Whakatāne Water Supply
Water Safety Plan

WHAKATĀNE DISTRICT COUNCIL

Version 6.04 | July 2019

This document was developed by Wai Comply Ltd on behalf of Whakatāne District Council with input acknowledged in the following table:

Document Contributors	
Tomasz Krawczyk	Manager Three Waters
Michael Van Tilburg	Team Leader Three Waters Asset Management & Planning
Neal Yeates	Team Leader Water Treatment Plant
Diana Kim	Asset Engineer – Three Waters Asset Management & Planning
Leilani Salanguit	Project Engineer – Capital Projects
Thomas King-Hazel	Senior Service Person – Three Waters Operations

Prepared by	
Josh Takao	
Director/Co-Founder – Wai Comply Ltd	

Peer Reviewed	
Matt Parkinson	
Director/Co-Founder – Wai Comply Ltd	

Authorised for Release			
Josh Takao			
Director/Co-Founder – Wai Comply Ltd			
Date:	June 2019	Version No:	6.02
Wai Comply Filename:	Whakatane Water Safety Plan WSP (A1422915)		
Client Filename:	Whakatāne Water Safety Plan WSP (A1422915)		

Glossary

WDC	Whakatāne District Council
BoP	Bay of Plenty
Health Act	Health Act 1956
WSP	Water Safety Plan
DWSNZ	Drinking-water Standards for New Zealand 2005 (Revised 2018)
DWA	Drinking Water Assessor
WTP	Water Treatment Plant
CCP	Critical Control Point
MAV	Maximum Acceptable Value
FAC	Free Available Chlorine
NTU	Nephelometric Turbidity Unit
E. coli	Escherichia coli
UV	Ultraviolet
DWO	Drinking Water Online
PLC	Programmable Logic Controller

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Commitment to Drinking-Water Quality Management

Whakatāne District Council is committed to managing the **Whakatāne Water Supply** effectively to provide safe, high-quality drinking-water that consistently meets the expectations of the Health Act 1956 and Drinking-water Standards for New Zealand, and other regulatory requirements.

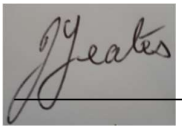
To achieve this, in partnership with stakeholders and relevant agencies, Whakatāne District Council will:

- Embrace a high standard of care to manage water quality at all points along the delivery chain from source water to the consumer to provide a continuous supply of safe drinking-water.
- Maintain a personal sense of responsibility and dedication to providing consumers with safe drinking-water.
- Integrate the needs and expectations of its consumers, stakeholders, regulators and employees into its planning.
- Use a preventive risk-based approach in which potential threats to water quality are identified and managed.
- Acknowledge that protection of source water is of paramount importance in protecting consumers against drinking-water contamination and illness.
- Maintain robust multiple barriers against contamination appropriate to the level of potential contamination.
- Develop appropriate contingency planning and incident response capability.
- Establish regular monitoring of the quality of drinking-water and effective reporting mechanisms to provide relevant and timely information and promote confidence in the water supply and its management.
- Participate in appropriate investigative activities to ensure continued understanding of drinking-water quality issues and performance.
- Continually improve its practices by assessing performance against corporate commitments, stakeholder expectations and regulatory requirements.

All managers and employees involved in the supply of drinking-water are responsible for understanding, implementing, maintaining and continually improving the drinking-water quality management system.

Tomasz Krawczyk

Manager Three Waters



Neal Yeates

Team Leader Water Treatment Plant

Michael Van Tilburg

Team Leader Three Waters Asset Management and Planning

Introduction

This Water Safety Plan (WSP) has been prepared for the Whakatāne Water Supply to identify public health risks to the consumers of the drinking-water supply. The Whakatāne District Council (WDC) is committed to the WSP and the future improvements as identified in this document.

The Whakatāne Water Supply provides water to Whakatāne and Ohope and is classified as a "*Large*" drinking-water supply under the Health Act 1956 with a registered population of 21,020 people.

