CHARTERS TOWERS
REGIONAL COUNCIL

Drinking Water Quality Management Plan
SPID 479

Annual Report
2021/2022

Contents

Water Service Provider Details

Detail	Information
SPID	479
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Water Service Areas covered by this plan	Charters Towers, Greenvale, Ravenswood, Pentland

Glossary of terms

ADWG 2011	Australian Drinking Water Guidelines (2011). Published by the National Health and Medical Research Council of Australia
Cfu/100mL	Colony forming units per 100 millilitres
CTRC	Charters Towers Regional Council
DWQMP	Drinking Water Quality Management Plan
E. coli	Escherichia coli, a bacterium which is considered to indicate the presence of faecal contamination and therefore potential health risk
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
MPN/100mL	Most probable number per 100 millilitres
RG	Ravenswood Gold
SCADA	Supervisory Control and Data Acquisition
WTP	Water Treatment Plant
WSP	Water Service Provider

1. Introduction

This is the Drinking Water Quality Management Plan (DWQMP) report for Charters Towers Regional Council (CTRC) for the financial year 2021/22.

CTRC is a registered service provider with identification (SPID) number 479, operating under an approved DWQMP to ensure consistent supply of safe quality drinking water in order to protect public health. This is done through proactive identification and minimisation of public health related risks associated with drinking water.

This DWQMP annual report includes:

- the activities undertaken over the financial year in operating our drinking water service
- drinking water quality summary
- summary of our performance in implementing our approved DWQMP

This report is submitted to the Regulator to fulfil our regulatory requirement and is also made available to our customers through our website or for inspection upon request at a Council office.

2. Summary of schemes operated

CTRC Regional Council has four Water Service Areas (WSA's), including Charters Towers, Greenvale, Ravenswood, and Pentland.

Charters Towers WSA

Drinking water for Charters Towers is provided from surface water sourced from the Burdekin River via the Charters Towers Weir and pumped from the Phil Mathews pump station to the Charters Towers Water Treatment Plant (WTP). The WTP is a conventional plant utilising coagulation, flocculation, clarification, sedimentation, filtration, and disinfection. The treated water is delivered to two reservoirs, each having a common inlet/outlet. Connected population is approximately 8,520 persons.

Greenvale WSA

Water is sourced from the Burdekin River from bed-sand spears. Four spears are currently installed, of which three are operational. The water is injected with chlorine for iron/manganese control before being pumped to storage where further chlorine injection is implemented for disinfection. Connected population is approximately 180 persons.

Ravenswood WSA

Water is sourced from the Burdekin River by Ravenswood Gold (RG). The water is pumped to a turkey nest dam and then to Suhrs Ck Dam. Water is then pumped to the mining operations with a portion (less than 10%) diverted to a Water Treatment Plant which supplies potable water to the town and the mining operations. Connected population is approximately 200 in the township plus a variable population in the accommodation camp and the mining administration.

Pentland WSA

Pentland is serviced by ground water from the Glen Houghton bore field which is a groundwater recharge system. Two bores pump water to a small tank for settlement where water is disinfected with chlorine before reticulation to the township via a reservoir. Connected population is approximately 200 persons.

Water Service Area	Water Source	Treatment Processes	Treatment Capacity	Towns Supplied
Charters Towers	Charters Towers Weir on the Burdekin River	Coagulation, flocculation, clarification, sedimentation, filtration and disinfection.	22ML/day	Charters Towers
Pentland	Ground water via Bore field	Settlement, disinfection	0.73ML/day	Pentland
Greenvale	Burdekin River via 4 spears	Disinfection	1ML/day	Greenvale
Ravenswood	Burdekin River via turkey nest dam	Coagulation, clarification, filtration, disinfection	0.5ML/day	Ravenswood

