.005	0.175	0.077	-
Lead	mg/L	11	0.00025	0.003	0.00102	0.01
Magnesium	mg/L	11	0.64	0.76	0.702	-
Manganese	mg/L	11	0.002	0.0076	0.00415	0.5
Molybdenum	mg/L	2	ND	ND	ND	0.05
Nickel	mg/L	2	ND	ND	ND	0.02
Perfluorooctanoic acid (PFOA)	µg/L	4	ND	ND	ND	0.56
pH	-	12	8	8.4	8.23	-
Potassium	mg/L	11	2	2.7	2.47	-
Selenium	mg/L	2	ND	ND	ND	0.01
Silicon	mg/L SiO_2	11	18	22	19.8	-
Silver	mg/L	2	ND	ND	ND	0.1
Sodium	mg/L	11	120	150	137	-
Sulphate	mg/L	11	0.5	0.5	0.5	-
Sum of PFAS	µg/L	4	ND	ND	ND	-
Sum of PFHxS and PFOS	µg/L	4	ND	ND	ND	0.07
Thallium	mg/L	2	ND	ND	ND	-
Thorium	mg/L	2	ND	ND	ND	-
Tin	mg/L	2	ND	ND	ND	-
Titanium	mg/L	2	ND	ND	ND	-
Total Alkalinity	mg/L $CaCO_3$	11	190	220	207	-
Total Dissolved Solids	mg/L	12	340	380	358	-
Total Hardness	mg/L $CaCO_3$	11	4.1	14	6.25	-
True Colour	Pt/CO units	2	0.5	2.1	1.3	-

Turbidity	NTU	12	0.05	7	1.01	-
Uranium	mg/L	2	ND	ND	ND	0.017
Vanadium	mg/L	2	ND	ND	ND	-
Zinc	mg/L	2	ND	ND	ND	-

Data compiled from all Cairns Lab reports from November 2019 to current (September 2021) is shown in Table 12 below. The data now includes monitoring of all three bores. Monitoring of Trihalomethanes (THMs) and chlorates are also now included.
Some chemical parameters that have historically shown to be consistently low or not detectable have been removed from the monitoring schedule.
Previously, monitoring of a significant number of rare metals was undertaken to establish the base water quality data. The measured values for these metals were either extremely low or not detected.

It is noted that the water quality data indicates that measured parameters have not changed to any significant extent since the last DWQMP.

Table 14 Summary of Water Quality Analysis Results, Cairns Lab Nov 2019 to Sept 2021,

Parameter	Unit	No. Samples	Min	Max	Mean	ADWG Health Guideline Value
Microbial Parameters (Treated Water)						
E. *coli*	CFU/100mL	81	<1	1	Refer to discussion 4.1.1	0
Total Coliforms	CFU/100mL	81	<1	1		-
Heterotrophic Plate Count	CFU/mL	78	<10	>20000		-
Microbial Parameters (Raw Water)						
E. *coli*	CFU/100mL	48	<1	<1	<1	0
Total Coliforms	CFU/100mL	47	<1	<1	<1	-
Heterotrophic Plate Count	CFU/mL	46	<10	1800	129.57	-
Chemical Parameters (Raw Water)						
Metals						
Aluminium	mg/L	15	<0.015	0.038	0.016	0.2
Arsenic	mg/L	15	0.0002	0.0037	0.000	0.01
Cadmium	mg/L	15	<0.001	<0.0002	<0.0002	0.002
Calcium	mg/L	15	0.19	0.84	0.591	-
Copper	mg/L	15	0.001	0.038	0.006	2
Iron	mg/L	15	0.044	1.81	0.259	-
Lead	mg/L	15	<0.001	<0.005	<0.0005	0.01
Magnesium	mg/L	15	0.21	0.8	0.641	-
Manganese	mg/L	15	0.0022	0.101	0.015	0.5
Potassium	mg/L	15	2.5	2.8	2.647	-
Silicon	mg/L SiO_2	15	3.7	21	18.167	-
Sodium	mg/L	14	110	160	132	-
Total Hardness	mg/L $CaCO_3$	14	1.3	5.4	4.1	-
General Chemistry						
Total Dissolved Solids	mg/L	15	340	390	360	-
Physical Properties						
Electrical conductivity	µS/cm	15	590	640	615	-
pH	-	15	8.1	9.3	8.4	-
Total Alkalinity	mg/L $CaCO_3$	15	200	230	213	-
Turbidity	NTU	15	0.1	4.8	0.8	-
Nutrients and Anions						
Fluoride	mg/L	64	1.20	1.70	1.47	1.5
Sulphate	mg/L	15	<1	<1	<1	-
Chloride	mg/L	15	60.00	71.00	65.40	-
Manufactured Chemicals						

Sum of PFAS	µg/L	0	-	-	-	-
Sum of PFHxS and PFOS	µg/L	0	-	-	-	0.07
Perfluorooctanoic acid (PFOA)	µg/L	0	-	-	-	0.56
Chemical Parameters (Treated Water)						
Organics						
Total Trihalomethanes	µg/L	10	<5	1980	Refer to discussion 4.4.1	250
General Chemistry						
Chlorate	mg/L	7	0.32	1.54	0.98	-

4.2 Customer Complaints

No formal methods are available for customers to raise complaints about water quality, however customers raise concerns through direct contact with Council staff or Council offices. Although no formal water quality complaints have been received from the community during the past two years, the Essential Services team advised that they received verbal complaints regarding discoloured water and poor taste during the preliminary commissioning of the new chlorination and pH correction plant early 2020.

The issue appears to have been the result of the introduction of the new acid dosing system discussed in Section 4.1.1and has since been resolved. Where complaints are lodged by the community, Council log the complaint in the plant diary and will attend the premises within 24 hours to investigate the complaint.

