VULCAN MINE

Management Plan
Water Quality Risk Management

Contents

1. PURPOSE

This document describes a risk management plan for Vulcan Mine potable water, its manufacture, supply and management to minimise risks of exposure to associated health hazards so as to help ensure a process for zero harm to the community and the environment as well as to reduce business liabilities.

The primary purpose of the Water Quality Risk Management Plan (WQRMP) is to describe processes that facilitate the provision of quality drinking water as per Australian health requirements. The processes allow the operations of the company to help meet the health obligations such as those prescribed by the Queensland Coal Mining Safety and Health Act 1999 and the Coal Mining Safety and Health Regulation 2017. That is, the risk management processes are designed to help control "manufactured" waters such as potable water quality to better ensure employees, contractors and third parties as well as the environment do not suffer adverse or harmful effects from correct use of or contact with manufactured and supplied waters.

This document serves to provide a key reference for persons responsible for drinking water quality and its management. Being the central point of reference, it provides clear sets of guidelines and processes that help enable fit for purpose applications of water, such as raw water sources for potable water manufacture and provision of potable water as well as the "direct" use of raw waters, particularly for dust suppression applications.

References such as Australian Drinking Water Guidelines, recycled water guidelines and are utilised to help guide some of the processes. The monitoring, documentation and reporting processes are designed to help facilitate a demonstrated confidence that is robust and able to meet challenges as well as and obligations.

The scope of this WQRMP may in the future expand to include other manufactured waters such as treated wastewaters (e.g. sewage and industrial waters), recycled waters and cooling system waters.

2. DEFINITIONS

Shall and Should	The word "shall" is to be understood as mandatory and the word "should" as non-mandatory, advisory or recommended.
Bore Water	The water supply to the drinking water plant that is yet to be treated and made suitable for human consumption. This does not include, recycled water, effluents and other uncontrolled waters. Bore water is also primarily used as process water (fire water & house down water) without treatment.
Mine Water	The water that is "captured" on site as runoff and or water managed for mine operational purposes that is otherwise considered "contaminated" and not suitable for supply for production of drinking water.
Raw Water	The water that is delivered to site by pipeline and intermittent surface storage dams validated as a supply for production of drinking water.
Potable Water	Water that is suitable for human consumption, food preparation, utensil washing, and oral hygiene includes drinking water that has been manufactured to the ADWG standards.
Non Potable Water	All water that is not deemed to be potable water e.g. Bore waters, Raw Water, Process Waters.
Responsible Person (Supervisor)	Person responsible for the supervision of the monitoring the supply of raw water coming to site, operation / maintenance and sampling of the site water treatment plant and reticulation systems.
Water Treatment Plant Operator	An employee or contractor engaged by Vulcan Coal to oversee the day to day operations of the Water Treatment Plant, Raw Water supply dam levels and the collection of Water Samples. These persons must have nationally recognised Certificate III qualifications in potable water treatment.

Testing Laboratory	An external contracted laboratory where all water samples are sent and results collated and returned to the Vulcan Coal site responsible person. The laboratory must wherever possible have recognised quality assurances systems (e.g. NATA, ISO17023 etc) and utilise fit-for-purpose methodologies. These methodologies must be fully disclosed.
Water Quality Event	An event where the test results from a water sample are not within the parameters of the relevant guideline listed in the Appendices causing the activation of the prescribed Trigger Action Response Plan (TARP).
ADWG	Australian Drinking Water Guidelines
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
COC	Chain of Custody
RSHQ	Resources Health and Safety Queensland
DESI	Department of Environment, Science and Innovation
EPA	Environmental Protection Act
FB	Field Blank – sample of distilled/deionised water
FB1	Field Blank
FB2	Field Blank water sample collection bottle
HPC	Heterotrophic Plate Count
HSE	Health Safety and Environment
NH&MRC	National Health & Medical Research Council
NTU	Nephelometric Turbidity Units
OEM	Original Equipment Manufacturer
OHS&E	Occupational Health Safety and Environment
PAC	Powdered Activated Carbon
QA	Quality Assurance
QC Samples	Quality Control Samples
RO	Reverse Osmosis
SOP	Standard Operating Procedure
SWI	Standard Work Instruction
TARP	Trigger Action Response Plan
TOC	Total Organic Carbon
TB	Test Blank – sample of distilled / deionised water
TBA	To be announced
THM	Trihalomethane
UF	Ultra-Filtration
UV	Ultraviolet
WH&SA	Workplace Health & Safety Act
WRC	Water and Rivers Commission
WQRMP	Water Quality Risk Management Plan

3. SCOPE

The current scope of the WQRMP and associated procedures apply to the management and direct use of raw water sources as well as for its use for the manufacture and supply of "compliant" quality potable water. The WQRMP is intended to cover monitoring of general water quality chemistry, water biology, sampling, sample dispatch, field measurements, laboratory testing, laboratory reporting, result interpretation, documentation control, response times, measured and controlled responses (Trigger Action Response Plans TARPs), reporting, training requirements, technical support and consultancy. In addition, the WQRMP also serves to define a chain of command for management and responses applicable to both raw water and to drinking water manufacture and supply.

The chain of command is illustrated in Appendix – Chain of Command Flow Chart

The WQRMP's scope does not extend to technical requirements by the original equipment manufacturer (OEM) of the water plant operational requirements and procedures, other than for general water monitoring values that can lead to health implications. The WQRMP allows for documented improvements and updates as required through controlled documentation processes nominated by site.

The current scope of the WQRMP does not currently include the waters listed below as these are addressed within environmental management plans and processes.

- Coal contaminated waters
- Sewage treatment
- Stormwater runoff
- Mine Affected water from Mining Infrastructure area and ROM

4. WQRMP PRINCIPLES

The principal function of the water treatment and the supply of potable water at Vulcan Mine is to ensure quality water that is compliant with current legislation, together with NH&MRC guidelines (i.e. the Australian Drinking Water Guidelines- ADWG) for community health at this mine site.

Although the treatment facility at Vulcan Mine serves a population of less than 5,000 and is thus a small water supplier, the obligations and liabilities remain for community health as well as for business. That is, the manufactured and or supplied waters must not cause harm if used correctly and as intended. Furthermore, the manufacturer and / or supplier must demonstrate a required level of due diligence in the risk management processes designed to help ensure the recognised water quality for each application.

A successful WQRMP requires the active participation by all Vulcan Mine employees and contractors who have a responsibility for the:

1. control and or use of raw water;
2. manufacture and supply of potable water;
3. monitoring of water quality; and
4. documented confidence through sustained robust risk management systems.

The functionality of the Vulcan Mine water team requires a management framework (illustrated below) that includes a recognised chain of command (Appendix 10.1) and Trigger Action Response Plans (TARPs) (Appendix 0-10.5) to provide the basis of measured and controlled responses. The water team is comprised of:

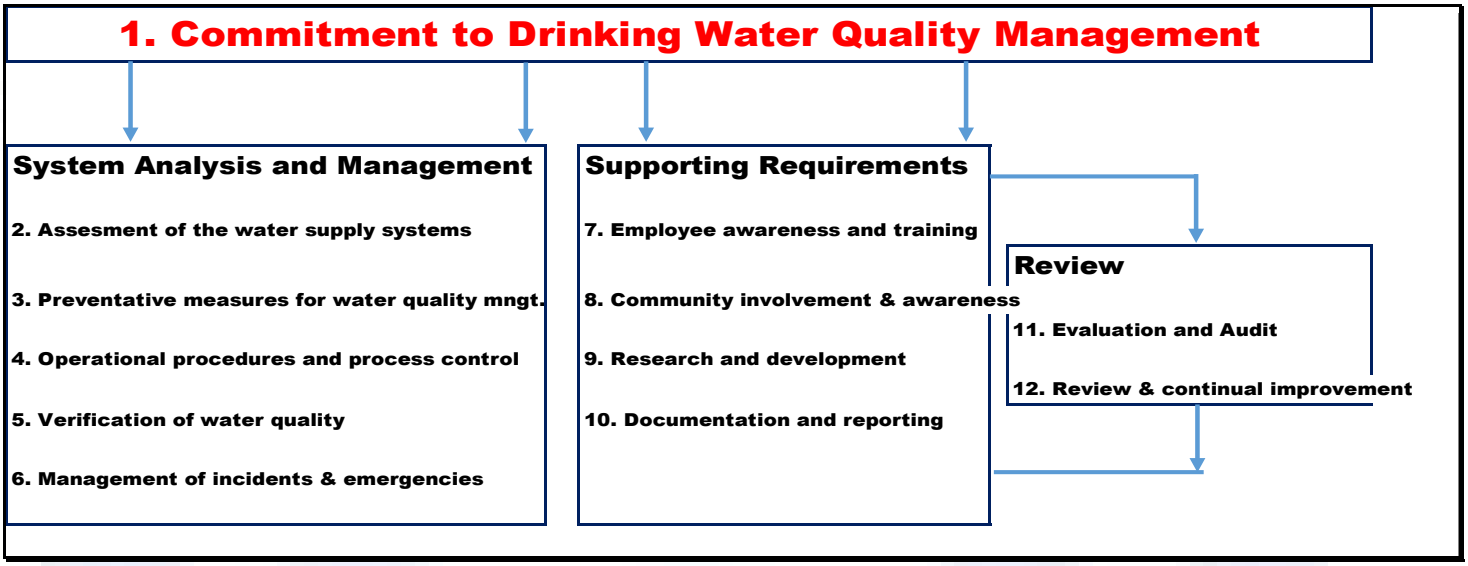
- site services system operators – Vitrinite Mine Services Operators
- senior management, including a nominated responsible person for water – HST Manager
- qualified third-party content expert to help drive a collective understanding – Dr Julian Catmull.
- a third-party water quality monitoring technician to collect water on a monthly basis to ensure compliance with water quality standards.

A key component to cost efficient production is to help ensure community health through safe water. It is the responsibility of the Vulcan Mine water team to be dedicated and provide consumers with QA/QC systems for quality water.