Table 1 - Sources and Treatment Capability

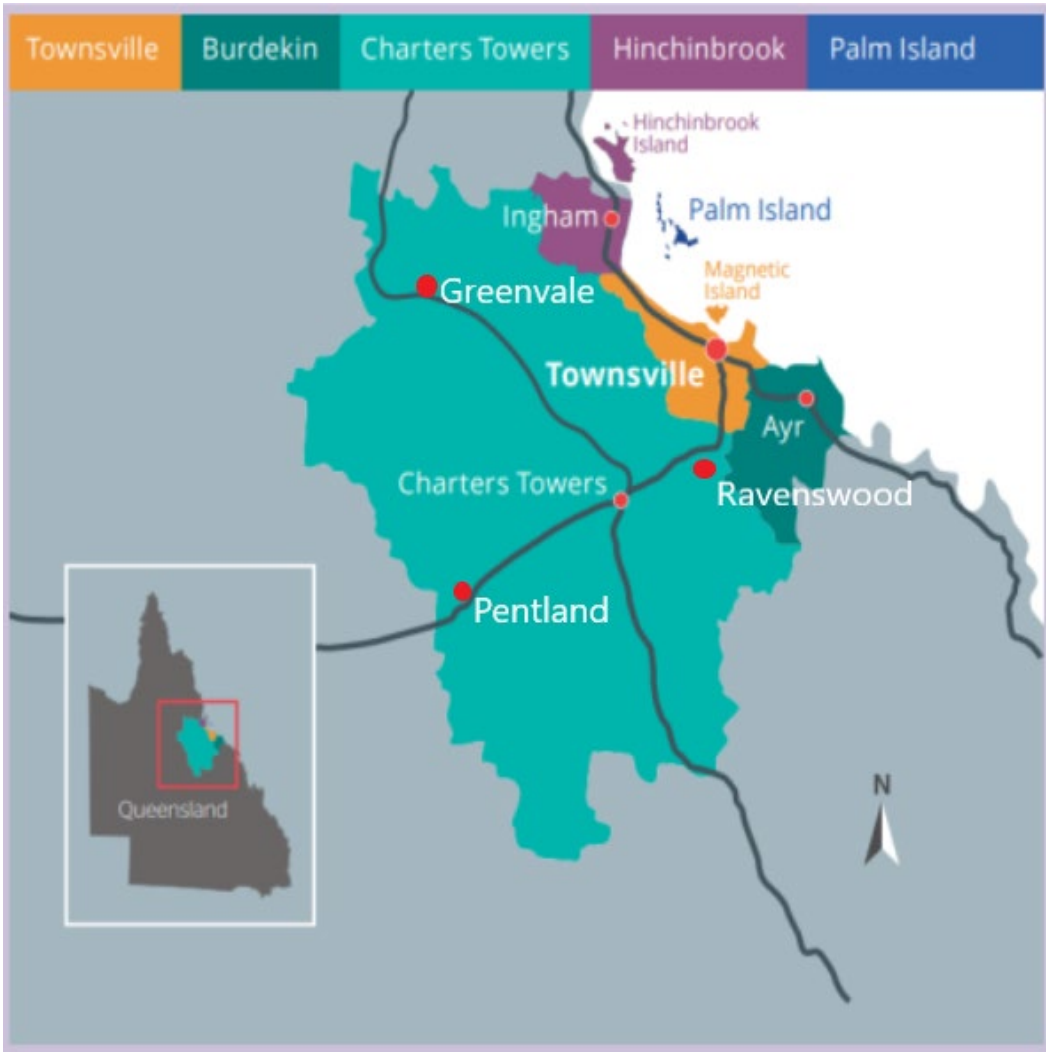

Figure 1: WSA Locations

3. DWQMP Implementation

The focus for management of water quality this year has been improving water sampling, compliance with the DWQMP and addressing the Risk Management Improvement Plan requirements. The Water Infrastructure Upgrade Program has continued with planning and design works for duplication of the 525mm AC trunk main and selection of a location for an intermediate reservoir to reduce the impact of surge pressures at the low end of the main. The DWQMP has been reviewed and the updated version was submitted to the Regulator and has been approved.

4. Verification monitoring – water quality information and summary

The results from the drinking water quality monitoring program conducted by CTRC have been compared against the Australian Drinking Water Guideline levels.

Testing for the presence of *Escherichia coli* is conducted at each of the four schemes within CTRC. Charters Towers has a population of 8,520 and therefore the required frequency is one sample per week plus one additional sample per month. Weekly Samples are collected at the reservoir and at a sampling location in the town. In addition, monthly samples are collected at three sites at the extremities of the network. In the 2021/22 financial year 152 samples were tested for E. coli, with an 'annual value' of 99.3% (E. coli was detected in 1 sample).

Pentland, Greenvale, and Ravenswood all have populations less than 1,000 persons so the required minimum frequency is one sample per month for each of these schemes. In the 2021/22 financial year 36 samples from Greenvale, 36 samples from Pentland and 36 samples from Ravenswood were tested for the presence of E. coli. Greenvale, Pentland, and Ravenswood returned 'annual values' of 100%.

A summary of the key parameters for the CTRC Drinking Water Quality Verification testing program is shown in Table 2.

The compliance results for E. coli testing are shown in Tables 3-6.

A complete listing of verification results is provided in Appendix A.

Scheme name	Parameter	Number Required	Number tested	ADWG Water quality criteria	No. Non-compliant samples	Comments
Charters Towers	E. coli	152	152	0	2	One Monthly Network sample (result 1cfu/100mL,)
Charters Towers	pH	152	152	6.5-8.5 aesthetic	0	
Charters Towers	Free Chlorine	152	152	0.5<>5.0	0	
Charters Towers	Trihalomethanes	4	7	0.25 mg/L	0	
Charters Towers	Turbidity	12	13	5 NTU aesthetic	0	
Charters Towers	True Colour	12	13	15 HU aesthetic	0	
Greenvale	E. coli	36	36	0	0	
Greenvale	pH	36	36	6.5 – 8.5 aesthetic	1	No pH control available
Greenvale	Free Chlorine	36	36	0 5<>5.0	0	
Greenvale	Trihalomethanes	4	5	0.25 mg/L	0	
Greenvale	Turbidity	36	36	5 NTU aesthetic	12	Ongoing turbidity issues “Boil Water” Alert in place
Greenvale	True Colour	12	12	15 HU aesthetic	0	
Pentland	E. coli	36	36	0	0	
Pentland	pH	36	36	6.5 – 8.5 aesthetic	0	
Pentland	Free Chlorine	36	34	< 5	0	
Pentland	Turbidity	12	12	5 NTU aesthetic	0	
Pentland	True Colour	12	12	15 HU aesthetic	0	
Ravenswood	E. coli	36	36	0	0	
Ravenswood	pH	36	36	6.5 – 8.5 aesthetic	0	
Ravenswood	Free Chlorine	36	36	< 5	0	
Ravenswood	Turbidity	36	36	<5 NTU aesthetic	0	
Ravenswood	Trihalomethanes	4	8	0.25 mg/L	0	
Ravenswood	True Colour	12	12	15 HU aesthetic	0	

Table 2 - Verification Summary

WSA	Charters Towers											
Year	2021 – 2022											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	14	12	12	12	12	13	8	16	14	12	15	12
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	1	0
No. of samples collected in previous 12 month period	149	147	149	149	149	152	146	152	152	152	155	152
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	1	1
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.3%
Compliance with 98% annual value	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 3 – Charters Towers E. coli Compliance

WSA	Greenvale											
Year	2021 – 2022											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	3	3	3	3	3	3	3	3	3	3	3	3
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	33	33	33	33	33	33	36	36	36	36	36	36
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 4 - Greenvale E. coli Compliance

WSA	Pentland											
Year	2021 – 2022											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	3	3	3	3	3	3	3	3	3	3	3	3
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	34	34	34	34	34	34	34	34	34	36	36	36
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 5 - Pentland E. coli Compliance

WSA	Ravenswood											
Year	2021 – 2022											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	3	3	3	3	3	3	3	3	3	3	3	3
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	35	35	35	35	35	35	35	35	35	35	35	36
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 6 - Ravenswood E. coli Compliance

5. Incidents reported to the regulator

For the reporting year 2021/22 the following incidents were notified to the Regulator under Section 102 or 102A of the Act for noncompliance issues that occurred:

DWI-7-479-00030 High Turbidity Event – Greenvale 20 Aug 2018 (Continuation of this event):
The Greenvale water system draws raw water from the Burdekin River via bed-sand spears. A rain event caused the turbidity to rise above the 1 NTU threshold, which required an incident report to be raised and for the residents to be advised to boil any water which was to be consumed. The turbidity has remained at an elevated level for the entire reporting period. There is no easy resolution to this issue. The bed-sand spears have been cleaned out, the filter tank at the reservoir has been cleaned and the reservoir itself has been cleaned, however the water remains turbid.