5. Assessment of Risks

Hazard identification and the risk assessment for the scheme was reviewed over a period of several weeks at Kowanyama when the ESM was available, combined with an inspection of each major piece of infrastructure as an overview.

5.1 Hazard Identification and Risk Assessment Team

The risk assessment is detailed in the risk register spreadsheet, separate to this main document. The team detailed are the people who were involved in developing the risk assessment up to this stage, future review of the risk assessment would be undertaken by the ESM and appropriate subject matter experts as required.

Table 15 Risk Assessment Team

Name	Position	Expertise and system knowledge
Micheal Leslie	Essential Services Manager (ESM)	12 months in current role at Kowanyama combined with additional relevant experience from other water systems
Brad Pinches	Review Facilitator	Experience in risk assessment and DWQMPs

Note, the ESM provided input from operators on the risk assessment process to enable an inclusive assessment.

5.2 Methodology

The methodology used for the risk assessment has been adopted from the DRDMW publication *Preparing a Drinking Water Quality Management Plan Supporting Information (Sept 2010).* The definitions of likelihood, consequence and uncertainty are presented below.

Table 16 Risk Assessment Likelihood Descriptions

Likelihood	Description
Rare	Occurs less than or equal to once every 5 years
Unlikely	Occurs more often than once every 5 years and up to once per year
Possible	Occurs more often than once per year and up to once a month (12/yr.)
Likely	Occurs more often than once per month (12/yr.) and up to once per week (52/yr.)
Almost Certain	Occurs more often than once per week (52/yr.)

Table 17 Risk Assessment Consequence Descriptions

Consequence	Description
Insignificant	Isolated exceedance of aesthetic parameter with little or no disruption to normal operation
Minor	Potential local aesthetic, isolated exceedance of chronic health parameter
Moderate	Potential widespread aesthetic impact or repeated breach of chronic health parameter
Major	Potential acute health impact, no declared outbreak expected
Catastrophic	Potential acute health impact, declared outbreak expected

Table 18 Likelihood Consequence matrix used for the risk assessment

Likelihood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Medium (6)	High (10)	High (15)	Extreme (20)	Extreme (25)
Likely	Medium (5)	Medium (8)	High (12)	High (16)	Extreme (20)
Possible	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
Unlikely	Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)
Rare	Low (1)	Low (2)	Low (3)	Medium (5)	Medium (6)

Table 19 Uncertainty definitions used in Risk Assessment

Level of Uncertainty	Definition
Certain	There is 5 years of continuous monitoring data, which has been trended and assessed, with at least daily monitoring; or The processes involved are thoroughly understood.
Confident	There is 5 years of continuous monitoring data, which has been collated and assessed, with at least weekly monitoring or for the duration of seasonal events; or There is a good understanding of the processes involved.

Reliable	There is at least a year of continuous monitoring data available, which has been assessed; or There is reasonable understanding of the processes Involved.
Estimate	There is limited monitoring data available; or There is limited understanding of the processes involved.
Uncertain	There is limited or no monitoring data available; or The processes are not well understood.

5.3 Acceptable Risk

Risks scored as low or medium were classified as acceptable risks. Risks with a rating of high and above in the risk assessment (unacceptable risks) have an associated item entered in the Improvement Plan. Where appropriate, risk scores of low and medium also have an assigned improvement action, such as where the uncertainty level was high (estimate) and it was decided to implement an improvement (or best practice). These risks will be re-evaluated during review of the DWQMP to ascertain that the risk level remains low or medium (with an improved uncertainty level).

5.4 Hazard identification, risk assessment and uncertainty matrices

Matrices developed during the risk assessment workshop are in the *Improvement Plan and Risk Register* spreadsheet, which is a supporting DWQMP document.

6. Managing Risks

In order to ensure that hazards and hazardous events are managed effectively, measures need to be in place to eliminate or reduce the associated risk. This DWQMP addresses this through the implementation of the following:

- preventive measures that reduce the likelihood of contaminants being at a concentration which may cause harm to the consumer (detailed in risk register)
- multiple barriers – a series of barriers that ensure contaminants are at an acceptable level
- critical control points – these are points in the system that can be monitored and action can be taken to prevent the process going out of control leading to a non-compliant product
- risk treatments (or proposed additional preventive measures) to reduce any unacceptable residual risk to an acceptable level.

It is important that all of the identified significant maximum risks are managed appropriately and that there are barriers in place to manage them.

6.1 Risk Management Measures

6.1.1 Existing Measures

Barriers and preventative measures were identified during the risk assessment review for the identified hazards, and this can be seen in the risk register present in the risk register and improvement plan supporting document.

Operational control is essential for the management of the drinking water supply system. In order to manage a process it must be capable of being monitored and corrective action applied to ensure processes function within the defined operational envelope.

Preventive measures that manage a significant risk are to have a documented procedure in place or an improvement action to document and formalise the procedure.

Within a process a number of points may be identified as critical, where increased control is required to ensure a quality product. A CCP is defined as an activity, procedure or process at which control can be applied and which is essential to prevent a hazard or reduce it to an acceptable level. Not all activities are amenable to selection as critical control points. A CCP has several operational requirements, including:

- operational parameters that can be measured and for which critical limits can be set to define the operational effectiveness of the activity (e.g. chlorine residuals for disinfection)
- operational parameters that can be monitored frequently enough to reveal any failures in a timely manner (online and continuous monitoring is preferable)
- procedures for corrective action that can be implemented in response to deviation from critical limits to bring the process back into control.