4.1 Water Quality Management Risk Management Framework

The Vulcan Coal WQRMP recognises the ADWG framework, and the commitment required to drive robust systems for continuity of high quality water supply throughout the site. This being applicable to the use of both raw water and drinking waters.

Table 1: The ADWG 12 elements of water quality risk management for quality drinking water.



4.2 Risk Management Framework Strategy

The risk management strategy adopted here for both raw water use and drinking water follows the general recommendations from the NH&MRC Australian Drinking Water Guidelines (ADWG):

- Carry out regular (daily) sanitary inspections of the water supply (to check for any direct or potential sources of contamination of the water supply such as uncontrolled runoff, drainage, drowned wildlife, Blue-Green Algae and serviceable bore caps.
- Use the guideline values, particularly the pH, free chlorine, physical chemistry, turbidity, microbiological values, as a guide for continuous improvement.
- Appoint a Responsible Person(s) to manage the records, entries into the database and responses (Trigger Action Response Plans - TARPs).
- Ensure monitoring schedules are maintained to provide documented evidence to support the required high levels of confidence in manufactured drinking water quality and associated supply (delivery) of this water quality.
- Engage third-party expertise where necessary to ensure an "arms-length" policy and eliminate potential conflicts of interest such as collection, dispatch and field analysis of water supply samples for laboratory analysis.
- All water treatment plant equipment and the general plant shall be maintained in good condition and as per OEM;
- Disinfection processes such as chlorine dosing and UV treatment is inspected regularly, and a thorough maintenance routine is in place.
- Ordering of chemicals and disinfectants for drinking Water Treatment Plants (WTPs) shall ensure these are potable grade as well as consider manufacture date, shelf life and safe storage / handling, e.g. typical shelf life of hypochlorite is 4-8 weeks.
- Ordering of filter media activated carbon and membranes are fit for purpose. That is, able to meet the water demands of site, with suitable loading capacity and flux capacity whether for the manufacture of drinking water or for general filtration of raw waters.

- Staff and or contractors responsible for the daily operations of water plants, particularly drinking water plants should have nationally recognised certificates (Cert III NWP30219 or recognised equivalent) of competency in water industry plant operations and treatment.
- Ensure all OHS&E requirements are adhered to and continually improved to ensure the safety and wellbeing of employees, the community and the environment.

5. Water: A General System Description

5.1 Source Water

The Vulcan Mine Water Management Plan describes the management of water including water sourced via the Bingegang pipeline from the McKenzie River.

5.2 Potable General System Descriptions:

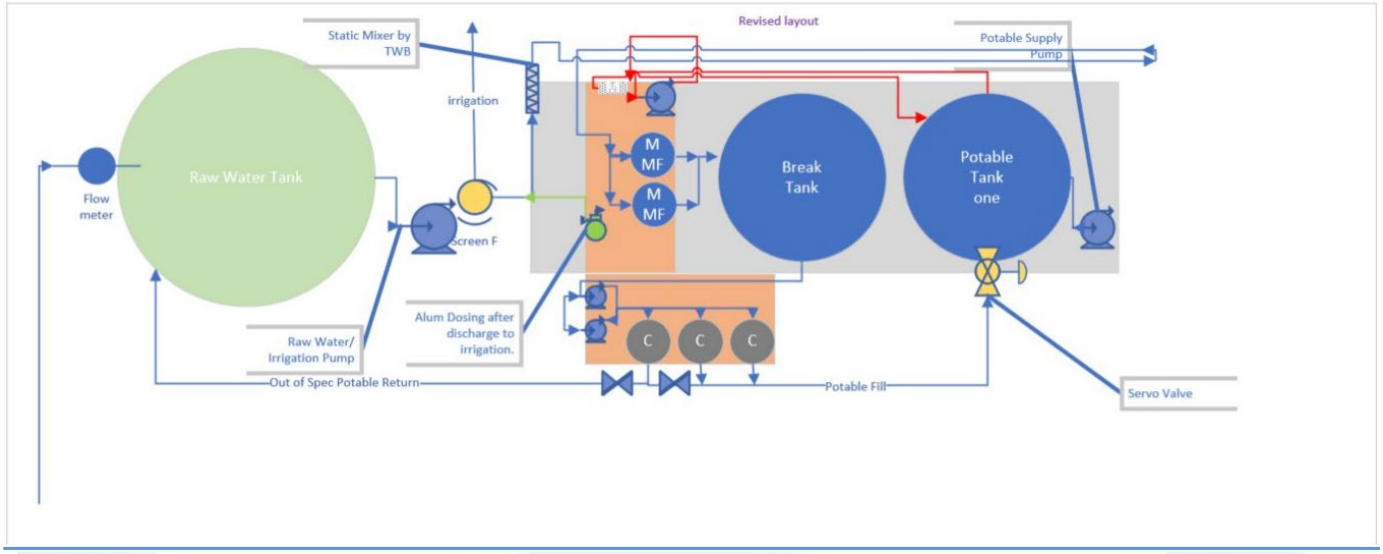
The Vulcan Mine Operations: The following is a general description of the water treatment plant.

The Drinking Water Treatment Plant and general functionality:

The initial water plant was purchased new from Continental Water and is housed in a purpose-built treatment plant room. The plant had been operated by site in accordance with instruction provided by the supplier.

3 x Activated Carbon Filters, and an Ultra-Filtration Unit.

Figure 1 Schematic of water supply and treatment at Vulcan Mine



5.3 Historical Source Water Data:

The historical data illustrates that elements measured here are at acceptable levels designated by health authorities and does require additional treatment interventions such as carbon filtration, and ultra filtration.

Furthermore, the conductivity (a measure of salinity) is below the stated maximum of 1000µS/cm.

For comparison the following figures conductivities are noted:

a) Potable water typically ranges from 200 – 1000 µS/cm

b) Livestock water contaminant levels can range from 3500 – 13000 µS/cm (ANZECC Guidelines);

c) Pool water is typically 6000 µS/cm; and

d) Seawater is typically 35000 µS/cm

Table 4: Vulcan Coal Raw Water (Bingegang) – Water Quality [1] Total Anion Cation Results

Parameter	Units	Raw Supply		Cations	Units	Raw Supply
pH	pH units	7.88		Calcium	mg/L	20
Conductivity	µS/cm	272		Magnesium	mg/L	8
Colour	Pt/Co	n/a		Sodium	mg/L	22
Turbidity	NTU	n/a		Potassium	mg/L	6
Silica	mg/L	9.57		Ammonium	mg/L	
Alkalinity	mg/L (as $CaCO_3$)	102		Iron	mg/L	1.52
Bicarbonate	mg/L (as $CaCO_3$)	102		Manganese	mg/L	0.194
Hardness (calc)	mg/L (as $CaCO_3$)			Copper	mg/L	<0.001
Total Dissolved Solids	mg/L			Zinc	mg/L	<0.005
Fluoride	mg/L			Aluminium	mg/L	<0.01
Chloride	mg/L	23		Strontium	mg/L	0.231
Sulphate	mg/L	<1		Barium	mg/L	0.069
Nitrate	mg/L	<0.01		Cadmium	mg/L	<0.0001
Phosphate as P	mg/L	<0.01		Arsenic	mg/L	<0.001
				Lead	mg/L	<0.001
				Chromium	mg/L	<0.001

This data was obtained from samples collected on 27/07/2021

5.4 Potable Outlet Filter Maintenance Requirements

These filters are to be considered as "barriers of last resort." The following maintenance should be implemented as a minimum requirement.

- Maximum 2-monthly filter cartridge change for in-line filters
- Maximum 3-monthly filter cartridge change for in-line water coolers and/or chillers
- Crimp tags or other authorised labelling methods are to be used to note the filter change dates in months.
- The maintenance of these filters includes solid coloured non-transparent housing and isolation valves.
- Recommended high performance 1–5-micron bacteriostatic carbon cartridges for all outside filters and carbon cartridges for appropriate chiller units.
- Carbon filters serve as both particle filters (down to 1 micron) as well as removing organics (e.g. humic acids, geosmin odours) and some ions.

5.5 Key Monitoring Limits

The potable water chemistry parameters should be maintained within ADWG limits as listed below. Note the ADWG limits are based upon chronic levels, and a short-term deviation in particular elements may not produce any ill health effects, but should still be addressed as per TARP.

Note that chlorine will often be high at the main storage point after dosing to allow for residual disinfection when distributed throughout the reticulation system.

A sudden change in quality may indicate contamination of the potable water system and so checks need to be performed rapidly to confirm this is not the case. These tests would include pH, chlorine, turbidity and conductivity testing at key distribution sample points and also the WTP. These parameters allow site instantaneous results on site and will assist with determining responses and if an external contamination has occurred.

Table 6: Key potable water quality operational minimal and maximums, with targets that will vary depending on conditions and system requirements.

Potable Water	Target	Min	Max	Justification
pH	7.5	6.5	8.0	This pH range is for biocidal efficiency as well as to minimise scaling and corrosion
Conductivity (µS/cm)	100-1000	50	1000	These limits will help to ensure natural mineral levels are not exceeded
Free Chlorine (ppm)	1.5	0.2	5.0[2]	The target level for potable water tanks must consider seasonal influences
Turbidity (NTU)	<1.0	NA	5	Turbidity contaminant makeup is unknown and thus a risk Turbidity consumes chlorine
HPC	<100 cfu/ml	N/A	500 cfu/ml	These are considered important indicators of system operational performance
E.coli and Thermotolerant Coliforms	<1 cfu/100ml	N/A	5 cfu/100ml	These are considered health risk indicators
Total Coliforms	<1 cfu/100ml	N/A	5 cfu/100ml	These are considered important indicators of system operational performance

6.0 MONTORING AND SAMPLING

6.1 General Monitoring Schedule Principals

Monitoring is to be based on the long-recognised principal that it is far more effective to test for a narrow range of key characteristics frequently together with sanitary inspection, than to conduct comprehensive but lengthy analyses less often. The monitoring should be structured to provide frequent "snapshots" of the water quality through the system supply and these include "daily" operational monitoring and "third-party" sampling and analyses.