DWI-479-21-09560

DWI-479-21-09824

The following non-compliant results were identified in the analysis of the verification data but were not reported to the Regulator at the time:

1 February 2022 Charters Towers Monthly Sampling Thermotolerant Coliforms
A value of "~1" for Thermotolerant Coliforms was detected in The Picnic Creek Road sample collected on 1 February 2022. This sample also returned a value of 1cfu/mL for the Heterotrophic Plate Count (HPC). In that same sampling run the sample collected from Wilson Court also returned a value of 3cfu/mL. However, no evidence of E. coli or coliforms was detected at either of these sites. The low HPC results were interpreted as non-reportable, and it is probable that operational staff overlooked the indication of a reportable value.

6 April 2022 Ravenswood Reticulation Thermotolerant Coliforms (DWI-479-22-09560)
A result of 1 Thermotolerant Coliforms/100 mL was recorded (Laboratory Registration No. 22-2251). There was also 1 cfu/100mL of Total coliforms but no E. coli and no Heterotrophic Plate Count detected in that location, or at the other reticulation sample location or in the Ravenswood Reservoir on that day.

Free Chlorine was measured at 2.75 mg/L which is sufficient to achieve a kill of any coliforms. The Ravenswood Gold testing conducted on 1 Jun 2021 showed the reservoir had 1.1 NTU turbidity, which is slightly over the operational limit of 1.0 NTU, but less that the Aesthetic Limit of 5.0 NTU, indicating that the treatment plant was operating well at the time. It is therefore likely that this result was a handling error in the sampling process.

17 & 23 May 2022 Charters Towers Monthly Sampling Multiple Results
Samples submitted on 17 May 2022 returned non-compliant results – E. coli 1 cfu/100mL, Total coliforms 1 cfu/100mL, Thermotolerant coliforms 1 cfu/100mL. A re-sample was ordered but no re-sampling results are recorded, indicating that it was not completed. The original sample was collected on a Tuesday, when all four Water and Wastewater Operators were working. Only two Operators were available from Wednesday to the following Sunday. Therefore, it is assumed that no follow up was done. It is noted that results for other sampling points at that time were compliant, and the previous and following samples were also compliant. However, as a result of the incident a review of procedures was completed, and a Corrective Action reporting system has been initiated.

1 December 2021, 1 February 2022, 6 April 2022 Ravenswood Turbidity

- On 1 December 2021 Turbidity at the Ravenswood Reservoir was recorded at 1.7NTU
- A result of 1.4 NTU was detected on1 February 2022,
- On 6 April 2022 a sample returned a value of 1.2 NTU

While these results did not exceed the Aesthetic value of 5 NTU, they were higher than the reportable value of 1.0 NTU, which is the target for effective disinfection.

Council receives a monthly water quality report from Ravenswood Gold, and these results were old by the time they were received. However, a team was sent to Ravenswood to flush the mains in the reticulation system, to ensure its safety. Ravenswood Gold was also contacted and requested to review the water treatment procedures to increase the residual Chlorine concentrations, which had been measured at 0.05 mg/L on 1 December 2022.

DWI-479-22-09824 Greenvale Chlorates 28 September 2022
During the 2021-22 Financial Year the Regulator advised Council of the need to monitor the levels of Chlorates generated by degradation of Sodium Hypochlorite. Council use Sodium Hypochlorite at the Greenvale Reservoir. While no testing for Chlorates was carried out in the 2021-22 Financial Year, analysis was included for samples collected on 28 September 2022, and an exceedance was found. This was confirmed by follow-up testing. A Management Plan has been submitted to the Regulator, and Council is considering options to address the issue. It is likely that funding for this will have to be obtained under the 2023-24 Capital Works budget.

6. Customer feedback

Month	Suspected Illness	Dirty Water	Taste and odour	Supply
Jul 2021	0	0	0	0
Aug 2021	0	0	0	0
Sep 2021	0	0	0	0
Oct 2021	0	0	0	0
Nov 2021	0	0	0	1
Dec 2021	0	0	0	0
Jan 2022	0	0	0	0
Feb 2022	0	1	0	0
Mar 2022	0	0	0	0
Apr 2022	0	0	1	0
May 2022	0	0	0	0
Jun 2022	0	0	0	0
Total	**0**	**1**	**1**	**1**

Table 7 - Customer Feedback

Date	Complaint	Resolution
24/2/2022	Greenvale Dirty Water	Discussed with customer and advised of the Boil Water Alert. Also advised that improved water quality will occur with development of Army Training Camp, but this would be several years away.
29/11/2021	Loss of supply	Contacted customer directly. Residence at top of hill in retirement village. Is sues caused by height difference from connection point. Checked and confirmed adequate supply pressure and flow at connection point. Advised Village management to review internal supply systems.

Table 8 - Complaint Details

7. Information Requirement Notice (IRN) Response

The Regulator issued an Information Requirement Notice (IRN) for the draft Drinking Water Quality Management Plan. A report in response to the IRN was submitted to the Regulator on 6 September 2021. The response addressed improvement issues including Council's agreements with Ravenswood Gold, potential contamination from the Ben Lomond Uranium Mine, Gold mining residuals in the Charters Towers area. Responses to other IRN items included:

- Emergency operation of the redundant Charters Towers WTP Module 1
- Ravenswood potable water supply infrastructure
- Potential contamination of the Ravenswood potable water supply from the gold mining operations
- Pentland bores infrastructure and operational arrangements
- Potential for contamination of Pentland potable water supply from unused bores
- Management of disinfection by-products including Chlorates
- Risk management for Whole of Service hazards such as cyclones, flood, power failures and cyber security
- Verification monitoring for Pentland and Ravenswood
- Operational monitoring for Greenvale

8. Risk Management Improvement Program

A working group has been formed to address issues noted in the Risk Management Improvement Program. Actions include:

- Replacement of the Treated Water Storage tank at the WTP with the larger tank made redundant by the upgrade. The replacement tank will also be fitted with a sealed roof, and will improve pumping performance as the additional height of feed water in the tank will prevent cavitation in the delivery pumps, which occurs from time to time with supply from the existing tank. The existing tank will be refurbished and re-purposed to provide treated water for backwashing.
- Reconfiguration of water supply to the flocculant dosing pumps at the head of the plant. In the upgrade the dosing pumps supplied raw water for mixing the flocculant. At times of high flow during flood events, the raw water contains very high turbidity, and the solids have worn out the pumps prematurely. A solution to the problem was to redirect water from the clear water lines to the pumps, involving installation of a 50 metre long supply line. This has effectively provided a clean supply for mixing of flocculant dosed into the raw water, and prevented failure of the flocculation system.
- To ensure the integrity of the treatment processes the original WTP configuration (Module 1) has been maintained and is operated on a routine basis. This will continue with reversion to Module 1 on a quarterly basis. The last run occurred in October 2022.
- Investigations into alternative methods of disinfection and Iron and Manganese control at Greenvale are continuing. Sodium Hypochlorite is dosed at the raw water pumps at the river extraction point to remove Iron and Manganese, and at the reservoir for disinfection. At this stage a proposal to install gaseous Chlorine at the reservoir is being assessed with regard to WHS issues. Any actions will be regarded as short-term to be effective until an upgraded supply and treatment system is installed for the proposed Australia-Singapore Military Training Initiative (ASMTI), expected in 2023. The upgrades to water and wastewater management will be first actions in any works carried out.
- Contractors have been engaged to clean the reservoirs at Pentland and Greenvale. This work also provided reports on the internal condition of the reservoirs and will provide support for maintenance activities.