All preventive measures were assessed to determine if they were a CCP. There could be more than one CCP for a particular hazard.
For each identified CCP, critical and alert limits were set and defined as follows:

- *Critical limit:* a set point that once exceeded the treatment process is taken to be out of control, which may result in a non-compliant product and action must be taken to remedy the situation
- *Alert limit:* a warning allowing an opportunity to take appropriate action to avert the breach of the critical limit
- *Target level:* representing day to day operational limits and procedures. This is what is to be achieved

6.1.2 Proposed Measures

Proposed preventative measures are included in the Risk register and improvement plan supporting document within the improvement plan, alongside timeframes and responsibilities for implementation.

6.2 Critical Control Points

Two critical control points were identified for the Kowanyama drinking water supply and are noted in Table . Detailed CCP procedures are supplied in Appendix B.

Table 20 Critical control points for the Kowanyama drinking water supply system.

Parameter	Frequency	Target Limit	Alert Level	Critical Limit
CCP Raw Water Abstraction				
Turbidity – Bores 1,2 and 3	Weekly	<0.7 NTU	>0.7 NTU	>1.0 NTU
CCP Disinfection				
Free chlorine – Final Water	Daily	0.5-1.0 mg/L	<0.3 mg/L >1.5 mg/L	>4 mg/L <0.15 mg/L
pH – Final Water	Daily	7.8-8.2	<7.5 or >8.2	>8.5

6.3 Risk Management Improvement Program

The risk management improvement actions from the hazard identification and risk assessment matrices have been reproduced as the risk management improvement program (RMIP). The tables are available in the *Improvement Plan and Risk Register* spreadsheet, which is a supporting DWQMP document (Refer Appendix C).

6.4 Operation and maintenance procedures

The following work checklists, records and procedures are used in the operation of the drinking water scheme. The ESM is responsible for delegating the tasks. Progress on

checklist actions is displayed on a chart on the walls of the water shed office and is reported to the Executive Manager – Infrastructure monthly by the ESM.
The ESM is responsible for developing and maintaining these documents and these are stored electronically on the ESM's computer. These documents are updated as needed. A version control book is used to record a summary of any changes to these documents, the date of change as well as the version number. An improvement plan item has been noted to include version identifiers on each procedure/checklist. Template checklists were updated during the DWQMP 2021 update, which have been included as appendices, and will be implemented in the future. These checklists were updated to reflect the preventative measures included in this revision of the DWQMP.

Table 21 Operational and maintenance procedures

Procedures	Detail	Location of document
Kowanyama Essential Services Work Schedule for Operation and Maintenance of Infrastructure (daily and weekly)	Work schedule details regular maintenance activities required to be undertaken.	Council H: drive Displayed on the water shed wall
Kowanyama Work Schedule for Operation and Maintenance of Infrastructure (monthly, yearly and five-yearly)	Work schedule details regular maintenance activities required to be undertaken.	Council H: drive Displayed on the water shed wall
Water Alert Notification Template	Developed by Queensland Health	Council H: drive
Water Quality Reporting Guideline for Drinking Water Service	DRDMW provides reporting guidelines on their website.	DRDMW Website
Palintest Turbimeter and P3 Photometers (Chlorine, pH, Turbidity) Manual	User Manual on how to operate equipment.	With Instrument
Benchtop Spectrophotometer (MD 200 - pH, Chlorine) Manual (Backup tester)l	User Manual on how to operate equipment.	With Instrument
Benchtop Spectrophotometer (TB 210 IR - Turbidity) Manual (Backup tester)	User Manual on how to operate equipment.	With Instrument
Standard Operating Procedure - Testing for Free and Total Chlorine	Procedure using the DPD method to obtain free and total chlorine readings.	Council H: drive With Instrument
Procedure - Testing for pH	Procedure using the Phenol Red method to obtain pH readings.	Council H: drive With Instrument
Procedure - Testing for Turbidity	Procedure using the spectrophotometer to obtain turbidity readings.	Council H: drive With Instrument
Standard Operating Procedure - Calibration of Online Free Chlorine Analysers	Procedure for calibrating online analysers used for 1.0 ML reservoir and final water sampling.	Council H: drive
Colilert 18 Quanti-Tray User Manual	User manual on how to undertake Colilert 18 testing	With Colilert Equipment
E. coli Detection Investigation Form	Checklist for investigating *E.coli* incidents	Water Shed Folder
Collecting Water Samples	Procedure for Collecting Water Samples for bacteriological examination	Water Shed Folder
Equipment cleaning and maintenance	Procedure for equipment calibration, cleaning and maintenance	Water Shed Folder

Procedures	Detail	Location of document
Critical Control Point Procedure – Raw Water Abstraction	Procedure for ensuring appropriate turbidity to support disinfection	Council H: drive Displayed on the water shed wall
Critical Control Point Procedure – Chlorination	Procedure for ensuring correct disinfection	Council H: drive Displayed on the water shed wall
Mains Break Repair	Procedure for mains break repair	Water Shed Folder
Mains flushing	Procedure for mains flushing	Water Shed Folder
Meter reading	Procedure for reading meters	Water Shed Folder
Utilities on Call	On call procedures detailed	Water Shed Folder
Reservoir Cleaning	Procedure for cleaning reservoirs (both 1 ML and 0.8 ML)	Water Shed Folder

6.5 Management of Incidents and Emergencies

The following levels for incidents and emergencies are to be used.