As per the ADWG, preventative actions are preferred and daily operational observations at the WTP as well as at the water source storage tanks are recommended as a minimum to help identify potential problems:

6.1.1 Daily Monitoring Requirements of Manufactured Waters

1. Daily monitoring of disinfection treatment systems; Chlorine levels, pH, Turbidity, Conductivity and Temperature
   - These being recorded daily to controlled documentation that specifies prescribed levels and functionality
   - These parameters must be recorded at the time of sampling by operators and third parties due to the short holding periods whereby the results would otherwise be invalid
   - Operators must respond daily to any parameters falling or trending outside of prescribed levels
   - Operator daily measurements must be independent of in-line automated parameters and thus allow comparison.

     adhoc monitoring conducted at intervals responsive to environmental conditions that are controlled by the site Water Service Operators

6.1.2 Third-Party Monitoring Principals

1. Water sample collection for microbial and chemical analysis by an accredited third-party eliminates any perceived conflicts of interest with site operations and other stakeholders including laboratories.

   Note: Sample collection and field analysis by certified competent persons (e.g. NWP30219 or 20119 Certificate II or Certificate III) provides quality assurance and significantly reduces business liability risks.

2. Laboratories must ensure quality assurance through having ISO IEC17025 accreditation. The National Association of Testing Authorities (NATA) in Australia governs these accreditations.

   *Note: A NATA accredited method of analysis may **not** be fit for purpose. Laboratories must disclose the origins and reference methods (e.g. Standards) used to derive data listed on their reports.*

6.1.3 Water Quality Health Risk Microbiological Organisms

1. Microbial contamination is recognised as the most significant risk to health (ADWG). Monitoring is conducted monthly for raw water, water coolers, ice machines and reticulation systems.
   a) Drinking water health risk organisms that the ADWG describe as *must not be detected in any 100mls* of drinking water: *Thermotolerant Coliforms*, including *E.coli (please refer to ADWG fact sheets)*
   b) Drinking water system Performance indicator organisms: *Total Coliforms* and *Heterotrophic Plate Count*;
   c) Water aerosol generating plant (vehicle wash and cooling towers); Legionellae and HPC
   d) Blue-Green Algae (Cyanobacteria) are also a microbial risk and require minimum monthly monitoring in raw water as well as treated waters. **Toxins** from these organisms present significant short term and potential long term health risks.

   Note: Key points are listed to 4 schedules, each provides a **snapshot** in time. Together all 4 provide data that generates statistically robust data when as recommended by the ADWG are sustained regular samples analysed over a 6-12 month period.

6.1.4 Water Quality Health Risk Chemistry

Water chemistry typically is conducted on a less frequent basis and is also risk based. For example, some heavy metals may be monitored monthly, where other chemicals such as pesticides, benzene compounds may be monitored quarterly or annually depending on the activities, historical data and level of risk identified in the area and in the water catchment.

6.2 Sampling Frequency

The sampling frequencies are based upon recognised documents such as the ADWG, WRC, ASNZS5667, WQRA#74. The frequency of monitoring and sampling should not be simply based on population size but must also consider the risk factors associated with industrial activities such as mining as well as business risks associated with documented due diligence and compliance. Note the samples points are listed in the Appendix.

Table 1a: Raw Water Sampling Schedule and Monitoring Parameters (these may already be part of Site's Environmental monitoring plan)

Location	Frequency	Characteristic	Responsibility
Source water supply	Quarterly	Standing Water Level	Sun Water
	Quarterly	pH and EC	Sun Water
Raw Water Tank	Weekly at the Water Treatment Plant Event/ Monthly – Remote potable locations	pH, Turbidity, Conductivity, Temperature Microbiological: E.coli and Thermotolerant Coliforms and HPC	Environment Check
	Monthly/Event	Legionellae, Blue Green Algae counts and toxin	Environment Check
	Quarterly then Annual when established history of compliance	Chem Suite 2: Pesticide, TPH, BTEXN (benzene and related compounds),	Environment Check
	Yearly	Chem Suite 1: Major Anions / Cations, Ionic Balance and TOC	Environment Check

Table 5b: WTP and Treated Water, Sampling Schedule and Monitoring Parameters

Description	Frequency	Characteristic	Responsibility
WTP **Feedwater**	Daily at the Water Treatment Plant.	Chlorine, pH, Turbidity, Temperature, Conductivity	Construction
	Monthly at the Water Treatment Plant	Microbiological: E.coli and Thermotolerant Coliforms and HPC	Third Party
	Monthly/Event	Metals A to Z (targeted risk elements for the location)	Third Party
	Quarterly then Annual when established history of compliance	Chem Suite 2: Pesticide, TPH, BTEXN (benzene and related compounds),	Third Party
	Monthly	Chem Suite 1: Major Anions / Cations, Ionic Balance and TOC	Third Party
	Monthly/Event (reservoirs open to the environment with primary contact risks)	Blue Green Algae / Toxins	Third Party
Treated Potable Water **Storages**	Daily at the Water Treatment Plant.	Chlorine, pH, Turbidity, Temperature, Conductivity	Operations
	Monthly at the Water Treatment Plant	Microbiological: E.coli and Thermotolerant Coliforms, total coliforms and HPC	Third Party
	Monthly for first 12 months than quarterly or events	Blue Green Algae / Toxins if required	Third Party
	Monthly for first 12 months than quarterly or events	Chem Suite 1: Major Anions / Cations, ionic balance, TOC; plus Trihalomethanes (THMs)	Third Party
	Biannually	Chem Suite 2: Pesticide, TPH, BTEXN (benzene and related compounds),	Third Party
Treated Water **Distribution System**	Monthly – At selected scheduled key points throughout.	Microbiological: E.coli and Thermotolerant Coliforms, total Coliforms and HPC	Third Party
		Free Residual Chlorine, Total Chlorine pH, Turbidity, Conductivity	Third Party
		Acceptable Taste/Odour	

6.3 Daily Water Monitoring

Daily operator monitoring of the key parameters pH, free chlorine, turbidity and conductivity must be conducted at treated water storage tanks and documented on daily logs. It would also be preferable if this data were entered to electronic formats to allow trending and comparison to any automated plant data.

Note: Water brought in from external sources such as potable water trucks must be subject to the same monitoring parameters to help ensure potable water quality.

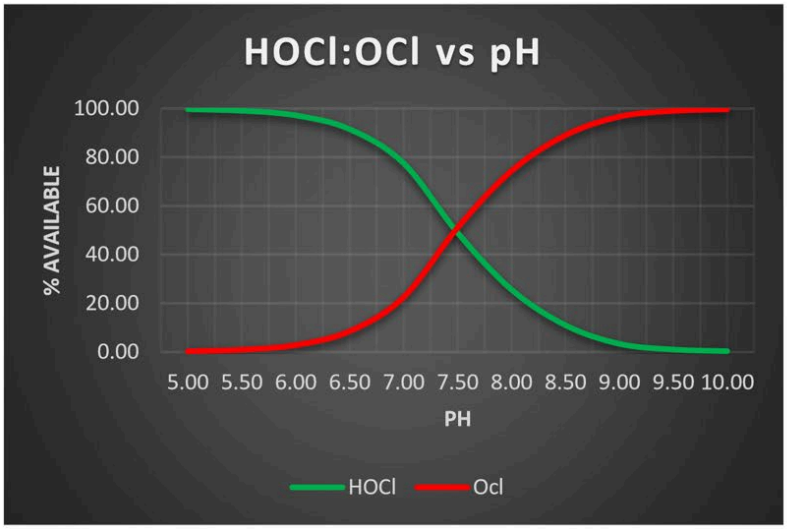
The daily checks shall include the following characteristics (except microbiological) for the following reasons:

6.3.1 Key Physico-Chemical Parameters:

a) **Sanitary Inspections:** The storage dams must be checked for any direct or potential contamination such as from uncontrolled runoff, drainage and drowned wildlife. Inspect lid of storage tanks to ensure lid is not displaced.

b) **pH**: It is essential to ensure optimum pH level is maintained for disinfection and other water treatment processes such as coagulation.

Chlorine disinfection efficiency (HOCl availability) is impaired when pH is above 8.0 and improves significantly between pH7.0 to pH8.0, as illustrated below in Figure 2.



pH	% $HOCl^-$	% OCl^-
5.00	99.71	0.29
5.50	99.09	0.91
6.00	97.18	2.82
6.50	91.50	8.50
7.00	77.53	22.47
7.50	49.00	51.00
8.00	25.65	74.35
8.50	11.00	89.00
9.00	3.34	96.66
9.50	1.00	99.00
10.00	0.34	99.66

Figure 2: Dissociation of chlorine in water at various pH. Note that HOCl is the most important biocide, so the higher the concentration of HOCl, the greater the biocidal effect.

Note: *Low pH(<6.5) and high pH (>8.5) levels will also increase corrosion and scaling potentials of metals, respectively. Hence the optimum of pH7.0-8.0 allows for measures of uncertainty and time for correction.*

c) **Residual Chlorine Disinfectant**: This checks the effectiveness of the disinfection system. When dosing with chlorine a free residual chlorine in the distribution system of 0.6mg/L minimum at the most distant outlets is adequate with pH in the ideal range.

A free chlorine residual of 1.0 - 3.0 mg/L may be required at the point of treatment to ensure adequate residual levels at the outer parameters of the distribution system. There should be a minimum free chlorine residual of 0.6mg/L after 30 minutes treatment.

- Trihalomethanes (THMs) are a disinfection by-product of chlorine reactions with organic residues/chemicals in water. THMs are regarded as tumour forming toxins and levels must be maintained below the ADWG health limits.