The current status of the work on the Risk Management Improvement Program is noted in Appendix B.

9. DWQMP Audit

An audit of the DWQMP was conducted in September 2022, and a copy of the Audit Report has been submitted to the Regulator. While the report found that most areas showed compliance it found that improvements to processes and systems could be made in a number of areas. Two major non-compliances were observed. These related to the methodology for collecting samples at the townships. Operators were running the sample taps for long periods as they attended to other activities. This practice has been addressed and the Operating Procedure for sample collection at the townships has been amended to ensure correct procedures. As a result of the number of Opportunities for Improvement, a working party comprised of team leaders and management which was formed to address issues noted in the Risk Management Improvement Program will also work through the issues noted in the Audit. This group meets fortnightly. It is expected that the work will take some time to complete.

Appendix A – Summary of compliance with water quality criteria

The reported statistics include results derived from repeat samples, or from emergency or investigative samples undertaken in response to a customer complaint or abnormal results.

External verification monitoring samples are taken internally but processed and analysed by Townsville Laboratories and a summary of the results for critical measures is included below.

Verification monitoring results

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Charters Towers	Alkalinity	mg CaCO3/L	5		13	0	60.36	167.6	118.52
Charters Towers	Aluminium	mg/L	0.01	0.2 (A)	13	0	0.01	0.066	0.02
Charters Towers	Ammonia as N	mg/L as N	0.02	0.5 (A)	13	0	0.02	0.17	0.03
Charters Towers	Anatoxin	µg/L	0.1		1	0	0.1	0.1	0.1
Charters Towers	Antimony	mg/L	0.0005	0.003 (H)	13	0	0.0005	0.0005	0.0005
Charters Towers	Arsenic	mg/L	0.0005	0.01 (H)	13	0	0.0005	0.002	0.0011
Charters Towers	Barium	mg/L	0.002	2 (H)	13	0	0.028	0.052	0.041
Charters Towers	Bicarbonate	Mg/L as CaCO3	5		13	0	36.8	102	72.1
Charters Towers	Blue Green Algae	cells/mL	20		12	0	20	20	20
Charters Towers	Boron	mg/L	0.004	4 (H)	13	0	0.004	0.028	0.02
Charters Towers	Bromodichloromethane	µg/L	2		5	0	15	32	23

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Charters Towers	Bromoform	µg/L	2		5	0	2	2	2
Charters Towers	Cadmium	mg/L	0.0004	0.002 (H)	13	0	0.0004	0.0004	0.0004
Charters Towers	Calcium	mg/L	0.7		13	0	9	23	16.7
Charters Towers	Carbonate	mg/L as CaCO3	5		13	0	5	5	5
Charters Towers	Chloride	mg/L	0.5	250 (A)	13	0	17.5	30.2	23.3
Charters Towers	Chlorine, Free	mg/L	0.05	5 (H)	152	0	0.05	2.53	1.19
Charters Towers	Chlorodibromomethane	µg/L	2		5	0	2	15	7
Charters Towers	Chloroform	µg/L	2		5	0	37	88	60.2
Charters Towers	Chromium	mg/L	0.0003	0.05 (H)	13	0	0.0003	0.005	0.0007
Charters Towers	Colour, True	Pt-Co Units	1	15 (A)	13	0	0	2	0.5
Charters Towers	Copper	mg/L	0.002	2 (H)	13	0	0.002	0.002	0.002
Charters Towers	Cylindrospermopsin	µg/L	0.05		1	0	0.05	0.05	0.05
Charters Towers	Cylindrospermopsis (Cyanophyta)	cells/mL	20		12	0	20	20	20
Charters Towers	Diatoms (Bacillariophyta)	cells/mL	20		12	0	20	20	20
Charters Towers	Dolichospermum sp. (Cyanophyta)*	cells/mL	20		12	0	20	20	20
Charters Towers	E. coli	cfu/100mL	1	0 (H)	152	1	0	1	0

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Charters Towers	Electrical Conductivity	µS/cm	1		13	0	179	426	311
Charters Towers	Fluoride	mg/L	0.02	1.5 (H)	13	0	0.02	0.11	0.09
Charters Towers	Hardness	mg/L CaCO3	1		13	0	48.4	139.1	94.9
Charters Towers	Heterotrophic Plate Count	cfu/mL	1		139	0	0	300	11.9
Charters Towers	Hydroxide	mg/L as CaCO3	5		13	0	5	5	5
Charters Towers	Iron	mg/L	0.002	0.3 (A)	13	0	0.002	0.04	0.005
Charters Towers	Lead	mg/L	0.0006	0.01 (H)	13	0	0.0006	0.0006	0.0006
Charters Towers	Magnesium	mg/L	0.5		13	0	6.3	22.1	13.4
Charters Towers	Manganese	mg/L	0.0003	0.5 (H)	13	0	0.0003	0.0006	0.0003
Charters Towers	Mercury	mg/L	0.0003	0.001 (H)	13	0	0.0003	0.0004	0.0003
Charters Towers	Microcystis (Cyanophyta)*	cells/mL	20		12	0	20	20	20
Charters Towers	Molybdenum	mg/L	0.0004	0.05 (H)	13	0	0.0004	0.001	0.0007
Charters Towers	Nickel	mg/L	0.001	0.02 (H)	13	0	0.001	0.001	0.001
Charters Towers	Nitrate as N, Calc	mg/L as N	0.01	50 (H)	13	0	0.02	0.1	0.05
Charters Towers	Nitrite as N	mg/L as N	0.01	3 (H)	13	0	0.01	0.01	0.01
Charters Towers	Oxidised Nitrogen as NOx-N	mg/L as N	0.01		13	0	0.02	0.1	0.048