Table 22 Alert levels of incidents and emergencies

Alert Level	Description	Key management response(s)	Position(s) responsible
Level 3 or High: **Emergency**	• outbreak of waterborne disease • declared disaster or emergency situation by the Council or state/national government *Requires coordination across the provider (Council) departments and is likely to require external resourcing and support from agencies, such as DRDMW, Queensland Health, local disaster management groups, emergency responders QFRS, Police*	Activate emergency response plan / disaster management plan *Refer to summary of actions and procedures*	As per Council's lines of authority. For example, could be the ESM or CEO
Level 2 or Medium: **Incident**	• non-compliance (typically against the ADWG values) • event (anything that has happened or is likely to happen, in relation to a drinking water service that may have an adverse effect on public health). Examples include natural disaster (flood, drought), bushfire, inability to operate system within acceptable operational limits, contamination of source water, contamination of treated water, terrorism. *Incident likely to be managed within the team responsible for drinking water operations and management in line with their DWQMP. In some cases, it may require coordination across the provider departments (Council) and external resources and support, such as from DRDMW, Queensland Health. Possible customer complaints.*	Activate drinking water incident response and reporting protocols. Ensure all control measures identified in the DWQMP are functioning effectively. Emergency response plan / disaster management plan on standby. *Refer to summary of actions and procedures.*	ESM
Level 1 or Low: **Operational Exceedance**	• Exceedances of operational limits (e.g. low or elevated chlorine in reticulation, pH). *Incident can be managed within the water operations team. An incident is not declared and the issue can be managed by local team in line with their DWQMP.*	Ensure all operational steps identified in the DWQMP are functioning effectively. Check and act upon operations and maintenance records and procedures. Incident response and reporting protocols on standby. *Refer to summary of actions and procedures*	ESO (i.e. act as a leading hand) or ESM

6.5.1 Response Actions

Most spare parts for components in the scheme are able to be flown in during the wet season if required when roads are cut-off.

The following Table details a summary of actions applies to each level of incident or emergency. This has also been included as a flow chart in Figure 4.

All incidents and emergencies are notified to the ESM who remains on call by mobile phone. The water staff have been instructed on incident and emergency response protocols in order to operate autonomously where they have responsibility. An incident reporting flowchart provided by DRDMW is displayed on the wall of the water shed office.

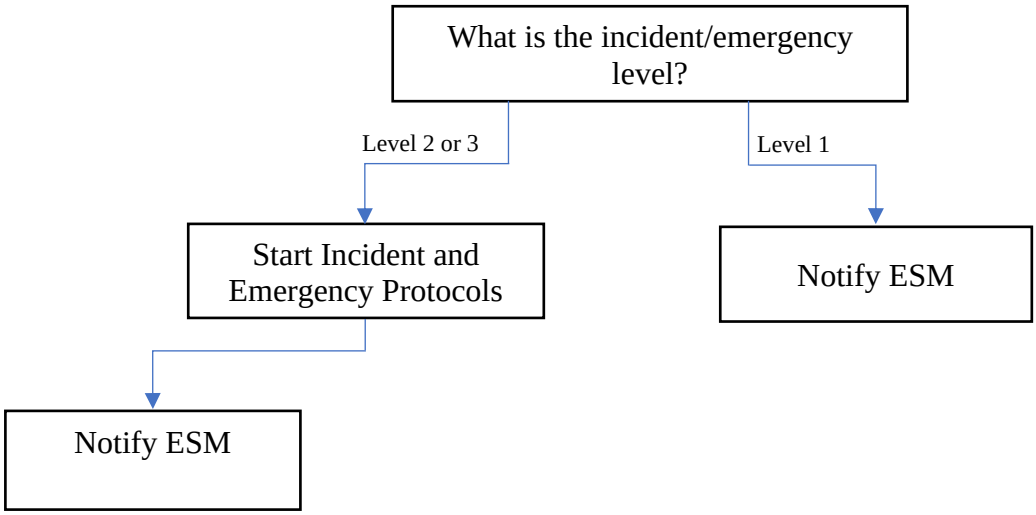

Figure 4 Preliminary Incident/Emergency Flow Chart

Table 23 Summary of IERP Actions

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
Level 3 or High: **Emergency**	Activate Council's emergency response plan / disaster management plan	• Notify Queensland Water Supply Regulator as soon as practicable on **1300 596 709** (24/7), as per reporting requirements. • Notify CEO immediately. • Coordinate notification, investigation and response of water related aspects. • Consider what community notification / messaging is needed (e.g. do not drink alert, boil water alert or bottled/emergency water distribution). • Coordinate community messaging, for e.g. boil water alert, do not drink alert as required.	Emergency response / disaster management plan, including communications protocols, alert templates (boil water, do not drink, availability of emergency supply).
Level 2 or Medium: **Incident**	Activate drinking water incident response and reporting protocols. Ensure all control measures identified in the DWQMP are functioning effectively. Emergency response plan / disaster management plan of Council on standby.	• Notify Queensland Water Supply Regulator on **1300 596 709** (24/7), as per reporting requirements. • Ensure ESM is aware as soon as possible. • Ensure all control measures identified in the DWQMP are functioning effectively. • Commence investigation to determine cause if not traceable through the DWQMP. • Arrange for re-samples to be taken where required. • Instigate immediate remediation actions, including isolation of affected area where possible. • Review associated laboratory reports and operational records. • Ensure emergency response plan / disaster management plan is on standby if the need arises.	Incident response and reporting protocols. DRDMW Water Quality and Reporting Guideline. Kowanyama DWQMP
Level 1 or Low: **Operational Exceedance**	Ensure all operational steps identified in the DWQMP are functioning effectively. Check and act upon operations and maintenance records and procedures. Incident response and reporting protocols on standby.	• Notify Leading Hand or ESM. • Review operations and maintenance records for anomalies. • Commence investigation to determine cause, if not identifiable through operational records. • Instigate immediate remediation actions. • Ensure all control measures identified in the DWQMP are functioning effectively. • Increase operational monitoring frequency where required. • Ensure incident response and reporting protocols are on standby if the need arises. • In case of customer complaints, coordinate investigation and resolution, including obtaining water samples where required.	Operations and maintenance schedules. Kowanyama DWQMP.