  Note: Never use organic acids such as citric acid for pH correction when using chlorine biocides

  Note: If the water has a low turbidity and colour and a disinfectant residual is maintained, authorities can be reasonably confident that most (if not all) pathogenic organisms will have been destroyed after a 30-minute contact period. Some pathogens are more tolerant and require removal by filtration such as Giardia and Cryptosporidium. Nevertheless, chlorination is still regarded as the most appropriate key defence against microbiological contamination.

d) **Electrical Conductivity (EC):** The salinity in terms of EC (µS/cm) needs to be measured to check possible changes in salinity. EC of 100-600µS/cm is typical of most drinking water supplies. Significant changes in salinity of reticulated water supplies is a key indicator of ingress of other source waters or diminished water treatment processes with regards to reverse osmosis.

e) **Turbidity:** Turbidity particles are contaminants, and these will have a "chlorine demand" where by, it may be more difficult to maintain adequate disinfection in a water supply if the turbidity exceeds 5 NTU limit. The preferred level of turbidity is <1NTU. Loss of chlorine through turbidity can have a significant effect on the microbiological quality of the drinking water. Particles in water can also shield microbial organism from biocide disinfectants as well as from UV disinfection.

f) **Temperature:** Elevated temperatures accelerate the breakdown of active chlorine (hypochlorous acid) and generate the loss of chlorine as chlorine gas. Temperatures above 50°C can also affect water treatment functions, including membrane permeate flux.

6.4 Water Chemistry Baseline Monitoring

The analytical parameters have been based on ADWG and include the daily monitoring above and the following proposed parameters being tested monthly:

- Major Anions: Fluoride, Sulphate, chloride, nitrite, nitrate, bromide, phosphate and alkalinity
- Major Cations; Calcium, magnesium, sodium, lead, zinc, cadmium, arsenic, potassium, iron, manganese, copper, zinc, aluminium, and ammonia
- Other metals based on catchment mineralization and industry: As, Al, Cd, Sb, Cr, Cu, Fe, Pb, Hg, Ni, Co, Mo, B
- Other Components if applicable such as cyanide, mercury, pesticides, trihalomethanes and aromatics such as benzene derivatives (BTEXN – explosive residues).

The above analyses will serve to help establish a chemical baseline because a number of components have not been analysed previously or frequently to establish a reliable history.

- *After 1 year of monitoring, monthly analyses could be reduced dependent on baseline data, local events and subject to review each year. This review could be undertaken during the preparation of an annual monitoring report for the Vulcan Coal potable water operation.*

6.4.1 Radionuclide Monitoring

Currently bore waters are not used as a primary water source by Vulcan Coal. However, if bore waters are used these should be tested for radionuclide's every 3 months for 1-2 years. Should the activity concentrations of the gross activities exceed the ADWG, then specific radionuclides should be identified, and their activity concentrations determined. If the gross activities are shown to be within acceptable levels as prescribed by the ADWG, the monitoring of radioactivity may be reconsidered and reduced to yearly or 2 yearly.

6.5 Field Monitoring / Testing Equipment and Sampling

All portable equipment should include detailed instruction and calibration manuals. Items that are generally required for fieldwork include:

(a) field case to house all field instruments and reagents

(b) controlled documentation (calibration logs, chain of custody, field data logs), clipboard, pen and permanent markers

(c) sample jars, frozen ice bricks and esky

(d) stop-watch,

(e) distilled water, disposable gloves and a disinfectant spray bottle.

(f) Safety data sheets

6.6 Monitoring Objectives

Vulcan Mine shall ensure high standards of management of raw water and potable water supply by:

- Ensuring compliant systems, schedules and processes for water management
- Ensuring designated storages, separation of water types and fit for purpose applications
- Ensuring high integrity of sampling collection through certified competent persons
- Ensuring high integrity of plant and field data measurements via certified competent persons
- Ensuring there are no perceived conflicts of interest with manufacture and management of water quality
- Rapid reporting of field and laboratory results to ensure "in-time responses"
- In-time responses are measured, as specified in pre-defined Trigger Action Response Plans
- Establishing a user-friendly data management system that enables trending and ease of assessment for the measured parameters
- Providing the workforce community with assurance of good quality drinking water supplies.

6.7 Pre-Sampling Requirements

Third-party, environmental and system operators must be able to respond quickly and effectively to adverse monitoring outcomes. Pre-sampling requirements should ensure:

- All sampling complies with the standards identified in the relevant Vulcan Mine Environmental and OH&S Management Plans
- Certified competent persons collect samples and conduct field measurements
- Familiarity with the TARPs
- Familiarity with the chain of command
- Chain of Custody forms and documentation that are used are approved and controlled.
- Site equipment is sufficient and fit for purpose.
- The required equipment will monitor / record correctly.
- Appropriate sample containers, eskies, ice bricks

6.8 Sample Quality Controls

Field blanks and sample controls can be used when required. Field blanks check sampling procedures used during sample collection as a possible source of contamination. It is recommended that field blanks be processed at the time of sampling in the field.

For instances where the analyte may not be stable or may be volatile, control spike samples can be provided in conjunction with prescribed preservatives.

Microbial Field Blanks (optional)

A sample of sterile water can be provided by the testing laboratory as the field blank (FB). At a field location, the FB sample is transferred from the FB1 to the empty FB2 container, labelled, preserved, packaged, and transported to the laboratory like the other samples. Field blanks check sampling procedures used during sample collection as a possible source of contamination. It is recommended that field blanks be processed at the time of sampling in the field.

Transportation Blanks (optional)

A Transportation blank provided by testing laboratory helps determine whether a field blank contamination was due to the sampling process.

6.9 Water Sample Containers and Preservation

Specific sample preservation techniques will be employed by the preferred laboratory supplier using the following Australian Standards:

(a) Biological: AS NZS 2031 Selection of containers and preservation of water samples for microbiological analysis

(b) Chemistry: AS5667.1 "Guidance on the Design and Sampling Techniques and the Preservation and Handling of Samples" and AS5667.11 "Guidance on Sampling of Ground waters".

Failure to use approved preservation techniques would ultimately lead to analytical results that are not representative of site conditions.

Once filled, all sample containers will be immediately tightly capped, stored and transported at 1^{O}C to10^{O}C using frozen ice bricks in eskies.

Note: Wet ice must not be used as when this melts the water can potentially contaminate samples as well as present an unknown hazard to couriers.

Preservation details are listed in the appendix

Preservation details should be recorded on the appropriate chain of custody (chain of custody) and the sample identified by functional identification sample ID label with specifics such as date, time, sampler name, site name.

7. Documentation

7.1 Potable Water Systems' Layout

All potable water systems shall comply with the Vulcan Mine requirements for Potable Water Systems "Layout" Procedures and includes the following:

- Potable Water Tanks and Signage
- Potable Piping and Valves e.g. Non-Return Valves / Backflow prevention Valves.
- Water Pumps and Relief Valves
- Water Tank Breather Filters
- Point of use Sediment / Carbon Filters
- Water Fountains / Coolers and Ice Machines
- Showers, Toilets and Urinals
- Kitchenettes

7.2 SWI's - Standard Work Instruction.

General maintenance tasks at the water treatment plants and associated work Instructions are the responsibility of the plant operators and should be incorporated within the WQRMP.

Standard Work Instructions (SWI's) will be developed for all tasks related to collection, field monitoring and dispatch of samples.

- *Vulcan Mine* - Microbiological Water Sample Collection
- *Vulcan Mine* -Water Treatment Plant Daily Checks

7.3 Records

Vulcan Mine shall develop a data base for the recording of sample results. A trend analysis from samples can be extracted as necessary from the Database.

The H&S Coordinator or delegate shall:

- *enter all the information in the data base*
- *review results, to identify trends, every month or in the case of an event*

7.4 Control of Samples and the Documentation

7.4.1 Chain of Custody

- The chain of custody is a legal document that must be completed and correct.
- Completed Chain of custody (COC) shall clearly note sample persons, sampling dates, reporting dates, reporting laboratory, time differentials and controls necessary to help validate the data and procedures.
- A completed chain of custody shall be forwarded with each sample batch sent to the laboratory.
- Copies of the chain of custody shall also be forwarded to the Vulcan Mine Responsible Person

7.4.2 Laboratory Notification and Confirmation of Sample Delivery

- Samples and associated Quality Controlled samples shall be shipped to the laboratory within the specified holding times (i.e. preferably within 24hrs for microbiological samples and <48 hours for most other analytes).
- The testing laboratory shall be notified by email using the Chain of custody to ensure they are prepared to receive the shipment of samples. Samples will be packed in eskies and kept cool with icepacks. Within 24 hours of receipt of the shipment of samples, the laboratory shall confirm receipt via E-mail.
- The copy of the original Chain of custody with sender and recipient confirmations is to be forwarded to the site Responsible Person for filing along with a copy of the corresponding laboratory report.

7.4.3 Information to be forwarded to Responsible Person:

The Vulcan Mine/Contractor monitoring person is to provide the Vulcan Mine Responsible Person with a copy of the following original sheets:

- Daily Parameter Logs
- Completed chains of custody.
- Instrument calibration documentation (Records)

The original documents are to be kept at a designated location by Vulcan Coal Responsible Person for safe keeping as well as accessibility to authorized persons. Documents need to be kept accessible for at least 7 years.

7.4.4 Sample Identification

Each sample container will be clearly labelled, and a sample identification number marked with permanent ink. Assigned to that sample number the following is to be recorded on the appropriate sample collection form:

- Sample Functional Location Number and any comments (if required)
- Sampling date and time.
- Sampler's name

7.4.5 Laboratory Reports

Laboratory reports for drinking water quality shall:

- Be NATA accredited and meet all the accreditations requirements
- List the peer reviewed standards used for the reported results and **not unique laboratory codes** that do not allow direct traceability to the required Australian Standards.
- List the microbiological and chemical findings and compliance requirements
- List on the same report the field measurements for each sample

7.5 Events

Events will be reviewed by the Vulcan Mine Responsible Person for discussion with Vulcan Mine HST Manager and if deemed necessary entered into a managed event database. Other relevant stakeholders notified in accordance with the TARPs and the defined chain of command. A follow up investigation process shall be undertaken to:

a) Identify the potential level of non-compliance
b) Identify if the actions taken were effective and appropriate
c) Make recommendations for improvements and controls to prevent a reoccurrence of the event

7.6 Action to be taken for non-compliances

On receipt of the sample results the Vulcan Mine Responsible Person will review them. If there are results outside the ADWG Parameters, the responsible person will refer to the relevant Trigger Action Response Plans (TARPs) and take the appropriate action.