The scheme is administered at the main council offices on Commerce St, Whakatāne. Both water treatment plant and reticulation operations are managed by the Council's Three Waters Department, and as of February 2019, the management, maintenance and operation of the Whakatāne Water Supply are the responsibility of:

- Manager Three Waters – Tomasz Krawczyk
- Team Leader Three Waters Asset Management & Planning – Michael Van Tilburg
- Manager Capital Projects – Jim Finlay
- Team Leader Three Waters Operations – Luke Shipton
- Team Leader Water Treatment Plant – Neal Yeates

WSP FRAMEWORK 2018 ADJUSTMENTS

The previous WSP prepared in 2013 officially gained approval that year. This renewal of the WSP is a complete review of the previous Whakatāne Water Supply WSP and takes into account some of the recent changes to the Drinking Water Standards New Zealand (DWSNZ) and the new WSP framework. As the new water Safety Plan Framework has recently been released, the development approach taken for this WSP was to incorporate where possible requirements of this new framework.

Components	Section of this WSP that incorporates each component
Commitment to drinking-water quality management	"Commitment to Drinking-Water Quality Management" section (page 1) and section 4.6
Assessment of the drinking-water supply system	Sections 4, 6,7 and 10
Existing preventive measures for drinking-water quality management	Sections 10 and 11
Operational procedures	Sections 4.6, 7.3 (Appendix A) and 10
Verification monitoring programme	Part of risk table items in section 10
Improvement plan	Section 11
Management of incidents and emergencies	Within some of the documents specified in sections 4.6 and section 12
Documentation and reporting	Sections 4.6, 7.3 (Appendix A) and 10
Investigations	Part of risk table items in section 10
Oversight, review and continual improvement	Section 1

1 Document Revision

1.1 FULL REVISION OF THE PLAN

This WSP will expire after five years (2024) as aligned with the Health Act 1956 – Section 69ZB. A formal review of this WSP will be undertaken which will include an assessment of any serious events, non-compliances, near misses and unexpected situations that have occurred, progress against the improvement schedule, and changes to supply elements and treatment processes. A full risk assessment will be completed as part of this process also.

Version No	Revision Details	Peer Reviewed by	Review Date
V1	Rob Blakemore OPUS	Nigel Anderson, WDC	27 October 2005
V2	Sarah Millar & Jim Graham OPUS	Warwick Farmer & Santha Agas WDC	1 July 2009
V3	Sarah Wilson OPUS	Jim Graham, OPUS & Santha Agas WDC	12 June 2012
V4	Sarah Wilson OPUS	Jim Graham, OPUS & Santha Agas WDC	12 June 2013
V5.00	Josh Takao Wai Comply	Matt Parkinson, Wai Comply	December 2018
V5.01	WDC review draft and mark up comments	Neal Yeates & Michael Van Tilburg WDC	8 January 2019
V5.02	Draft 2 – Wai Comply review WDC comments, incorporate WSP framework 2018 and DWSNZ 2018 requirements	Matt Parkinson Wai Comply	15 February 2019
V5.03	WDC final review	David Bewley, Neal Yeates & Michael Van Tilburg WDC	1 March 2019
V5.04	FINAL – Josh Takao Wai Comply	Matt Parkinson Wai Comply	3 March 2019
V5.05	Insertion of signatures, minor modifications and submission to Drinking Water Assessor	Michael Van Tilburg	4 March 2019
V6.00	Draft 1 – Josh Takao Wai Comply	n/a	21 June 2019
V6.01	WDC final review	Sala Ranasinghe, David Bewley, Neal Yeates & Michael Van Tilburg WDC	28 June 2019
6.02	FINAL – Josh Takao Wai Comply	Matt Parkinson Wai Comply	28 June 2019
6.03	Modifications after teleconference with Drinking Water Assessor. Resubmit to Toi Te Ora Public Health	Michael Van Tilburg WDC	17 July 2019
6.04	Approval from DWA - change to 'Report on adequacy of a Drinking Water Supply's Water Safety Plan (RAN007_RangitāikiPlains_WSPadequacy_240619_v1)	Toi Te Ora approval added by Michael Van Tilburg	19 July 2019

1.2 ANNUAL ASSESSMENT OF WATER SUPPLY AND WSP PERFORMANCE

Assessment of the performance of this WSP will be undertaken annually. The assessment will consider any events, a review of historic monitoring data, non-compliances, near misses and unexpected situations that have occurred, progress against the improvement schedule, and changes to any of the supply elements. The performance assessment will be prepared in the form of a report by the Team leader Three Waters Asset Management & Planning and submitted to the Manager Three Waters by *31 May* each year.