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Charters Towers	pH	pH units		8.5 (A)	152	0	7.16	8.21	7.76
Charters Towers	Phosphate as P	mg/L as P	0.01		13	0	0.01	0.04	0.01
Charters Towers	Planktolyngbya sp	cells/mL	20		3	0	0	20	13.3
Charters Towers	Potassium	mg/L	0.5		13	0	2.5	4.7	3.6
Charters Towers	Pseudoanabaena sp (Cyanophyta)	cells/mL	20		12	0	20	20	20
Charters Towers	Selenium	mg/L	0.001	0.01 (H)	13	0	0.001	0.001	0.001
Charters Towers	Silica as SiO2	mg/L	0.1		13	0	17.8	25.3	20.8
Charters Towers	Silver	mg/L	0.0004	0.1 (H)	13	0	0.0004	0.0004	0.0004
Charters Towers	Sodium	mg/L	1.2	180 (A)	13	0	10.6	33	20.5
Charters Towers	Sulphate	mg/L	0.5	250 (A)	13	0	1.3	4.9	2.9
Charters Towers	Thermotolerant Coliforms	cfu/100mL	1	0 (H)	139	2	0	1	0
Charters Towers	Total Coliforms	cfu/100mL	1		139	0	0	1	0
Charters Towers	Total Dissolved Solids by EC	mg/L		600 (A)	13	0	114	273	199
Charters Towers	Trihalomethanes, Total	µg/L	8	250 (H)	7	0	39	108	77
Charters Towers	Turbidity	NTU	0.1	5 (A)	13	0	0.1	0.6	0.2
Charters Towers	Uranium	mg/L	0.0004	0.02 (H)	13	0	0.0004	0.0009	0.0005

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Charters Towers	Zinc	mg/L	0.001	3 (A)	13	0	0.001	0.003	0.002
Greenvale	Alkalinity	mg CaCO3/L	5		12	0	144.1	297.4	234.8
Greenvale	Aluminium	mg/L	0.01	0.2 (A)	12	4	0.01	2.02	0.46
Greenvale	Ammonia as N	mg/L as N	0.02	0.5 (A)	12	0	0.02	0.08	0.03
Greenvale	Antimony	mg/L	0.0005	0.003 (H)	12	0	0.0005	0.0005	0.0005
Greenvale	Arsenic	mg/L	0.0005	0.01 (H)	12	0	0.001	0.002	0.002
Greenvale	Barium	mg/L	0.002	2 (H)	12	0	0.039	0.074	0.058
Greenvale	Bicarbonate	mg as CaCO3/L	5		12	0	87.9	198	149.4
Greenvale	Boron	mg/L	0.004	4 (H)	12	0	0.006	0.032	0.021
Greenvale	Bromodichloromethane	µg/L	2		5	0	21	31	28
Greenvale	Bromoform	µg/L	2		5	0	2	2	2
Greenvale	Cadmium	mg/L	0.0004	0.002 (H)	12	0	0.0004	0.0004	0.0004
Greenvale	Calcium	mg/L	0.7		12	0	14.2	30.6	22.9
Greenvale	Carbonate	mg as CaCO3/L	5		12	0	5	5	5
Greenvale	Chloride	mg/L	0.5	250 (A)	12	0	27.4	44.8	33.9
Greenvale	Chlorine, Free	mg/L	0.05	5 (H)	36	0	0.05	1.72	0.85
Greenvale	Chlorodibromomethane	µg/L	2		5	0	3	10	7
Greenvale	Chloroform	µg/L	2		5	0	69	214	112
Greenvale	Chromium	mg/L	0.0003	0.05 (H)	12	0	0.0003	0.002	0.0006
Greenvale	Colour, True	Pt-Co Units	1	15 (A)	12	0	0	4	1.9
Greenvale	Copper	mg/L	0.002	2 (H)	12	0	0.002	0.005	0.002
Greenvale	E. coli	cfu/100mL	1	0 (H)	36	0	0	0	0
Greenvale	Electrical Conductivity	µS/cm	1		12	0	387	662	543
Greenvale	Fluoride	mg/L	0.02	1.5 (H)	12	0	0.044	0.067	0.054

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Greenvale	Hardness	mg $CaCO_3$/L	1		12	0	110	251	186
Greenvale	Heterotrophic Plate Count	cfu/mL	1		36	0	0	300	62.5
Greenvale	Hydroxide	mg/L as $CaCO_3$	5		12	0	5	5	5
Greenvale	Iron	mg/L	0.002	0.3 (A)	12	4	0.006	1.2	0.27
Greenvale	Lead	mg/L	0.0006	0.01 (H)	12	0	0.0006	0.0006	0.0006
Greenvale	Magnesium	mg/L	0.5		12	0	18.1	45.6	32.6
Greenvale	Manganese	mg/L	0.0003	0.5 (H)	12	0	0.002	0.08	0.015
Greenvale	Mercury	mg/L	0.0003	0.001 (H)	12	0	0.0003	0.0004	0.0003
Greenvale	Molybdenum	mg/L	0.0004	0.05 (H)	12	0	0.0006	0.002	0.0009
Greenvale	Nickel	mg/L	0.001	0.02 (H)	12	0	0.001	0.001	0.001
Greenvale	Nitrate as N, Calc	mg/L as N	0.01	50 (H)	12	0	0.02	0.06	0.04
Greenvale	Nitrite as N	mg/L as N	0.01	3 (H)	12	0	0.01	0.01	0.01
Greenvale	Oxidised Nitrogen as NOx-N	mg/L as N	0.01		12	0	0.02	0.06	0.04
Greenvale	pH	pH units		8.5 (A)	36	1	7.55	8.53	8.27
Greenvale	Phosphate as P	mg/L as P	0.01		12	0	0.01	0.06	0.04
Greenvale	Potassium	mg/L	0.5		12	0	3.6	6.9	5.3
Greenvale	Selenium	mg/L	0.001	0.01 (H)	12	0	0.001	0.001	0.001
Greenvale	Silica as SiO2	mg/L	0.1		12	0	17.7	48.5	31.7
Greenvale	Silver	mg/L	0.0004	0.1 (H)	12	0	0.0004	0.001	0.0004
Greenvale	Sodium	mg/L	1.2	180 (A)	12	0	28.7	49.3	38.1
Greenvale	Sulphate	mg/L	0.5	250 (A)	12	0	0.99	5	1.68
Greenvale	Thermotolerant Coliforms	cfu/100mL	1	0 (H)	36	0	0	0	0
Greenvale	Total Coliform	cfu/100mL	1		36	0	0	40	1