The TARPS are detailed in the appendices

- **TARP 1 Potable Water** – Test Results of Potentially Toxic Cyanobacteria (Blue - Green Algae)
- **TARP 2 Potable Water** – Test Results for Microbiology (E. coli, Faecal coliforms)
- **TARP 3 Potable Water –** Test Results for Physical and Chemical Parameters.

7.7 Review, Approval and Nature of Changes

This WQRMP shall be reviewed and updated as necessary following an incident or when new information becomes available. Further this document is to be reviewed by the Hygienist or Water Specialist every two years with the Vulcan Coal Water Team. All changes to the WQRMP shall be subject to the Vulcan Coal Change Management Process.

7.8 Laboratory Accreditation

Laboratories where samples are sent must be ISOIEC 17025 NATA Accredited and shall supply copies of their accreditation scope to allow direct reference to the required Australian Standards. These records are to be maintained by the Vulcan Coal Responsible Person.

7.9 Training in Water Industry Operations

All necessary training in water treatment, operations and management shall be conducted by a registered training organisation and nationally accredited in all areas of training they conduct. All trainers shall be approved by the Vulcan Mine Training Department prior to conducting training.

8. ROLES AND RESPONSIBILITIES

8.1 Table 8a: General Role and Responsibility Descriptions

Role	Responsibilities
Vulcan Mine SSE	Monitor / approve the implementation of the Vulcan Coal WQRMP. See below.
Vulcan Mine HST Manager	Provide assistance and review the Vulcan Coal WQRMP. Review the TARPs.
Vulcan Mine Safety and Compliance Advisor	Review data, interpretation and evaluation. Provide assistance and review the Vulcan Coal WQRMP. Review the TARPs. Review communication procedures to ensure a controlled and coordinated response is achieved when necessary. See Appendix - Chain of Command. Ensuring these are reviewed by the Vulcan Coal water team.
Vulcan Mine Construction Manager	Collating all information from samples and databases. Coordination and supervision of the Water Treatment Plants, audits and action plans conducted by external personnel / companies.
Construction Services	Production of drinking water, maintenance of plant, recording plant data and ensuring correct responses as per WQRMP schedules and TARPs for sampling and monitoring of water quality. To conduct the necessary programmed maintenance and to raise Work Orders for all works requiring Maintenance Department input.
Site Infrastructure Services	To maintain the various plants in an operational condition that facilitates safe water and chemical systems through the timely repairs of identified issues and to conduct the necessary Preventative Maintenance on a routine basis.

8.2 Table 8b: Control and Management Roles of Site Managers, superintendents and Supervisors

Role	Responsibilities
Vulcan Managers, Superintendents and Supervisors	1. Implement this plan within their areas of control / responsibility. 2. Ensure that all persons responsible for the supply and/or manufacture of water are fully aware of their responsibilities identified in this plan. 3. Ensure personnel conducting work under this plan, who are within their area of control, are appropriately trained and authorized by site. 4. Audit compliance with the plan. Record any non-compliance and undertake appropriate corrective actions to rectify any deficiencies. 5. To develop appropriate response plans for major operational disruption such as power failure, lightning strike, flooding, equipment failure, etc. 6. Ensure all drawings, P&ID, operating procedures and hazard registers are maintained and reviewed annually. 7. Ensure procedures are reviewed when changes are required as needs permits. 8. Ensure procedures are developed to standardise water system and infrastructure disinfection when biological events occur. This may require working in conjunction with the maintenance department. 9. Ensure all equipment is fit for purpose and is maintained in operating condition 10. Ensure all online monitoring instrumentation is in calibration 11. Ensure good communication processes and regular meetings with stakeholders and water specialists

8.3 Table 8c: *Vulcan Mine Water Management Team* shall ensure high standards of management of raw and potable water:

Role	Responsibilities
Vulcan Mine Water Management Team	1. Ensuring compliant systems, schedules and processes for water management 2. Ensuring designated storages, separation of water types and fit for purpose applications 3. Ensuring high integrity of sampling collection through certified competent persons that are an independent contractor. 4. Ensuring high integrity of plant and field data measurements via certified competent persons 5. Use the guideline values, in particular the pH, free chlorine, physical chemistry, turbidity, microbiological values, as a guide for continuous improvement. 6. Appoint a Vulcan Coal Responsible Person to manage the records, entries into the database and responses (TARPs). 7. Ensure monitoring schedules are maintained so as to provide documented evidence to support high levels of confidence in water quality and associated maintenance of this water quality 8. Carry out regular (daily) sanitary inspections of the water supply (to check for any direct or potential sources of contamination of the water supply such: (a) potable water system - water ingress through defective pipelines and defective storage tanks inspection lids as well as (b) Water storage dams - uncontrolled runoff, drainage, drowned wildlife 9. Ensure plant operator and maintenance staff are appropriately certified and authorised to conduct plant operations and maintenance 10. Rapid reporting of field and laboratory results by qualified third party to ensure "in-time responses" are measured, as specified in pre-defined Trigger Action Response Plans 11. Establishing a user-friendly data management system that enables trending and ease of assessment for the measured parameters 12. Provide a suitable document management system to maintain current procedures, data forms, JSA, etc. 13. Ordering of chemicals and disinfectants for Water Treatment Plants shall consider manufacture date, shelf life and safe storage / handling; e.g. typical shelf life of hypochlorite is 4-6 weeks. 14. To provide the site community with assurance of safe water supplies and systems.

8.4 Table 8d: All site workers, contractors and visitors

All shall comply with this procedure to ensure safety to themselves and to others who may be affected by activities controlled by this procedure.

Role	Responsibilities
Workers, Contractors and Visitors	1. Site personnel represent the consumers of the potable water and therefore are ideally located to identify aesthetic changes in the water supply. 2. All site personnel should be made aware of the procedures of recording aesthetic differences in the potable water, in both verbal (low level observation) and written formats.

8.5 Table 8e: The maintenance department is responsible for the following:

Role	Responsibilities
Construction Department	1. To conduct the repairs identified in Work Orders raised by Operations 2. To conduct the necessary Programmed Maintenance Tasks 3. To ensure maintenance personnel are trained in the operation of the various plants 4. To ensure work instructions and troubleshooting manuals remain up to date to assist with prompt repair 5. To ensure availability of critical spares should a mechanical or electrical failure occur 6. To conduct routine audits of the plants to identify issues and possible improvements. 7. To ensure only compliant materials are used in the potable water reticulation system as per AS/NZS 3500 8. After conducting significant maintenance, ensure potable water tank and/or reticulation systems disinfection is conducted in accordance with ASNZS3500 (appendices H and I) or authorised SWI

9. REFERENCES

- Queensland Coal Mining Safety and Health Act 1999
- Queensland Coal Mining Safety and Health Regulations 2017
- Work Health and Safety Act 2017
- Queensland Workplace Health and Safety Act 2011
- Workplace Health and Safety Regulations 2011
- Queensland Environmental Protection (Water) Policy 2009
- Queensland Environmental Protection Act 1994
- Water Supply (Safety and Reliability) Act 2008 (Queensland) Correct operation of plant
- Water & Rivers Commission (WRC) in their "Guidelines for Drinking Water –Appendix 3"
- Australian Drinking Water Guidelines 2011 (May 2021 Update).
- Workplace Health and Safety Queensland. June 2007. Guide to workplace use of non-potable water including recycled waters
- AS2031.1 – 2012, "Selection of Containers and Preservation of Water Samples for Microbiological Analysis".
- AS/NZS 5667.1-1998, "Water Quality – Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples".
- AS/NZS 5667.5-1998, "Water Quality – Sampling, Part 5: Guidance on sampling of drinking water and water used for food and beverage processing".
- AS 4032.3 – 2004 Water supply- Valves for the control of heated water supply temperatures Part 3. Requirements for field-testing, maintenance or replacement
- AS 2845.3 – 2010 Water supply- Backflow prevention devices Part 3: Field testing and maintenance of testable devices
- AS/NZS 3500 Plumbing and Drainage. Part 1: Water Services
- AS/NZS 4360:2004 Risk Management
- ISO 5667-14 – 1998, "Water Quality – Sampling, Part 14: Guidance on quality assurance of environmental water sampling and handling".
- American Society for Testing & Materials:
- ASTM D5612-94, "Standard Guide for Quality Planning and Field Implementation of a Water Quality Measurement Program".
- World Health Organisation 1996 "Guidelines for drinking-water quality" Second Edition:
- Volume 1 – Recommendations.
- Volume 2 – Health criteria and other supporting information.
- Volume 3 – Surveillance and control of community supplies, Geneva, 1996

10. DOCUMENT CONTROL

Version	Date	Description	Document Controller
01	26/06/2024	Initial Draft	Allira Spencer
02			
03			