The following staff will be responsible for including any relevant items arising from this report that require attention or significant capital funding in the Annual Plan or Long-Term Plan:

- Manager Three Waters – Tomasz Krawczyk
- Team Leader Water Treatment Plant – Neal Yeates
- Team Leader Three Waters Asset Management & Planning – Michael Van Tilburg
- Manager Capital Projects – Jim Finlay

1.3 DWA ASSESSMENT OF VERSION 5 – CLEARANCE OF NON-CONFORMANCES

In March 2019, the "Whakatāne Water Supply - Water Safety Plan (Version 5)" was submitted to the Drinking Water Assessor for a WSP Adequacy Assessment. This assessment resulted in a number of Non-conformances and recommendations, which caused the WSP to be determined as "Not Approved".

Since receiving the WSP Adequacy Assessment Report, WDC have reviewed the WSP with specific focus on clearing all Non-conformances. The table below summarises the Non-conformances identified by the DWA and a brief description of the actions taken by WDC to rectify it.

NC Number	NC Description	Adjustment to resolve NCs
1	The WSP doesn't include sufficient information to meet the requirements of a catchment risk assessment. WDC to provide sufficient evidence of a catchment risk assessment and document this in the WSP.	New CRA developed and used to understand the 'Unmitigated Risks' for the water supply. Refer to document 'Whakatāne River – Catchment Risk Assessment, June 2019.
2	Possible minor errors in the risk tables relating to analysis of public health risks . WDC to review and correct or advise the DWA. • Risk table 2.1. Preventative measures don't appear to change the likelihood therefore the remaining risk likelihood is not expected to change. Consider any catchment management activities that occur and list as preventative measures. • Risk tables 3.1, 3.3, 12.4, 13.9 and 14.2. Possible errors between the unmitigated and remaining risks calculations. Likelihood and/or consequence hasn't been changed based on listed preventative measures.	All 'Unmitigated' and 'Residual' Risks in ALL tables reviewed and updated where required. 'Residual' Risks have been reconsidered in line with differing types of preventative measures. Risk table items 1.1, 1.2, 1.3, 1.4 and 1.9 have been reviewed and updated upon completion of CRA.
3	Possible errors in the information related to the management of public health risks listed above. WDC to review and correct or advise the DWA. • Risk table 6.6.Preventative measure states 1-1.5 days stock held at plant. This appears to be incorrect. • Risk table 10.3. Preventative measure states fluoride level analysed continually on-line. Page 7 implies no online analyser and the improvement schedule also proposes an online analyser.	Risk 6.6 table modified to reflect stock held on site Continuous monitoring of Fluoride reference removed from Risk Table 10.3.
4	Insufficient information related to the management of public health risks listed above. WDC to review and correct or advise the DWA. • Risk table 14.3. The WSP contains insufficient detail on the preventative measures relating to the verification of set points, alarms and auto-shutdowns. • Related to this, other WDC WSPs contain a WDC-wide improvement item: site assessment to determine that all practical measures are in place via Electrical, Mechanical and Physical to avoid overdosing.	Additional detail added to 14.3 which includes general statement around continuous monitoring, triggering of alarms, and automatic plant shut down limits (critical limits) Added Improvement "OP-IMP 11"

NC Number	NC Description	Adjustment to resolve NCs
5	Risk table 13.7. Listed preventative measures are worded like planned improvements. WDC to review and correct or advise the DWA. • Other WDC WSPs contain WDC-wide improvement items that are not included in this plan: assessment of pesticide results, third party damage policy, systematic workflow procedure, supply specific flushing plan, Hydraulic modelling/ pressure management.	Corrected wording as requested. Added Improvements "OP-IMP 26 to 30" for WDC generic actions
6	Improvement item OP-IMP 18: Improvement timing listed as quarterly. It is not clear when this started or when it is planned to occur. WDC to review and include a date. If an improvement item is a regular activity that has begun consider moving to the risk tables appropriate preventative measure section with adequate details. • An improvement schedule is included and appears to be aimed at addressing preventative measures, monitoring or corrective actions that require improvement. Many improvement schedule items cover multiple council-owned water supplies. The scope and detail of the improvement item is considered largely adequate.	Changed intended completion date from Quarterly to "August 2019"
New	Improvement schedule has a number of operational projects planned to be completed by June 2019.	Changed intended completion dates to reflect proposed resourcing

2 Consultation

In September 2018, Josh Takao from Wai Comply Ltd held a workshop at the Whakatāne District Council office where all items pertaining to the development of this WSP were reviewed. This included discussions on critical points, barriers to contamination, risks to the supply operation and performance of the plant and future upgrades. The workshop involved staff from both WDC management and operation with the information provided specifically used to compile the risk tables.