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Greenvale	Total Dissolved Solids by EC	mg/L		600 (A)	12	0	248	424	347
Greenvale	Trihalomethanes, Total	µg/L	8	250 (H)	5	0	108	245	147
Greenvale	Turbidity	NTU	0.1	5 (A)	36	12	0.4	34.9	6.2
Greenvale	Uranium	mg/L	0.0004	0.02 (H)	12	0	0.0004	0.001	0.0008
Greenvale	Zinc	mg/L	0.001		12	0	0.001	0.005	0.002
Pentland	Alkalinity	mg CaCO3/L	5		12	0	102.6	120.6	112.6
Pentland	Aluminium	mg/L	0.01	0.2 (A)	12	0	0.01	0.01	0.01
Pentland	Ammonia as N	mg/L as N	0.02	0.5 (A)	12	0	0.02	0.02	0.02
Pentland	Antimony	mg/L	0.0005	0.003 (H)	12	0	0.0005	0.0005	0.0005
Pentland	Arsenic	mg/L	0.0005	0.01 (H)	12	0	0.0005	0.0006	0.0005
Pentland	Barium	mg/L	0.002	2 (H)	12	0	0.013	0.023	0.017
Pentland	Beryllium	mg/L	0.0004	0.06 (H)	1	0	0.0004	0.0004	0.0004
Pentland	Bicarbonate	mg as CaCO3/L	5		12	0	62.6	121	72.6
Pentland	Bismuth	mg/L	0.0006		1	0	0.0006	0.0006	0.0006
Pentland	Boron	mg/L	0.004	4 (H)	12	0	0.004	0.029	0.018
Pentland	Bromodichloromethane	µg/L	2		5	0	2	2	2
Pentland	Bromoform	µg/L	2		5	0	2	2	2
Pentland	Cadmium	mg/L	0.0004	0.002 (H)	12	0	0.0004	0.0004	0.0004
Pentland	Calcium	mg/L	0.7		12	0	17	25.1	21.5
Pentland	Carbonate	mg as CaCO3/L	5		12	0	5	5	5
Pentland	Chloride	mg/L	0.5	250 (A)	12	0	14.4	18.2	15.3
Pentland	Chlorine, Free	mg/L	0.05	5 (H)	36	0	0.8	2.17	1.33
Pentland	Chlorodibromomethane	µg/L	2		5	0	2	2	2

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Pentland	Chloroform	µg/L	2		5	0	2	2	2
Pentland	Chromium	mg/L	0.0003	0.05 (H)	12	0	0.0003	0.0007	0.0005
Pentland	Cobalt	mg/L	0.0003		1	0	0.0003	0.0003	0.0003
Pentland	Colour, True	Pt-Co Units	1	15 (A)	12	0	0	1	0.08
Pentland	Copper	mg/L	0.002	2 (H)	12	0	0.002	0.008	0.004
Pentland	E. coli	cfu/100mL	1	0 (H)	36	0	0	0	0
Pentland	Electrical Conductivity	µS/cm	1		12	0	258	295	281
Pentland	Fluoride	mg/L	0.02	1.5 (H)	12	0	0.26	0.3	0.27
Pentland	Geosmin*	ng/L	2		1	0	5	5	5
Pentland	Hardness	mg CaCO3/L	1		12	0	66.9	98.6	83.4
Pentland	Heterotrophic Plate Count	cfu/ml	1		27	0	0	3	0
Pentland	Hydroxide	mg/L as CaCO3	5		12	0	5	5	5
Pentland	Iron	mg/L	0.002	0.3 (A)	12	0	0.002	0.003	0.002
Pentland	Lead	mg/L	0.0006	0.01 (H)	12	0	0.0006	0.0006	0.0006
Pentland	Lithium	mg/L	0.0004		1	0	0.0007	0.0007	0.0007
Pentland	Magnesium	mg/L	0.5		12	0	6.1	9.7	7.8
Pentland	Manganese	mg/L	0.0003	0.5 (H)	12	0	0.0003	0.0004	0.0003
Pentland	Mercury	mg/L	0.0003	0.001 (H)	12	0	0.0003	0.0003	0.0003
Pentland	Methyl Isoborneol*	ng/L	2		1	0	5	5	5
Pentland	Molybdenum	mg/L	0.0004	0.05 (H)	12	0	0.0006	0.001	0.0008
Pentland	Nickel	mg/L	0.001	0.02 (H)	12	0	0.001	0.001	0.001
Pentland	Nitrate as N, Calc	mg/L as N	0.01	50 (H)	12	0	0.06	0.12	0.09
Pentland	Nitrite as N	mg/L as N	0.01	3 (H)	12	0	0.01	0.01	0.01
Pentland	Oxidised Nitrogen as NOx-N	mg/L as N	0.01		12	0	0.06	0.12	0.09

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Pentland	pH	pH units		8.5 (A)	36	0	6.97	7.91	7.29
Pentland	Phosphate as P	mg/L as P	0.01		12	0	0.08	0.13	0.08
Pentland	Potassium	mg/L	0.5		12	0	1.7	2.7	2.2
Pentland	Residual alkali*	index	0.1		12	0	0.1	0.6	0.1
Pentland	Rubidium	mg/L	0.0005		1	0	0.0005	0.0005	0.0005
Pentland	Selenium	mg/L	0.001	0.01 (H)	12	0	0.001	0.001	0.001
Pentland	Silica as SiO2	mg/L	0.1		12	0	36.5	55.2	50.3
Pentland	Silver	mg/L	0.0004	0.1 (H)	12	0	0.0004	0.003	0.0006
Pentland	Sodium	mg/L	1.2	180 (A)	12	0	18.2	25.8	22
Pentland	Strontium	mg/L	0.003		1	0	0.199	0.199	0.199
Pentland	Sulphate	mg/L	0.5	250 (A)	12	0	6	7.9	7
Pentland	Thallium	mg/L	0.0004		1	0	0.0004	0.0004	0.0004
Pentland	Thermotolerant Coliforms	cfu/100mL	1	0 (H)	27	0	0	0	0
Pentland	Tin	mg/L	0.0004		1	0	0.0004	0.0004	0.0004
Pentland	Titanium	mg/L	0.001		1	0	0.001	0.001	0.001
Pentland	Total Coliform	cfu/100mL	1		28	0	0	2	0
Pentland	Total Dissolved Solids by EC	mg/L		600 (A)	12	0	165	189	179
Pentland	Trihalomethanes, Total	µg/L	8	250 (H)	5	0	8	8	8
Pentland	Turbidity	NTU	0.1	5 (A)	12	0	0.1	0.3	0.16
Pentland	Uranium	mg/L	0.0004	0.02 (H)	12	0	0.0004	0.0007	0.0005
Pentland	Vanadium	mg/L	0.0006		1	0	0.006	0.006	0.006
Pentland	Zinc	mg/L	0.001	3 (A)	12	0	0.004	0.012	0.007
Ravenswood	Alkalinity	mg CaCO3/L	5		12	0	43.4	94.32	65.1
Ravenswood	Aluminium	mg/L	0.01	0.2 (A)	12	7	0.111	1.05	0.48
Ravenswood	Ammonia as N	mg/L as N	0.02	0.5 (A)	12	0	0.02	0.04	0.02