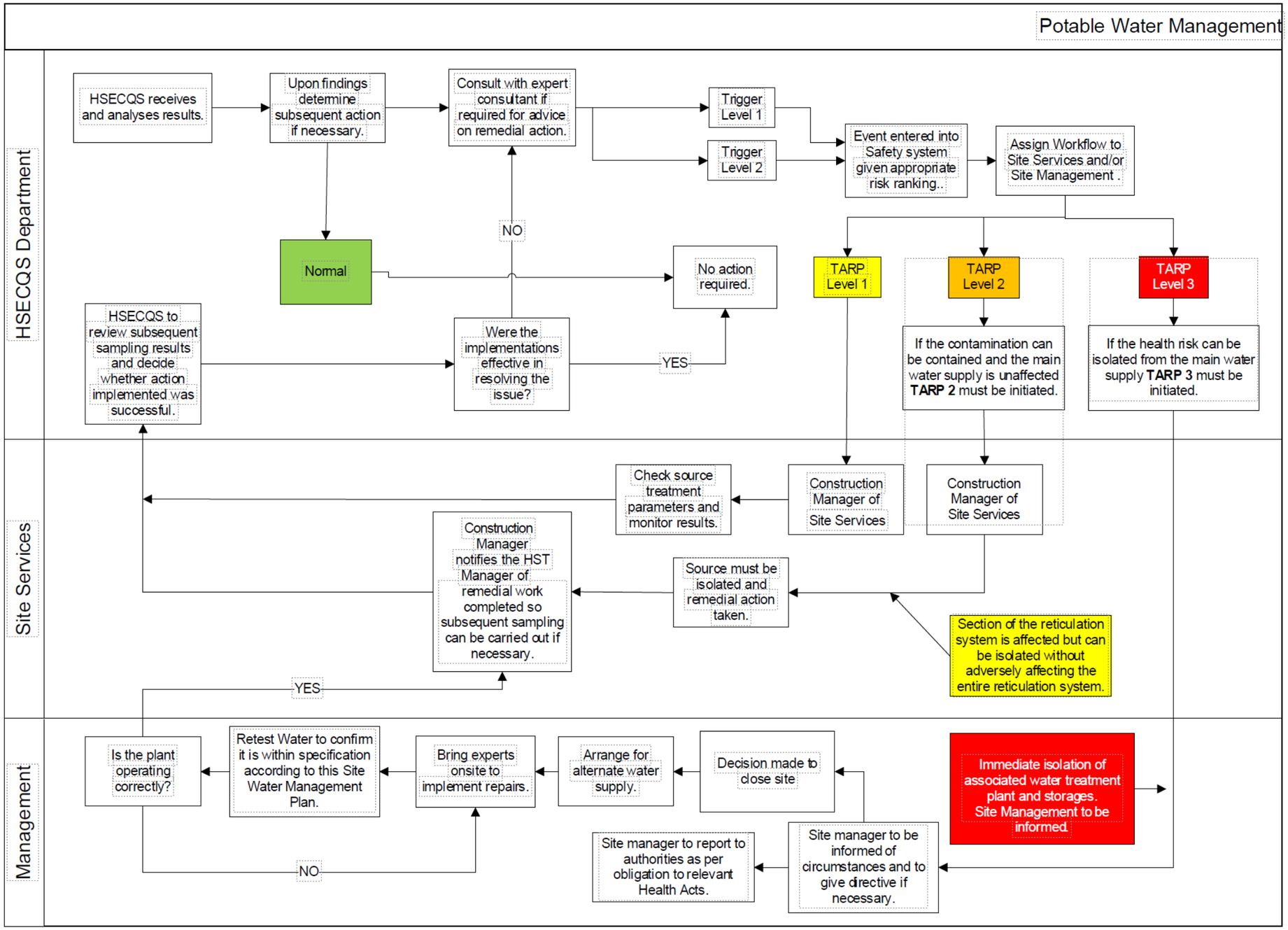
11. APPENDICES

Table 10: Summary of TARPs and Key Operational Documents

No.	Title
11.1	Chain of Command Flow Chart
11.2	TARP 1– Raw Water – Cyanobacteria
11.3	TARP 2– Potable Water – Microbiology
11.4	TARP 3– Potable Water – Physical and Chemical Parameters
11.5	ADWG Key Chemical Parameters for Potable Water
11.6	Key Sampling Point Inventory

11.1 Appendix – Chain of Command Flow Chart

Example only:



11.2 Appendix TARP 1 : Water – Potentially Toxic Cyanobacteria

	Normal	Level 1 Low Probability of Health Impacts	Level 2 Moderate Probability of Health Impacts	Level 3 High Risk of Adverse Health Impacts
Trigger	<2000cells/mL(PTC)	Total 2000 - 6500 cells/ml (PTCs)	Total 6,501 – 100,000 cells/mL (PTCs)	Total >100,000 cells/mL (PTCs)
Actions	N/A	Short term adverse health outcomes are unlikely. Identify options to reduce exposure. [4] Investigate alternative potable water sources. availability Investigate & seek advice on treatment possibilities. According to authorities [2] toxin analyses are not required in this cell count range	The presence of PTC should be treated with caution until the absence of toxicity is confirmed . Water may be unsuitable for drinking without appropriate treatment. Immediate action to provide temporary alternative water for potable use. Conduct toxin analyses . Consult authorities for water treatment options – if any - that are known to effectively remove the specific toxins identified Initiate appropriate advice & implementation.	Water may be unsuitable for drinking without appropriate treatment. Also increased risks of adverse health effect from primary contact (immersion). Immediate action to provide temporary alternative water for potable use. Conduct toxin analyses Consult authorities for water treatment options IF ANY that are known to effectively remove the specific toxins identified Initiate appropriate advice & implementation.
Minimum Monitoring.	Monthly Sample collection. Counts & PTC identification Scum inspection, if present.	Based on WQRQ report 74 doubling time for algae of 4-6 days, weekly sample collection is advised Cell counts & identification of potentially toxic species in raw water & storage. Scum inspection, particularly at off takes	Increase to twice weekly sample collection to establish population growth trend and until the absence of toxicity is confirmed .for current bloom Cell counts & identification of potentially toxic species in raw water, drinking water storage & designated point of use locations Scum inspection, particularly at off takes Toxin analyses of raw and treated water	Twice weekly sample collection. Cell counts & identification of potentially toxic species in raw water, drinking water storage & at designated point of use locations. Scum inspection, particularly at off takes Request toxin analyses
Criteria for downgrading alert.	N/A	Total < 2000 cells/mL (2 consecutive bi-weekly[4]).	< 6,500 cells/mL (3 consecutive samples) or historical counts of current bloom indicate absence of toxin for counts and bloom decreasing in cell counts I f possible, validate the absence of algae toxin-cyanotoxin	<100,000 cells/mL (3 consecutive samples). If possible, validate the absence of algae toxin-cyanotoxin.
Notification	Forward copies of test results to the Site Responsible Person for filing.	Discuss with the Responsible Person. Responsible Person is to discuss with Health & Safety Superintendent.	Discuss with the Responsible Person & who is to advise Health & Safety Superintendent & HSEC Manager. If necessary advise affected personnel.	Discuss with the Responsible Person & who is to advise HST Manager. HST Manager shall notifiy General Manager. If necessary advise affected personnel.

Additional Information and References:

1) Sample Points: (as per site based sampling protocol - includes all open, light-receiving raw water sources (e.g. dam, reservoir), pre-treatment (inflow) and post-treatment storage tanks and designated key points of use (e.g. Potable tap, auxiliary units). Note: Collect WTP inflow samples if sampling at reservoir offtakes to the WTP is not possible.
2) Guidance Levels, Health Risks and Recommended Actions closely follow the Water Quality Research Australia recommendations published in 2010 (Report 74),
3) Health impact from ingestion results from the presence of algae toxins (cyanotoxins). Potentially toxic species should be identified to species level if possible. Analytical methods to identify and quantify cyanotoxins may vary with cyanobacterial species. The absence of potentially toxic species and cyanotoxin requires to be validated for the end-user at alert levels 2 and 3.
4) Exposure reduction may include amongst others: use of alternative water and appropriate water treatment. Especially sensitive groups may include asthmatics, persons with liver or kidney conditions including previous injury / cirrhosis / transplant, persons with skin allergies including chronic dermatitis, pregnant women.

If algae toxins (cyanotoxins) are present the water is unsuitable for drinking and immediate site-wide notification is advisable.

11.3 Appendix TARP 2: Potable Water – General Microbiology

	Normal	Level 1 Low Probability of Health Impacts	Level 2 Moderate Probability of Health Impacts	Level 3 High Risk of Adverse Health Impacts
Trigger	Coliforms not detected (<1 cfu/100ml) **AND:** Heterotrophic plate count typically < 100cfu/ml but levels up to 500cfu/ml may be acceptable in the absence of faecal indicators.	E. coli and thermotolerant (faecal) coliforms detected (1- 5 cfu/100ml) at **an individual tap or auxiliary end-use unit** but **not** detected after treatment or **throughout the distribution system (<30% of samples)** **AND / OR** Other coliforms are detected **AND / OR** Other coliforms are detected with Heterotrophic plate count exceeding 100cfu/ml but <500cfu/ml for less than <30% of locations.	E. coli and thermotolerant (faecal) coliforms detected >5 cfu/100ml at an individual tap or auxiliary end-use unit but **not** detected after treatment or **throughout the distribution system (<30% of samples)** **OR** Coliforms detected together with Heterotrophic plate count levels > 500cfu/ml for more than >30% **of the test locations throughout the distribution system and after treatment**.	E. coli and thermotolerant (faecal) coliforms detected (> 5 cfu/100ml) immediately after treatment plant and at more than 30% of locations throughout the distribution system.
Monitoring	Monthly laboratory microbiological analyses, pH and free chlorine field test when sampling.	Immediately upon receipt of results contact laboratory to confirm accuracy. Take new micro samples from same locations after corrective actions.	Immediately upon receipt of results contact laboratory to confirm accuracy. Collect for analysis after corrective actions (a) Chlorinated flush water for micro, pH and chlorine (b) Next day micro samples from same locations after corrective action implementation.	Immediately upon receipt of results contact laboratory to confirm accuracy. Collect for analysis after corrective actions (a) Chlorinated flush water for micro ,pH and chlorine (b) Next day micro samples from same locations after corrective action implementation.
Actions	N/A	Check WTP to ensure adequate disinfection and normal operating conditions. Service UV arrangement and replace filters. Clean Thimbles Test cut-off solenoid Line flushing.	Isolate point of consumption Investigate water treatment and disinfection. Flush lines as per standard ASNZS3500. Shock dose tank or line disinfection according to AS/NZS3500 (appendix H and I). Flush lines Supply alternative water/ice (e.g. Bottled manufactured water and ice-bags for these locations)	Isolate point of consumption Investigate water treatment and disinfection. . Shock dose tank or line disinfection according to AS/NZS3500 (appendix H and I). Flush lines Supply alternative water/ice (e.g. Bottled manufactured water and ice-bags for these locations)
Criteria for downgrading alert	N/A	If re-test after corrective actions returns compliant result.	If re-tests after corrective actions are compliant.	If system re-tests after corrective actions are compliant.
Notification	Site Responsible Person to file all	Discuss with the Site Responsible Person. Site	Discuss and Site Responsible Person is to advise HSEC	Discuss and Site Responsible is to advise HST Manager.