Following the workshop, telephone discussions and email contact has been used to provide information necessary for the preparation of this WSP. The WSP has also been reviewed by David Bewley, Michael Van Tilburg and Neal Yeates of WDC prior to submission to the DWA.

3 Supply Details

Table 1. Summary of Whakatāne Water Supply details

Supply Details		
Supply Name	Whakatāne	
WINZ Community Code	WHA005	
Supply Owner	Whakatāne District Council	
Chief Executive	Steph O'Sullivan	
General Manager Planning and Infrastructure	David Bewley	
Manager Three Waters	Tomasz Krawczyk	
Team Leader Three Waters Asset Management and Planning	Michael Van Tilburg	
Manager Capital Projects	Jim Finlay	
Population Served by Supply	21,020 (Drinking Water Register 2019)	
Source Details		
Source Name	Whakatāne River	
Source WINZ Code	S00217	
Type of Source	River	
Consent Expires	2026	
Maximum Consented water take:	20,000 m^3/day	
Grid Reference of Source (NZTM)	**Easting**: 1950194	**Northing**: 5788532
Treatment Details		
Plant Location	Whakatāne	
Plant WINZ Code	TP00323	
Treatment Processes	Coagulation & Flocculation, Clarification, Sand filtration, Gas Chlorination, Fluoridation, UV disinfection, pH	
Average Daily Volume	5,000 m^3 (Winter) and 8,000 m^3 (Summer)	
Peak Daily Volume	12,000 m^3	
Distribution Details (A)		
Distribution Zone Name	Whakatāne	
Distribution Zone WINZ Code	WHA005WH	
Distribution Zone Population	15,020 (Drinking Water Register 2019)	
Distribution Details (B)		
Distribution Zone Name	Ohope	
Distribution Zone WINZ Code	WHA005OH	
Distribution Zone Population	6,000 (Drinking Water Register 2019)	

4 Whakatāne Water Supply Description

The Whakatāne Water Supply is described as a "Large" water supply in the Health Act with a registered population of 21,020 people.

The scheme sources its water from the Whakatāne River and is of a quality that can drastically change. This changeability of source water reflects the size and complexity of the catchment.

The Whakatāne Water Treatment Plant (WTP) is located on Te Tahi Street and uses a complex arrangement of coagulation/sedimentation/rapid sand filtration, chlorination, pH adjustment and UV disinfection to treat the water. Fluoride is also dosed in this water supply as well as Powdered Activated Carbon at times when it is required. This WTP has been continually upgraded demonstrating Council's ongoing commitment to drinking water quality improvement.

There are two zones in in this water supply, with fluoride the only chemical determinand required to be monitored.

As of June 2019, there are three operators and one team leader who operate the WTP. A number of WDC staff also support the operations team.

4.1 HISTORY OF NETWORK

The Whakatāne water supply was established by the Whakatāne Borough Council prior to 1971. The original treatment plant was a Patterson Candy plant constructed by Mahy Construction. Water was supplied to the Whakatāne community from this treatment plant which consisted of silt traps, a flash mixer, four clarifiers, and three gravity sand filters.

Since the initial build, the following improvements have been made:

- 1978 – Three additional sand filters and chemical storage added
- 1984/85 – Trunk main to the Ōhope distribution zone
- 2002 – Manual filter to waste facilities from each of the sand filters
- 2004 – Intake pipe replaced and a T-screen installed
- 2008 – Floating intake added at the current intake position
- 2010 – Temporary upstream intake installed
- 2011 – Ultraviolet light reactors were installed
- 2013 – Filters upgraded and automated
- 2014 – Electrical and Scada upgrade
- 2016 – Renewal of chemical tanks and inlet ports
- 2016 – Install roof structure over clarifiers 2 & 3 plus over filters 1, 3 and 5
- 2017 – intake pipe 'Nessie' constructed
- 2019 – Renewal of trunk main from Ōtarawairere Road Reservoir to Ōhope Mahy reserve with new separate inlet pipework at Ōtarawairere Road Reservoir

4.2 CATCHMENT CHARACTERISTICS AND ABSTRACTION

The Whakatāne WTP sources water from the Whakatāne River, where it is abstracted under a resource consent that allows abstraction of up to 20,000m^3/day. Peak summer production is approximately 12,000 m^3/day and winter production averages 5,000 m^3/day.