6.5.2 Process for incident reporting

The incident response and reporting protocols have been adopted from the Queensland Water Supply Regulator Drinking Water Service Provider Monitoring and Reporting Requirements Guidelines, Queensland Water Supply Regulator reporting forms *Notification of a drinking water event or detection of a parameter with no water quality criteria: Form WSR507* and *Notice of noncompliance with water quality criteria: Drinking water: Form WSR017* are submitted as required.

For cyber security events, an event that impacts on the water service will be reported to Regulator and to the Queensland Government Chief Information Office (through the Qld Govt Information Security Virtual Response Team). An event that does not impact on the water services will be reported to the Queensland Government Chief Information Office only.
These are summarised in Table 24 as below.

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Table 24 Incident reporting requirements

Incident	Reporting Requirements (to Water Supply Regulator)
Detection of *E. coli,* detection of a pathogen, failure to meet ADWG health guideline values (refer Table 10.6)	Follow reporting requirements as attached in Appendix E Incident Reporting. 'Immediately' notify the incident to the regulator of the circumstances and follow up that initial notification by giving the regulator written notice in the approved form, 'as soon as practicable'.
Radiological (exceed screening levels for either gross alpha or gross beta activity or both as stated in ADWG Table 10.7)	'Immediately' notify the incident to the regulator of the circumstances and follow up that initial notification by giving the regulator written notice in the approved form, 'as soon as practicable'.
Parameters with no ADWG guideline value	'Immediately' notify event to the regulator of the circumstances and follow up that initial notification by giving written notice in the approved form, 'as soon as practicable'.
An event likely to affect water quality	'Immediately' notify event to the regulator of the circumstances and follow up that initial notification by giving written notice in the approved form, 'as soon as practicable'.
A cyber security event that impacts on the water service	• 'Immediately' notify event to the regulator of the circumstances and follow up that initial notification by giving written notice in the approved form, 'as soon as practicable'. • Call Queensland Government Information Security Virtual Response Team (QGISVRT) on 07 3215 3951 immediately, and written correspondence should be sent by email qgisvrt@qld.gov.au
A cyber security event that does not impact on the water services	• Call Queensland Government Information Security Virtual Response Team (QGISVRT) on 07 3215 3951 immediately, and written correspondence should be sent by email qgisvrt@qld.gov.au
'immediately' means without reasonable delay, but no later than on the same day you became aware of the incident or event. **'as soon as practicable'** means - • for the initial notification - within 24 hours after you immediately notified the regulator of the incident or event, but no later than the close of business the next business day; and	

- for the investigation report - within five (5) business days after completing your investigation of the incident or event, which includes identifying the root cause and the actions proposed to prevent or minimise the likelihood of a recurrence of the incident or event.

'circumstances' means a description of the incident or event, which may include the possible cause of the incident or event, the assessed potential of the event to adversely impact public health, any relevant water quality sampling or testing conducted or proposed, and any corrective action(s) taken or proposed.

The drinking water event reporting number is 1300 596 709, and written correspondence should be sent by email to DrinkingWater.Reporting@DRDMW.qld.gov.au.

6.5.3 Notification of Alerts about Water Quality

If an alert about the quality of the water was required to be distributed to the community the most effective method would likely be by posters and subsequent word of mouth.

Customers with vulnerable health may need to be notified by phone such as:

- Hospital
- School
- Retirement home

Vulnerable customers are listed in table Table below.

Table 25 Vulnerable Customers in Kowanyama Community

Vulnerable Customer	Contact Person	Phone number
Kowanyama Hospital	Director of Nursing	Ph: 4083 7600
Kowanyama State School	State School Principal	Ph: 4083 7333
Aged Care Centre	Aged Care Service Manager	Ph: 4083 7162

6.5.4 Staff Training of Incident Responses

Incident responses and learnings from incidents are discussed informally with staff to capture learnings from the incident.

6.6 Service Wide Support – Information Management

The following table summarises the recording keeping activities undertaken at KASC pertaining to the DWQMP. Table below summarises the activities.

Table 26 Information Management Activities/Document Summary

Information	Storage Location/Retention	Frequency	Responsible Position(s)
Daily Water Quality Testing Records (Excel spreadsheet)	Council network drive (H:) (kept indefinitely) Data recorded on SWIMLocal	Updated Daily	Staff undertaking the Sampling; Reviewed by ESM
External Laboratory Water Quality Results	Council network drive (H:) (retained by Council up to 5 years)	As received from external laboratory, reported to Council monthly	ESM
Operation and maintenance checklists	Council network drive (H:) (retained by Council up to 5 years)	Reported to Council monthly	ESM
SCADA Trends (Trended weekly by the ESM)	Council network drive (H:) (retained by Council up to 5 years)	Reported to Council monthly	ESM
Work Checklists and Form Templates	Council network drive (H:)	Updated and accessed as required, or per operation and maintenance procedures	ESM

Information	Storage Location/Retention	Frequency	Responsible Position(s)
Benchtop Spectrophotometer Calibration Record	Sticker on the instrument	Updated externally annually	ESM/Contractor
Kowanyama Fluoride Fact Sheet	Council network drive (H:)	N/A	ESM
Infrastructure repair record	Council network drive (H:) (retained by Council up to 5 years)	N/A	ESM
WSR017 - Notice of Noncompliance with Water Quality Criteria – Drinking Water	Council network drive (H:) / DRDMW Website	N/A	ESM
WSR507 Notification of a drinking water event or detection of a parameter with no water quality criteria	Council network drive (H:) / DRDMW Website	N/A	ESM
WSR503 – Drinking water quality: incident reporting	Council network drive (H:) / DRDMW Website	N/A	ESM
Boil Water Alert form	Council network drive (H:)	N/A	ESM

7. Operational and Verification Monitoring

7.1 Operational Monitoring

Operational monitoring is conducted at Kowanyama ASC (refer Table 28) and includes monitoring of samples at the locations as per Table 27.
Online telemetry is available for a number of areas of the scheme, including:

- pump running status (bore pumps, town pumps, chlorine pumps)
- actuated valve status
- flow rates (Bore 1, Bore 2, Bore 3 and final water)
- reservoir levels (1.0ML reservoir and 0.8ML reservoir)
- free chlorine levels (1.0ML reservoir and final water)

The online telemetry also includes the readings from a flouride analyser which is monitored on SCADA. Council now possesses a portable flouride measuring device which allows Council to undertake real-time monitoring of fluoride levels and to check the online analyser calibration.
In addition to being displayed on the HMI, SCADA alarms are transmitted by email message, available on the ESM's mobile phone. The ESM then directs responses to be undertaken.
The current operational monitoring program is presented below. The Environmental Health Worker (EHW) collects the operational monitoring samples. The ESM is responsible for assessing the operational and verification monitoring water quality results weekly and investigating any trends and ensuring appropriate training levels for staff.
The operational monitoring program is appropriate to confirm and maintain the effective operation of the preventive measures due to the broad spectrum of sampling sites throughout the community. These parameters will ensure that the treatment process and operational measures are working appropriately to control risks and provide timely indication to undertake immediate corrective action.

Table 27 Operational monitoring sites

Site	Site Location		Sampling	
	Longitude	**Latitude**	**Parameters Tested**	**Frequency**
Bore 1	141.747404	-15.472237	Turbidity, *E. coli**	Weekly
Bore 2	141.738764	-15.471058	Turbidity, *E. coli**	Weekly
Bore 3	141.746930	-15.47587	Turbidity, *E*. coli*	Weekly
Final Water (Water Shed)	141.746935	-15.475666	Online Free Chlorine	Continuous
			*E. coli**	Weekly
			Free Chlorine, Total Chlorine, pH, Turbidity	Daily
Airport tap	141.749722	-15.481944	Free Chlorine,	Daily
China residence	141.743056	-15.469444	Free Chlorine,	Daily
Council office	141.747222	-15.472778	Free Chlorine,	Daily
Hospital (prior to onsite tank)	141.746111	-15.475833	Free Chlorine,	Daily
Pindi St	141.742778	-15.474167	Free Chlorine,	Daily
School	141.745278	-15.472222	Free Chlorine,	Daily
Trudy residence	141.745833	-15.470278	Free Chlorine,	Daily

* *E. coli* monitoring used for source water monitoring.

Table 28 Operational monitoring undertaken at KASC, including targets

Process step / location in system	Parameter	Associated hazard	Sampling			Target limit	Action if target limit is not met	Critical limit	Action if critical limit is exceeded
			Frequency	Method	Analysis				
Bore Sites	Turbidity	Harmful Pathogens	Weekly	Grab sample	In-house	0.7 NTU	Ensure residual chlorine level is maintained in the reticulation/ reservoirs. Increase dose rate as required. Consider using an alternate bore or shutting down the plant. Increase monitoring until below target limit.	1 NTU	Consider using an alternate bore or shutting down the plant.
	E. coli	Harmful Pathogens	Weekly	Grab sample	In-house	Not Present	Verify integrity of bore head. Ensure residual chlorine level is maintained in the reticulation/ reservoirs. Increase dose rate as required. Increase monitoring (including reticulation *E. coli* monitoring	n/a	n/a
	Bore Head Integrity	Harmful Pathogens	Weekly	Visual Inspection	EHW	No evidence of vandalism. Bore head, concrete pad, seal and fences intact.	Notify ESM. ESM to arrange repair of asset. Consider if increased *E. coli* monitoring or use of an alternate bore is required.	n/a	n/a
Online chlorine analysers • Final Water • 1.0ML Reservoir	Free chlorine	Harmful Bacteria Chemical hazard	Continuous	Online analyser	Online	>0.5 mg/L, <1.5 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM.	>4 mg/L <0.15 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM. If <0.15 mg/L for

									extended period of time, then test for free chlorine and *E. coli* in the reticulation. If can't achieve >0.5 mg/L after immediate corrective action, immediately report as an 'event' to DRDMW.
Final Water (Water Shed)	Free chlorine	Harmful Bacteria Chemical hazard	Daily (on working days)	Grab Sample	In-house	>0.5 mg/L <1.5 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM.	>4 mg/L <0.15 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM. If <0.15 mg/L, then test for free chlorine and *E. coli* in the reticulation. If can't achieve >0.5 mg/L after immediate corrective action, report as an 'event' to DRDMW. If >4 mg/L, test for Total Chlorine.
	Total Chlorine	Chemical	Daily (on working days)	Grab Sample	In-house	>0.5 mg/L <1.5 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM.	>5 mg/L <0.15 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM. If more than 5 mg/L, immediately

								report to DRDMW as a 'water quality criteria'.
pH	Chemical	Daily (on working days)	Grab Sample	In-house	> 7.5, < 8.2	Retest, check free chlorine level and adjust as required. .	> 8.5	Retest, check free chlorine level and adjust as required. Manually dose with hydrochloric acid. If >8.5 chlorination may not be effective, therefore, test for free chlorine and if low, or if target limit for pH can't be achieved after immediate corrective action, report immediately as an 'event' to DRDMW.
Turbidity	Harmful Pathogens	Weekly	Grab sample	In-house	0.7 NTU	Check for contamination of reservoirs	1 NTU	Advise ESM. Check free chlorine level (in-line analyser and manually in the water shed), if free chlorine is not within the target range or turbidity can't be improved after corrective action, or if there is a potential for contamination of reservoirs, immediately report to DRDMW as an 'event'.