Additional Information and References:

1. Sample Points: as per site based sampling protocol - includes raw water, post treatment, treated water storage, potable distribution and point of use (e.g. Potable water taps, auxiliary utilities such as chillers, ice-machines, and bottled water dispensers).
2. Guidance Levels: Health Risks and Recommended Actions closely follow the Australian Drinking Water Guideline NHMRC/ADWG.
3. Exposure reduction may include amongst others: use of alternative water (e.g. Bottled water and commercial ice supplies).
4. All potential end-users should be notified if a particular location or the entire potable water system is affected.

11.4 Appendix TARP 3: Potable Water – General Physical & Chemical Parameters

	Normal	Level 1 Low Probability of Health Impacts	Level 2 Moderate Probability of Health Impacts	Level 3 High Risk of Adverse Health Impacts
Trigger	Both, the aesthetic (preferred) and health limits outlined in the ADWG see are met. Special focus on the free residual chlorine to be 0.6 ppm at the point of use throughout the reticulation system. pH 6.5-8.2	Any health limits are exceeded and up to double the guideline health limit. OR Any Aesthetic limits are exceeded. OR Free Residual Chlorine < 0.3 ppm	Any health levels are more than double the ADWG guideline health limit at individual potable end use locations. OR FRC <0.05 ppm AND There is NO indication of possible: (a) Contaminant ingress via distribution line fracture or cross-connection; (b) Substantial treatment chemical overdosing; or (c) Accidental spill of hazardous substances into the potable water raw water supply, distribution and storage.	Any health levels are more than double the ADWG guideline health limit at several locations throughout the system. OR There **IS** an indication of possible: (a) Contaminant ingress via distribution line fracture or cross-connection; (b) Substantial treatment chemical overdosing; or (c) Accidental spill of hazardous substances into the potable water raw water supply, distribution and storage.
Monitoring	Frequencies vary depending on local risk. Refer to sampling schedules.	Immediately upon receipt of results contact laboratory to confirm accuracy. Collect a second confirmatory sample if health limits have been exceeded.	Immediately upon receipt of results contact laboratory to confirm accuracy. Take new samples from same location on two consecutive days after corrective action implementation.	Immediately contact the laboratory to confirm accuracy and collect confirmatory samples. Take new samples from same location on two consecutive days after corrective action implementation.
Actions	N/A	Check WTP to ensure adequate operating conditions. Investigate possible changes in raw water sources and/or qualities. Consult with water treatment specialists.	Isolate end use unit. Check WTP to ensure adequate operating conditions. Investigate possible ingress and/or contamination. Consult with water treatment specialists. Investigate possible changes in raw water sources and/or qualities. Investigate and Seek alternative water source Clean and maintain unit (Change in-line filters, line flushing).	Immediately upon receipt of results investigate possible ingress and/or contamination. Consult with a water treatment specialists. Once a significant barrier breach is confirmed, shut down the potable water supply and isolate the contaminant source. Supply alternative water for the reticulated water system including for drinking water, ice machines, showering and other primary contact uses. (eg. Bottled manufactured water and ice bags). Check WTP to ensure adequate operating conditions. Initiate treatment re-commissioning, fine-tuning and/or treatment upgrade appropriate for the non-compliant parameter(s).

Additional Information and References:

1. Sample Points: as per site based sampling protocol- includes raw water, post treatment, treated water storage, potable distribution and point of use (e.g. Potable water taps, showers, auxiliary utilities such as chillers, ice-machines, and bottled water dispensers).
2. Guidance Levels: Health Risks and Recommended Actions closely follow the Australian Drinking Water Guideline NHMRC/ADWG (2011)
3. Exposure reduction may include amongst others: use of alternative water (e.g. Bottled water).
4. All potential end-users should be notified if a particular location or the entire potable water system is non-compliant.
5. Note the ADWG threshold values are based upon long term (chronic) exposures rather than short term (acute) exposure.

11.5 Appendix TARP 4: Raw Water (process waters, untreated water, recovered waters) – Legionella

	Normal	Level 2 Moderate Probability of Health Impacts	Level 3 High Risk of Adverse Health Impacts
Trigger	Legionellae zero to 400cfu/ml	Legionellae detected but less than 401 to 999cfu/ml.	Legionellae detected & counts greater than or equal to1000cfu/ml.
Monitoring	Monthly	After corrective action (closely following the AS3666:3 monitoring schedules) retest twice within 3 to 7 days after actions have been taken	After corrective action (closely following the AS3666:3 monitoring schedules) retest twice within 3 to 7 days after actions have been taken
Actions	Normal activities Sample and Monitoring as per WQRMP (e.g. week rosters for ERZ controllers, monthly for other points; snapshot rotating rosters) Ensure when equipment stood down for 7 days or more to be drained of water Workers to wear P2 masks in aerosol generating areas where there is the potential to come into contact with aerosols taking into account the environmental conditions at the time(e.g. wind drift)	Enforce PPE usage and restrictions in inspection district Workers to wear P2 masks in aerosol generating areas where there is the potential to come into contact with aerosols taking into account the environmental conditions at the time (eg wind drift) and areas known to be affected This includes from - last open cut throughs - vapour drift zones Where equipment has not been used for greater than 7 days and is not drained of water, the water shall be drained or flushed before aerosol generating machinery (sprays, drills) is operated For pressurised systems (e.g. drills, CHPP, washpad hoses etc) - Isolate and release pressure from water circuits prior to maintenance and repair work For UG mine waters, fish bowl, goves, - ensure circulation and no stagnation - pump waters to surface storage systems	Enforce PPE usage and restrictions in inspection district As per orange controls plus Complete adequate risk management prior to undertaking task (JSA Minimum) Restrict access to personnel deemed to be in an at risk group to area of concern Restrict access to areas where aerosoled water may exist prior to maintenance Where equipment has not been used for greater than 7 days and is not drained of water, the water shall be drained or flushed before aerosol generating machinery (sprays, drills) is operated - Flush water systems (lines and tanks) on equipment such as miners with a biocide or disinfectant treatment as per SOP. For pressurised systems (e.g. drills, CHPP, washpad hoses etc) - Isolate and release pressure from water circuits prior to maintenance and repair work
OH&S Officer	Advise Controllers and Supervisors of status and TARP alert level	Advise Controllers and Supervisors of status and TARP alert level including re-test results. Ensure chain of command notifications and TARPs as per WQRMP.	Advise Controllers and Supervisors of status and TARP alert level, including re-test results. Ensure chain of command notifications and TARPs as per WQRMP.
Supervisor	Sample monthly as per SWG	Note on report and at inspection board requirements for PPE – P2 mask Sample twice weekly as per MP and SWG	As per orange requirements plus: treat area where deemed necessary as per SOP Enforce PPE usage and restrictions in inspection district
Notification	Obtain sampling kits and organise freight for Samples IMO's to test eye wash stations and emergency showers weekly on surface	Obtain sampling kits and organise freight for samples Provide information and updates for Workers	Vulcan Mine HST Manager is to advise SSE. If necessary, advise affected personnel.
Criteria for alert[vi] downgrade	N/A	If two consecutive re-tests within 7 days after treatment are compliant after flushing or treatment.	If two consecutive re-tests within 7 days are compliant after system disinfection.

11.6 Appendix TARP 5: Potable Water – Legionella

	Normal	Level 1 Low Probability of Health Impacts	Level 2 Moderate Probability of Health Impacts	Level 3 High Risk of Adverse Health Impacts
Trigger	Legionellae not detected (<10cfu/ml)	Legionellae detected at 10 to 99 cfu/ml	Legionellae detected but less than 100 to 999cfu/ml.	Legionellae detected & counts greater than or equal to1000cfu/ml.
Monitoring	Monthly	After corrective action (closely follow the AS3666:3 monitoring schedules) retest twice within 3 to 7 days after actions have been taken	After corrective action (closely following the AS3666:3 monitoring schedules) retest twice within 3 to 7 days after actions have been taken	After corrective action (closely following the AS3666:3 monitoring schedules) retest twice within 3 to 7 days after actions have been taken .
Actions	N/A	Investigate & optimise plant & system operations Review appropriate water treatment systems. Take necessary remedial action including Flush lines Flush potable lines to restore chlorine level For hot water systems, ensure water temperatures set above 65 Deg C as specified by site Flush hot water systems with greater than or equal 65oC water for 10 minutes Resample for laboratory analysis.	Investigate & optimise plant & system operations Review water treatment systems. Consider appropriate remedial action which may include Deploy alternative water source Isolate or restrict access to water source; Mandatory PPE;+ P2 face mask Pump water to designated recovery areas Flush area with clean water Ensure water circulation with no aerosol generation For treated water supply point of use treatment or flush & disinfect the storage & distribution system according to AS 3666:3 standard or AS/NZS3500-appendix G & H. Consult with water treatment specialists. For hot water systems, ensure water temperatures set above 65oC as specified by site Flush hot water systems with greater than or equal 65oC water for 10 minutes Resample for laboratory analysis. Expected turnaround time for results from lab is 7-10 days as per ASNZS3896	Restrict access to inhalable aerosol sources; Investigate & optimise system operations Review water treatment systems where appropriate. Consider appropriate remedial action which may include Deploy alternative water source Isolate or restrict access to water source; Mandatory PPE;+ P2 face mask Pump water to designated recovery areas Flush area with clean water Ensure water circulation with no aerosol generation For treated water supply point of use treatment or flush & disinfect the storage & distribution system according to AS 3666:3 standard or AS/NZS3500-appendix G & H. Consult with water treatment specialists For hot water systems, ensure water temperatures set above 65oC as specified by site Flush hot water systems with greater than or equal 65oC water for 10 minutes Resample for laboratory analysis. Expected turnaround time for results from lab is 7-10 days as per ASNZS3896
OH&S Officer	Advise Controllers and Supervisors of status and normal ops TARP alert level	Advise Controllers and Supervisors of status and TARP alert level including re-test results. Ensure chain of command notifications and TARPs as per WQRMP.	Advise Controllers and Supervisors of status and TARP alert level including re-test results. Ensure chain of command notifications and TARPs as per WQRMP.	Advise Controllers and Supervisors of status and TARP alert level, including re-test results. Ensure chain of command notifications and TARPs as per WQRMP.
Supervisors	Provide communications to oncoming crews at pre starts in regards to wearing P2 masks in affected areas	Provide communications to oncoming crews at pre starts in regards to wearing P2 masks in affected areas	Provide communications to oncoming crews at pre starts in regards to wearing P2 masks in affected areas	Provide communications to oncoming crews at pre starts in regards to wearing P2 masks in affected areas
Notification	Obtain sampling kits and organise freight for samples IMO's to test eye wash stations and emergency showers weekly on surface	Obtain sampling kits and organise freight for samples Provide information and updates for Workers	Obtain sampling kits and organise freight for samples Provide information and updates for Workers	Vulcan Mine HST Manager is to advise SSE. If necessary advise affected personnel.
Criteria for alert downgrade	N/A	If two consecutive re-tests within 7 days after treatment are compliant after flushing or treatment.	If two consecutive re-tests within 7 days after treatment are compliant after flushing or treatment.	If two consecutive re-tests within 7 days are compliant after system disinfection.