The plant flow rate is determined from previous use, balanced with the operational requirement to keep the reservoirs at 80% full.

The source water catchment for the supply is effectively the entire catchment of the Whakatāne River and its connecting tributaries. The catchment includes a number of land uses including agricultural, industrial/commercial, residential and conservation estate (Te Uruwera). The catchment has a number of discharges upstream of the abstraction point, with the most significant of these being the Tāneatua Oxidation Pond discharge.

In June 2018, a log credit requirement of *"Three (3.0)"* was confirmed by the DWA as being appropriate for the Whakatāne River source. This decision was supported by the Whakatāne River crypto monitoring summary spreadsheet, MicroAqua Tech sample results, field sample sheets and sampling schedule extract.

Turbidity levels in the source water vary significantly depending on conditions in the catchment. Salinity can also be an issue especially during periods where king tides are experienced, however the new intake upstream of the plant mostly mitigates this. Cyanobacteria has also been identified in the catchment and a recently developed Cyanotoxin and Cyanobacteria Management Protocol will be activated should this issue arise. Both salinity and cyanotoxin related issues mostly affect the Whakatāne River during summer when river flow rates are at their lowest.

4.3 TREATMENT

Treatment processes include coagulation, pH correction, flocculation, sedimentation, filtration, disinfection, and fluoridation. In addition, pH is adjusted prior to sedimentation and post filtration with the addition of hydrated lime. Powdered activated carbon (PAC) is dosed for taste, odour and cyanotoxin removal prior to sedimentation, and is controlled by plant flow rate.

Chlorine residual is maintained with the addition of chlorine gas. The chlorine controller receives a feedback signal from an inline meter, and the controller adjusts the chlorine pump dose rate according to the difference in process variable vs. controller set point, and plant flow rate. If measured results drop below set point, dose rate is increased, and vice versa. For the inline chlorine dosing, manual checks are carried out on a daily basis.

pH is controlled with the addition of hydrated lime slurry. pH is measured before and after the lime addition tank, and speed of lime addition is controlled by the two measurements (by PLC), and by plant flow rate. Manual checks for pH controllers are carried out tri-weekly, results are checked against calibrated lab meters, and any necessary adjustments are made. High or low set point alarms are raised at the control system.

Turbidity is measured in stream for raw water, settled water, individual and combined filter, final treated water and post reservoir. If the individual filter turbidity meter reads over the high set point, the filter automatically shuts down and cannot be started again until the high turbidity has been resolved. Alarms are raised at the control system.

After filtration, chlorine and fluoride are added, just prior to the chlorine contact tank, which is situated under the floor of the treatment plant (providing retention time of 30 minutes up to 260m^3/h plant flowrate – additional retention is provided in the three reservoirs). Water is then passed through UV system.

Fluoride is preventatively managed by the use of a day tank with diluted chemicals in lieu of an inline analyser. This will not allow the fluoride to be slightly overdosed for more than one day at the most and the reservoirs will allow further dilution.

4.4 RETICULATION & STORAGE

Treated water is pumped to three reservoirs with a combined capacity of 7,900 m^3 and is then gravity fed to the lower areas of the scheme. To service the higher areas, water is pumped to nine reservoirs with a combined capacity of 2,548m^3. The reservoirs include storage of 115m^3 on Melville Rd, 450m^3 in two reservoirs located at Kohi Point Lookout Rd, and 2,270m^3 at a reservoir on Ōtarawairere Road. All reservoir levels are telemetered to the Te Tahi Road control room.

Reticulation maintenance is managed in house by Council staff who are appropriately skilled and trained in working on water supply systems. Hygiene protocols need to be developed reflecting industry best practice for staff as there is some work conducted on wastewater and stormwater assets also.