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Ravenswood	Antimony	mg/L	0.0005	0.003 (H)	12	0	0.0005	0.0005	0.0005
Ravenswood	Arsenic	mg/L	0.0005	0.01 (H)	12	0	0.0007	0.002	0.001
Ravenswood	Barium	mg/L	0.002	2 (H)	12	0	0.023	0.074	0.034
Ravenswood	Bicarbonate	mg as CaCO3/L	5		12	0	26.5	57.5	39.7
Ravenswood	Boron	mg/L	0.004	4 (H)	12	0	0.01	0.035	0.025
Ravenswood	Bromodichloromethane	µg/L	2		10	0	14	26	19
Ravenswood	Bromoform	µg/L	2		10	0	2	2	2
Ravenswood	Cadmium	mg/L	0.0004	0.002 (H)	12	0	0.0004	0.0004	0.0004
Ravenswood	Calcium	mg/L	0.7		12	0	11.3	21.1	16.8
Ravenswood	Carbonate	mg as CaCO3/L	5		12	0	5	5	5
Ravenswood	Chloride	mg/L	0.5	250 (A)	12	0	25.6	41.2	30.3
Ravenswood	Chlorine, Free	mg/L	0.05	5 (H)	36	0	0.05	2.75	1.51
Ravenswood	Chlorodibromomethane	µg/L	2		10	0	6	11	8
Ravenswood	Chloroform	µg/L	2		10	0	20	68	33.1
Ravenswood	Chromium	mg/L	0.0003	0.05 (H)	12	0	0.0003	0.0004	0.0003
Ravenswood	Colour, True	Pt-Co Units	1	15 (A)	12	0	0	6	7
Ravenswood	Copper	mg/L	0.002	2 (H)	12	0	0.002	0.002	0.002
Ravenswood	E. coli	cfu/100mL	1	0 (H)	36	0	0	0	0
Ravenswood	Electrical Conductivity	µS/cm	1		12	0	362	461	395
Ravenswood	Fluoride	mg/L	0.02	1.5 (H)	12	0	0.047	0.12	0.064
Ravenswood	Hardness	mg CaCO3/L	1		12	0	66.9	118.7	98.1
Ravenswood	Heterotrophic Plate Count	cfu/mL	1		35	0	0	300	18
Ravenswood	Hydroxide	mg/L as CaCO3	5		12	0	5	5	5
Ravenswood	Iron	mg/L	0.002	0.3 (A)	12	0	0.009	0.097	0.021

Scheme	Parameter	Units	Limit of Reporting	ADWG Guideline Value (A-Aesthetic; H- Health)	Count	Exceeded	Min	Max	Avg
Ravenswood	Lead	mg/L	0.0006	0.01 (H)	12	0	0.0006	0.0006	0.0006
Ravenswood	Magnesium	mg/L	0.5		12	0	9.7	16.5	13.9
Ravenswood	Manganese	mg/L	0.0003	0.5 (H)	12	0	0.0006	0.02	0.004
Ravenswood	Mercury	mg/L	0.0003	0.001 (H)	12	0	0.0003	0.0005	0.0003
Ravenswood	Molybdenum	mg/L	0.0004	0.05 (H)	12	0	0.002	0.003	0.002
Ravenswood	Nickel	mg/L	0.001	0.02 (H)	12	0	0.001	0.001	0.001
Ravenswood	Nitrate as N, Calc	mg/L as N	0.01	50 (H)	12	0	0.01	0.12	0.03
Ravenswood	Nitrite as N	mg/L as N	0.01	3 (H)	12	0	0.01	0.01	0.01
Ravenswood	Oxidised Nitrogen as NOx-N	mg/L as N	0.01		12	0	0.01	0.12	0.03
Ravenswood	pH	pH units		8.5 (A)	36	0	6.83	7.52	7.17
Ravenswood	Phosphate as P	mg/L as P	0.01		12	0	0.01	0.03	0.01
Ravenswood	Potassium	mg/L	0.5		12	0	2.2	3.8	3.2
Ravenswood	Selenium	mg/L	0.001	0.01 (H)	12	0	0.001	0.001	0.001
Ravenswood	Silica as SiO2	mg/L	0.1		12	0	5.6	10.9	8.9
Ravenswood	Silver	mg/L	0.0004	0.1 (H)	12	0	0.0004	0.002	0.0005
Ravenswood	Sodium	mg/L	1.2	180 (A)	12	0	19.7	40	30.7
Ravenswood	Sulphate	mg/L	0.5	250 (A)	12	0	52.6	85.1	73.1
Ravenswood	Thermotolerant Coliforms	cfu/100mL	1	0 (H)	33	1	0	1	0
Ravenswood	Total Coliform	cfu/100mL	1		35	0	0	1	0
Ravenswood	Total Dissolved Solids by EC	mg/L		600 (A)	12	0	232	295	253
Ravenswood	Trihalomethanes, Total	µg/L	8	250 (H)	11	0	41	101	60
Ravenswood	Turbidity	NTU	0.1		36	0	0.3	3.1	1.1
Ravenswood	Uranium	mg/L	0.0004	0.02 (H)	12	0	0.0004	0.0004	0.0004