Note: Legionellae quantitative analysis by the prescribed method ISO11732 and has a limit of reporting (sensitivity) of 1cfu/100ml

Additional Information and References:

1. Sample Points: as per site based sampling protocol - includes activities where the generation of and exposure to aerosol is likely (sprays, point of use for firewater, wash down bays, dust-suppression)
2. Monitoring locations and frequencies should be determined under a site based risk management plan in accordance with equivalent risks in regulated cooling tower operations (e.g. AS5059, AS 3666 series).
3. Guidance on health risks and recommended actions can be obtained from Australian Standards for cooling tower operations and for treated reticulated water supplies the Australian plumbing standards for hot water supply systems (AS 3500.4.1) and disinfection of storage tanks and water services (AS3500.1.2 appendix G and H).
4. Exposure reduction may, include amongst others: use of alternative water, restricting access, flush and disinfection according to AS 3666:3 standard and/or Tank or line disinfection according to AS3500.1 (appendix G and H), source or point of use treatment and mandatory PPE (e.g. P2 face mask).
5. To meet the legal obligations under the Occupational Health and Safety Acts, it is a requirement that: (a) staff who may be affected by the presence of Legionella are kept well informed with the water exposure risks and their management; (b) Risk management and applicable procedures maintain the Legionella risk at an acceptable level.

Note: Health impact from Legionella occurs almost exclusively via inhalation of water aerosols containing these bacteria.

11.7 Appendix - Key ADWG Chemical Parameters

Note, chemical parameters must be validated and the list below is an example only

Element	Health Limit (mg/L)	Aesthetic Limit (mg/L)	Comment (Limited to Cannington's Potable Water)
Aluminium (acid soluble)	*	0.2	No health issues established currently
Ammonia	*	0.5	High levels may corrode copper pipes and fittings. Presence may indicated sewage contamination and/or microbial activity.
Arsenic	0.01		From natural sources and mining wastes
Barium	2		Primarily from natural sources
Boron	4		From natural leaching of minerals and contamination.
Cadmium	0.002		Indicates industrial or agricultural contamination, from impurities in galvanised fittings, solders and brasses
Chloride	*	250	From natural mineral salts and effluent contamination
Chlorine	5	0.6	Odour threshold generally 0.6 mg/L but 0.2 mg/L for a few people. It may be necessary to increase the dose rate above 0.6 to ensure disinfection throughout the reticulation system.
Colour (true)		15HU	An important aesthetic characteristic. Treatment process can be optimised to remove colour.
Copper	2	1	From corrosion of pipes and fittings. Taste threshold is typically 3 mg/L. Cu > 2mg/L can cause ill effects in some people.
Dissolved Oxygen	N/A	>85% saturation	Low concentrations allow growth of nuisance microorganisms such as iron/manganese/sulphate and nitrate reducing bacteria). These cause taste and odour problems, staining and corrosion. Low oxygen concentrations are normal in groundwater supplies.
Fluoride	1.5		Occurs naturally in Cannington's ground water. Often added at up to 1 mg/L to protect against dental caries. >1.5 mg/L can cause dental fluorosis >4.0 mg/L can cause skeletal fluorosis.
Hardness (as CaCO3)	N/A	200	60-200 mg/L is good quality water. >200 mg/L can lead to scaling issues.
Iron	*	0.3	Occurs naturally in surface waters up to 1 mg/L and up to 100 mg/L in oxygen depleted groundwaters. Taste threshold 0.3 mg/L. High concentrations stain laundry and fittings. Iron bacteria cuase blockages, taste/odour and corrosion
Lead	0.01		Occurs in water via dissolution from natural sources or household plumbing containing lead.
Manganese	0.5	0.1	Ocurs natually in water, low in surface water and higher in oxygen depleted groundwater. >0.1 mg/L causes tast and staining
Mercury	0.001		Very low concentrations occur naturally. Organic forms are most toxic, but these are associated with biota not water.
Nitrate	50		Adults can drink over 100 mg/L. 50 mg/L is a limit for infants. Indicates effluent contamination.
Nitrite	3		Rpadily oxidised to nitrate.
pH	*	6.5-8.5	Aesthetic suitability will limit consumption to safe ranges. pH<6.5 may be corrosive. pH>8 progressively decreases efficiency of chlorination. pH>8.5 may cause scalen and taste problems.
Radionucleides	1.0 mSv		Total estimated dose per year from all radionuclides in drinking water, excluding the does from potassium-40, should not exceed 1.0 mSv.
Silica		80	Can form films on Reverse Omosis membranes.
Sodium	N/A	180	Guideline value is taste threshold.
Sulphate	500	250	Naturally occurring and with acid addition. Guideline value is taste threshold. SO4>500 mg/L can have a purgative effective.
Total Dissolved Solids	N/A	600	Based on Taste: TDS<600 mg/L is regarded as good quality drinking water. 600-900 mg/L is fair quality. 900-1200 mg/L is poor quality. TDS>1200 is regarded as unacceptable.
Turbidity	*	5 NTU	>0.2 NTU is the target for effective filtration of Cryptosporidium and Giardia. <1 NTU is the target for effective disinfection.
Zinc	*	3	Usually from corrosion of galvanised pipes/fittings and brasses. Natural concentrations generally <0.01 mg/L. Taste problems > 3 mg/L.

* Insufficient data to set a guideline value based on health considerations.

11.8 Appendix - Table 11: Water Sample Containers and Preservation Requirements (refer to AS2031 for currency)

Chemical Parameter / Analyte	Maximum Holding Time	Container Size	Container Type	Preservation
pH (field measurement preferred)	6 hours	100ml	Polyethylene	NONE Unfiltered, natural (UN);
EC and TDS	24 hrs	500ml	Polyethylene	NONE Unfiltered, natural (UN); Refrigerate 4°C
Major Components	1 week	1000ml	Polyethylene	NONE Unfiltered, natural (UN); Refrigerate 4°C
Metals-General	28 days	100ml	Polyethylene	NONE Unfiltered, natural (UN); - IF sample to be field filtered (0.45µm) (FA); Refrigerate 4°C
Hg	3 days	100ml	Borosilicate (Amber) Glass with Teflon-lid	Unfiltered, natural sample added to a pre-treated bottle with Hg preservative (pre-acidified bottle with HNO_3 to reduce pH to 1-2 and potassium dichromate added [95%HNO3, 5% K2Cr07)](HG); Refrigerate 4°C
TPH	24 hrs	1000ml	Borosilicate Glass with Teflon-lid	Bottle to have been solvent –washed NONE Unfiltered, natural (UN-GL) Refrigerate 4°C
Nitrite (NO_2)	2 days	200ml	Polyethylene	NONE Unfiltered, natural (UN-FREEZE); Freeze immediately upon sampling
Microbiological	24 hrs	250ml	Gamma sterilized disposable plastic containers	Jar must be sterile Na-thiosulphate preserved Unfiltered, natural (STERIL), Refrigerate 4°C (ICE BRICKS, NOT ICE!)
Gross Radioactivity	28 days	1000ml	Polyethylene	Pre-acidified bottle with HNO3 to reduce pH to 1-2, sample to be field filtered (0.45µm) (FA); Refrigerate 4°C

11.9 Appendix - Inventory of Key Sample Point Rosters

The table below of key sample points and rosters is an example only. Currently Vulcan Coal roster will be very simple but this will evolve as the site grows.

1. Key points for the proposed rosters need to be formally identified with signage
2. Each sample point requires a unique identification number (UIN). E.g. VC###
3. Each sample point requires a permanent UIN tag

Note: These rosters are structured to allow regular snapshots of the water system performance in terms of microbiology and water chemistry.

Identifier	Location	Roster 1	Roster 2	Roster 3
VIT_PTW_001	Office Kitchen Sink	VIT_PTW_001	VIT_PTW_001	VIT_PTW_001
VIT_PTW_002	Office Kitchen Dispenser			
VIT_PTW_003	ERT Office Sink			
VIT_PTW_004	ERT Office Ice Machine			
VIT_PTW_005	ERT Training Room Sink			
VIT_PTW_006	ERT Male Amenities Basin			
VIT_PTW_006	ERT Female Amenities Basin			
VIT_PTW_007	CRIB Sink			
VIT_PTW_008	CRIB Ice Machine			
VIT_PTW_009	CRIB Water Dispenser			
VIT_PTW_010	Igloo Potable			