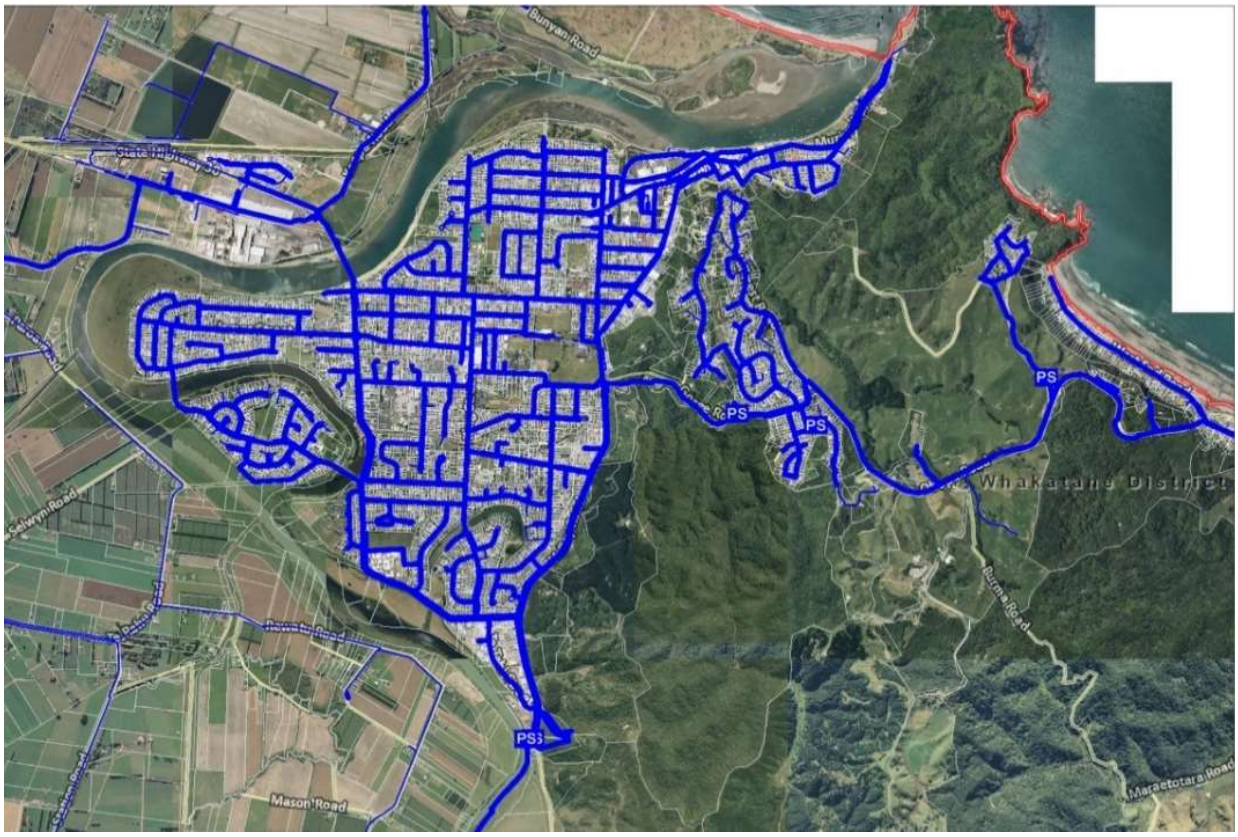


Figure 1. Location of the Whakatāne WTP, reservoir and reticulation system.

4.5 MONITORING

There is a large amount of continuous monitoring conducted at the Whakatāne WTP largely due to the number of treatment processes that are in place. Many of the critical parameters have been covered in the 'Water Supplies CCPs & Process Control Summaries' document and includes monitoring for turbidity (raw, settled, filtered and treated), pH, conductivity, UV transmittance, and FAC.

It is possible to conduct continuous FAC monitoring in the distribution zone due to WDC recently purchasing portable devices capable of this, but the information being collected is still being assessed for accuracy.

Manual sampling at the WTP and distribution zones also occurs and includes monitoring for *E. coli*/Total Coliforms*, pH, turbidity, FAC and chemicals (Fluoride). The latest program for this can be found in the WDC Sampling Scheduler which is produced on a quarterly basis.