	E. coli	Harmful Pathogens	Weekly	Grab sample	In-house	Not Present	Verify integrity of reservoirs and check for contamination from vermin. Ensure residual chlorine level is maintained in the reticulation/ reservoirs. Increase dose rate as required. Investigate turbidity level. Increase monitoring (including reticulation *E. coli* monitoring	1 MPN/100 mL or 1 CFU/100 mL	Immediately report to DRDMW as a 'water quality criteria'.
	Fluoride	Health Hazard	Continuous	Online analyser	Online	<1.4 mg/L	Check calibration of online analyser using portable fluoride analyser Adjust blend of bore water	≥1.5 mg/L	Use Bore 3 only and retest. **Immediately Report to DRDMW** as a 'water quality criteria'**.**
Reservoirs	Reservoir Integrity	Harmful Pathogens	Weekly	Visual Inspection	EHW	No evidence of vandalism. Hatches closed. Reservoir roof, vermin screens and flashing intact.	Notify ESM. ESM to arrange repair of asset. Consider if increased *E. coli* monitoring or use of an alternate bore is required. Consider activating incident protocol	Some evidence of vandalism. Hatches not closed. Evidence of vermin ingress into reservoir	Activate incident reporting protocol and report to DRDMW as an 'event' immediately and follow the advice from the Regulator, TPHU (Tropical Public Health Unit, Cairns) and incident management team.
Reticulation Sites	Free chlorine	Harmful Bacteria Chemical hazard	Daily (on working days)	Grab Sample	In-house	>0.3 mg/L, <1.5 mg/L	Retest, check dosing pumps or calibration of instrument, further action dependent on findings, tell ESM.	>4 mg/L <0.15 mg/L	Retest, check dosing pumps or calibration of instrument, flush branch lines if appropriate, advise ESM. Immediately report to DRDMW if free chlorine level can't be achieved in a timely manner.

									Test for *E. coli* if multiple sampling points are affected.

7.2 Verification Monitoring

Verification monitoring is used to confirm that safe water is delivered to customers in compliance with the ADWG and the *Public Health Act (2005)* and the *Public Health Regulations (2018)*.

Verification monitoring is provided for chemical parameters using water extracted from the bores, while microbial parameter verification is provided for reticulation sites in the township. Verification monitoring of *E. coli* is conducted weekly using an in-house Colilert presence/absence system. The verification results are confirmed on a monthly basis using results from a NATA accredited laboratory, where verification monitoring of Total Coliforms and Heterotrophic Plate Count is also conducted.

The verification sites, parameters tested and the frequency of monitoring are selected to manage risks as documented in the risk assessment.

Verification samples for both chemical and microbial verification are collected by the Environmental Health Worker (EHW). Chemical verification samples and monthly microbial samples are analysed by the NATA accredited Cairns Regional Council water laboratory. Samples are despatched in coolers with ice bricks. Results from verification samples are provided to the ESM via email, and the ESM is responsible for assessing water quality results.

Naturally occurring fluoride does not have a required monitoring frequency and is often stable at this level. Although there have been past instances of fluoride concentrations above ADWG health guideline limits, there is no mechanism for fluoride removal is currently available

The verification monitoring sample sites are summarised in Table . The verification monitoring program is listed in Table .

Table 29 Verification Monitoring sampling sites

Type of Site	Site Name	Site Location	
		Longitude	Latitude
Bores	Bore 1	141.747404	-15.472237
Bores	Bore 2	141.738764	-15.471058
Bores	Bore 3	141.746930	-15.475870
Town	Final Water (Water Shed)	141.746935	-15.475666
Town	Airport tap	141.749818	-15.482089
Town	China residence	141.742983	-15.469419
Town	Council Office	141.747359	-15.472664
Town	Hospital	141.746160	-15.475852
Town	Pindi St	141.74282	-15.47418
Town	School	141.745187	-15.472174
Town	Trudy residence	141.745898	-15.470154

Table 30 Kowanyama water supply verification monitoring program

Verification Sites	Parameter	Frequency	**Target limit**	**Action if target limit is not met**	**Critical limit**	**Action if critical limit is exceeded**
Microbial Parameters						
Town monitoring sites	*E. coli*	Weekly in house and monthly at Cairns Lab	Nil detected	Refer details in "Detection Incident Investigation Form" in Appendices Issue "Boil Water Alert"	any detection	Immediately report to DRDMW as a 'water quality criteria'.
	Heterotrophic Plate Count	Monthly	<100 CFU/mL	Investigate potential source of contamination, flush mains	>500 CFU/mL	Temporarily shutdown mains, scour all mains, super chlorinate mains and retest
	Total Coliforms	Monthly	Nil detected	Investigate potential source of contamination, flush mains Check free chlorine level in the reticulation and at the WTP and adjust as required. Check if turbidity is within the target range	any detection	If suspect contamination, immediately report to DRDMW as an 'event'.
Chemical Parameters						
Bores 1,2 & 3	Aluminium	Quarterly	0.2 mg/L (aesthetic)			If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Arsenic	Quarterly			≥0.01 mg/L	Isolate bore, immediately report to DRDMW as a 'water quality criteria'.
	Barium	Quarterly			≥2 mg/L	Immediately report to DRDMW as a 'water quality criteria'.
	Boron	Quarterly			≥4 mg/L	Immediately report to DRDMW as a 'water quality criteria'.
	Cadmium	Quarterly			≥ 0.002 mg/L	Immediately report to DRDMW as a 'water quality criteria'.