Appendix B - Risk Management Improvement Program

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Charters Towers	Very High	Replace the concrete reservoir as it is not in good condition.	Monitor roof condition, Seal off points of entry.	Reservoir and rising main project is currently in the design phase - this will result in the decommissioning of the concrete reservoir.	2025	Planning Stage. This will be a very difficult job as the reservoir dates from 1890 and has leaks and internal walls.
Charters Towers	Very High	Investigate options to create a larger roofed treated water storage.	Monitor for evidence of possums or birds gathering above the tank.	The WIUP has made available the Mod 2 clarifier tank. Previous consideration of turning it into a treated water storage has now been developed into a requirement, as the existing CWT has developed serious leakage around its base.	2022	24/11/22 In progress. Investigations complete. RFT issued. Module 2 to be converted to a covered Clear Water Tank. Expect construction early 2023, completion by EOFY.
Charters Towers	High	Conduct Health Based Targets assessment of the raw water and treatment to determine if UV treatment is warranted.	Increase sampling of raw water for E.coli as an indicator for crypto to form baseline data for the study.	Conduct a health based targets assessment of the raw water.	2023	To be commenced early 2023.
Charters Towers	High	Dedicated inlet and outlet mains at the reservoir to ensure adequate turnover.	Utilise re-chlorination system to maintain residual in the reservoirs.	This forms part of the rising main and reservoir replacement project.	2025	Rechlorination system is in place. Duplication of trunk main and reconfiguration of reservoir to be completed as stages of upgrade. Still in Planning stage with Consultancy.

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Charters Towers	High	Periodic check of chemical purity through supplier.		Implement QA process by sending samples to the lab.	2021	Not started. To be arranged by Tech Officer W&WW Treatment Early 2023.
Charters Towers	Moderate	Minor upgrades to ensure the old module can still run without compromising water quality.		The closeout of WIUP will deliver a range of minor upgrades to allow Mod 1 to continue to operate with the new plant.	30-Jun-21	Module 1 still functional. Test runs performed October 2022.
Greenvale	Very High	Document and label pipework. Document processes. Establish control over changes to infrastructure configuration.	Work performed at Greenvale is under review in light of future upgrades.	On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On hold.
Greenvale	Very High	Full Health Based Target Assessment required to determine suitable level of treatment required for crypto/giardia.		It is expected that this work will form part of the baseline for possible defence upgrades of the water system at Greenvale.	2023	On hold.
Greenvale	Very High	Investigation of full water treatment system.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	With consultants.

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Greenvale	High	Review hypo stock management, holding times, consider possibility of moving to gas chlorination. Consider carrying out a Chlorates investigation to form a baseline if an ADWG limit is brought in.	Hypo management protocols to be developed.	High Chlorate level (1.6mg/L) detected in treated water. Investigate short-term use of 70kg Gas Cylinders for disinfection.	2023	Researching potential suppliers of transportable dosing systems. Will need Capital funding.
Greenvale	High	Reservoir roof improvement program to ensure they are sealed against vermin and runoff		Complete review of all reservoirs is to be conducted (currently resource constrained).	2023	On Hold.
Greenvale	High	Improve asset mapping capability to reduce the risk of cross connections.		Corporate system is moving towards asset mapping.	2023	On Hold.
Greenvale	High	Long term plan for Greenvale water treatment will need to include redundancy of dosing systems.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On Hold.
Greenvale	High	Consider having a generator for chlorine dosing system to maintain the residual in the reservoir.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On Hold.

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Greenvale	High	Consider changing to chlorine gas so that longer lasting stock can be held without deterioration.		To be replaced by gaseous system as part of new WTP.	2023	Investigating options for short-term, to operate until new treatment system is installed.
Greenvale	High	Dual chlorine analysers would be beneficial due to the remote location.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On Hold.
Greenvale	Moderate	Consider installation of a chlorine analyser for the raw water arriving at the reservoir installed so that it can become a backup analyser for the treated water if needed.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On Hold.
Greenvale	Low	Perform analysis on pH, iron and manganese at the river pump station to determine if the dosing is effective.		On hold until Defence requirements in Greenvale are finalised as the water system will be upgraded.	2023	On Hold.
Pentland	Very High	Document treatment process, identify failure modes, label equipment and pipework. Implement a maintenance authorisation system.		Conduct complete review of infrastructure and procedures.	2023	Not Started.
Pentland	Very High	Clean tanks at the pump station and replace/rectify rooves.		Pentland tank review program.	2023	To be completed FY 22-23, in conjunction with water main duplication.

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Pentland	High	Disconnect Meatworks tanks from the system.		Reticulation task.	2021	To be completed FY 23-24.
Pentland	High	Consider installation of Duty/Standby dosing systems.		Conduct complete review of infrastructure and procedures.	2022	To be completed FY 23-24.
Pentland	High	Formal system to manage chlorine stocks for Pentland.		Operators to establish management system.	2023	In progress.
Pentland	Moderate	Regular flushing program for Pentland Reticulation.		Reticulation to establish flushing program for townships.	2023	Not started.
Ravenswood	Very High	Produce updated drawings of the water and sewerage systems.		Reticulation task to confirm main locations.	2023	To be completed under new agreement with Ravenswood Gold
Ravenswood	Very High	Consider plant upgrade to address shortfalls.		Ravenswood Gold is considering moving the water treatment plant as part of a mine expansion. Requirements for the new plant will address these deficiencies.	2023	In progress. Relocated WTP design proceeding.
Ravenswood	High	Improvement in the management and oversight of the WTP processes.	Transfer of infrastructure has been negotiated. Agreement on a water supply contract proceeding.	Ravenswood Gold is considering moving the water treatment plant as part of a mine expansion. Requirements for the new plant will address deficiencies in current systems.	2023	In progress. CTRC to request involvement in planning and design of the new WTP.

Scheme	Risk	Action Requirement	Interim Action	Long Term Plan	Target Date for Long Term Action	Actions to Date
Ravenswood	High	Consider changing to gas chlorination in order to avoid long holding times for hypo		To be addressed in the design of the relocated WTP	2023	Ravenswood Gold has advised that the Sodium Hypochlorite storage system will be air conditioned to minimise formation of decay products Issues for agreement include potential Stamp Duty ~ $1M, and risk management.
Ravenswood	High	Consider addition of a second chlorine analyser		To be addressed in the design of the relocated WTP	2023	Not started. To be discussed as part of relocation of WTP
All Schemes	High	Training for maintenance staff in water quality when dealing with water main breaks		Provide training opportunities Update SOP's for Reticulation	2022	Consultant has been engaged to review and update Reticulation Team SOP's