	Calcium	Quarterly				If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Chloride	Quarterly	250 mg/L (Aesthetic)			If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Copper	Quarterly	1 mg/L (Aesthetic)		≥ 2 mg/L	Isolate bore, immediately report to DRDMW as a 'water quality criteria'.
	Electrical conductivity	Quarterly				If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Fluoride	Quarterly	1.4 mg/L		≥ 1.5 mg/L	Investigate which bore is reading high and isolate bore if mixed treated water is >1.5 mg/L, immediately report to DRDMW as a 'water quality criteria'.
	Iron	Quarterly	0.3 mg/L (Aesthetic)			Taste threshold 0.3 mg/L. High concentrations stain laundry and fittings. Iron bacteria cause blockages, taste/odour, corrosion. If detected above the max. that was previously detected, consult with the DRDMW and TPHU
	Lead	Quarterly			≥ 0.01 mg/L	Immediately report to DRDMW as a 'water quality criteria'.
	Magnesium	Quarterly				If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Manganese	Quarterly	0.1 mg/L (Aesthetic)		≥ 0.5 mg/L	>0.1 mg/L causes taste, staining. Immediately report to DRDMW as a 'water quality criteria'.

	Molybdenum	Quarterly			≥ 0.05 mg/L	Immediately report to DRDMW as a ‘water quality criteria’.
	Sum of perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS)	Five Yearly	ND		≥0.07 µg/L	Isolate bore if concentration ≥0.07 µg/L, immediately report to DRDMW as a ‘water quality criteria’.
	Perfluorooctanoic acid (PFOA)	Five Yearly	ND		≥0.56 µg/L	Isolate bore if concentration ≥0.56 µg/L, immediately report to DRDMW as a ‘water quality criteria’.
	pH	Quarterly	pH 6.5–8.5			Extreme pH values (<4 and >11) may adversely affect health; >8 progressively decreases efficiency of chlorination. Consult with the DRDMW and TPHU, may need to be reported as ‘an event’
	Potassium	Quarterly				If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Silicon	Quarterly				If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Sodium	Quarterly	180 mg/L (Aesthetic)			If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Sulphate	Quarterly	250 mg/L (Aesthetic)			If detected above the max. than that was previously detected, consult with the DRDMW and TPHU

	Total Alkalinity	Quarterly				
	Total Dissolved Solids	Quarterly	600 mg/L (Aesthetic)			Based on taste: <600 mg/L is regarded as good quality drinking water; 600-900 mg/L is regarded as fair quality; 900-1200 mg/L is regarded as poor quality; >1200 mg/L is regarded as unacceptable. If detected above the max. than that was previously detected, consult with the DRDMW and TPHU
	Total Hardness	Quarterly	200 mg/L (Aesthetic)			Increasing scaling problems.
	Turbidity	Quarterly	0.7 NTU	Check for contamination of reservoirs	1 NTU	Advise ESM. Check free chlorine level (in-line analyser and manually in the water shed), if free chlorine is not within the target range or turbidity can't be improved after corrective action, or if there is a potential for contamination of reservoirs, immediately report to DRDMW as an 'event'.
	Radionuclides – Gross alpha and gross beta activity concentration	2-yearly	ND		≥0.5 Bq/L	If either or both screening values of 0.5 Bq/L for gross alpha and 0.5 Bq/L for gross beta activity (with contribution of Potassium-40 subtracted) activity are exceeded; immediately report to DRDMW as a 'water quality criteria'.
Final Water (Water Shed)	Turbidity	Weekly in-house and monthly at Cairns Lab	0.7 NTU	Check for reservoir contamination. Increase monitoring until below target limit	1.0 NTU	Advise ESM. Check free chlorine level (in-line analyser and manually in the water shed); if free chlorine is not within the target range or turbidity can't be improved after corrective action, or if there is a potential for

						contamination of reservoirs, immediately report to DRDMW as an ‘event’.
	Chlorate	Quarterly			≥0.8 mg/L	Immediately Report to DRDMW as a parameter with ‘no water quality criteria’.
	Trihalomethanes (THMs) (Total)	Quarterly			≥0.25 mg/L	Immediately Report to DRDMW as a ‘water quality criteria’

Glossary

Word	Description
ADWG	Australian Drinking Water Guidelines 2011
CCP	Critical Control Point
DRDMW	Department of Regional Development, Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
EHW	Environmental Health Worker
ESM	Essential Services Manager
HMI	Human Machine Interface
GAB	Great Artesian Bore
KASC	Kowanyama Aboriginal Shire Council
NATA	National Association of Testing Authorities
SCADA	Supervisory Control and Data Acquisition
WSR	Water Supply Regulator

References

National Health and Medical Research Council (NHMRC) and Natural Resource Ministerial Management Council (NRMMC), 2017, Australian Drinking Water Guidelines 6, Version 3.4 < https://www.nhmrc.gov.au/_files_nhmrc/file/publications/nhmrc_adwg_6_version_3.3_2.pdf>

DNRM (2005) Hydrogeological framework report for the Great Artesian Basin resource plan area. Queensland

Department of Natural Resources and Mines. DERM, The Great Artesian Basin factsheet, February 2011, http://www.derm.qld.gov.au/factsheets/pdf/water/w68.pdf

Department of Energy and Water Supply, Preparing a Drinking Water Quality Management Plan Supporting Information, September 2010, https://www.dews.qld.gov.au/__data/assets/pdf_file/0011/45587/dwqmp-supportinginfo.pdf

CSIRO (2009) Water in the Mitchell region, pp. 347-416 in CSIRO (2009) Water in the Gulf of Carpentaria Drainage Division. A report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project. CSIRO Water for a Healthy Country Flagship, Australia. xl + 479pp

Water Services Association of Australia – Manual for the application of Health-Based Targets for Drinking Water Safety, September 2015

Appendices

Appendix A – Template procedure checklists

Appendices

Appendix B – Critical Control Point Procedures

Appendices

Appendix C – Risk Management Improvement Plan and Risk Register

Appendices

Appendix D – Catchment Categorisation – Kowamyama Bores Assessment

Appendices

Appendix E – Incident Reporting

Appendices

Appendix F – Bore Water Analyses March 2023