Alarms systems are also present with operators responding to these depending on criticality (High, High/High, Low or Low/Low).

Water quality information for source (characteristics and variability), treated and reticulated water, both recent and historic, add to the understanding of treatability, water quality hazards and the events that have triggered the presence of these in the past. The information described above aids WDC in achieving this, and further allows it to review information relating to hazardous events and overall risk assessment on a frequent basis.

**For the purposes of this WSP any further reference to E. coli forthwith includes total coliform testing by default as per DWSNZ (revised 2018) requirements which take effect from the 1st March 2019.*

4.6 KEY COUNCIL DOCUMENTS

There are a number of key documents that support the implementation of this WSP and they have been listed in the table below. It should be noted that the documents are currently in different states of review with some requiring review and/or update during the term of this WSP.

Document Type	Document Name	Status
Council Planning Docs, Bylaws and Policies	WDC Long Term Plan 2018-2028	Final
	WDC Annual Plan	Completed Annually
	Asset Management Plan – Part B: Water Supply	Final
	WDC Engineering Code of Practice: Chapter 6 (Issue 8 – April 2008)	Final
	Combined Waters Bylaw (September 2017)	Final
	Connection/Disconnection Policy	To be developed
	Backflow prevention Policy	To be developed
Response	WDC Water Supplies CCPs and Process Control Summaries v1	Draft
	Incident Response Plan – Three Waters Assets (Water, Wastewater and Stormwater) last updated 2018.	Due for review
	Cyanotoxin and Cyanobacteria Management Protocol	Final
Operational	Water Treatment Plant Procedures 2012	Due for review
	WDC Sampling Scheduler (developed quarterly)	Final
	Trojan UV O&M Manual	Final
	Log credit – crypto or CRA report/determination even by a DWA	Final
Reports	3 Waters Strategy – Water Supply 2017 (AECOM)	Final
	Whakatane & Plains Water Supply Strategy 2014	Final
	WDC Whakatane Reservoirs – Condition and Seismic Assessment Report 2010 (OPUS)	Final
	Whakatane & Ohope Water Supply Alternative Source (2011)	Final
	Whakatāne River Sanitary Survey 2007 (OPUS)	Final

5 Photos of the Whakatāne Water Supply

Figure 2. Inlet Structure

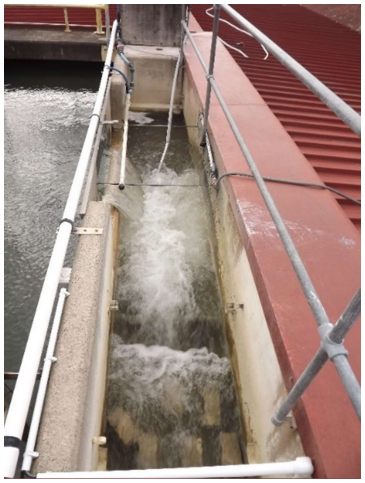


Figure 3. Coagulant addition and rapid mixing

Figure 4. Polymer addition and slow mixing

Figure 5. Carbon addition

Figure 6. Clarifiers

Figure 7. Filters

Figure 8. Dose pumps

Figure 9. Bulk chemical storage

Figure 10. Polymer makeup tanks

Figure 11. UV Reactors and High Lift Pumps

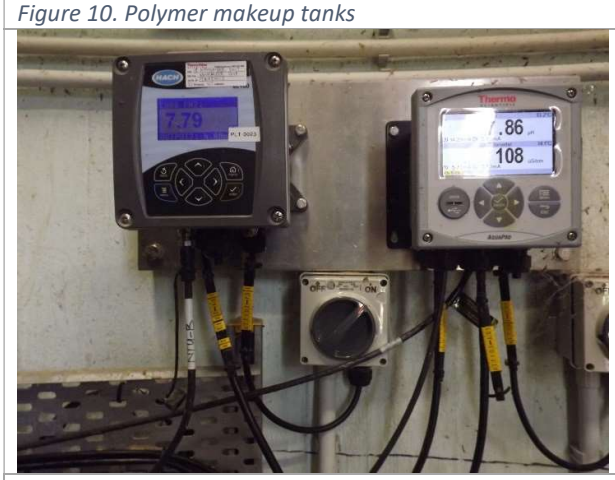


Figure 12. Raw Water Monitoring

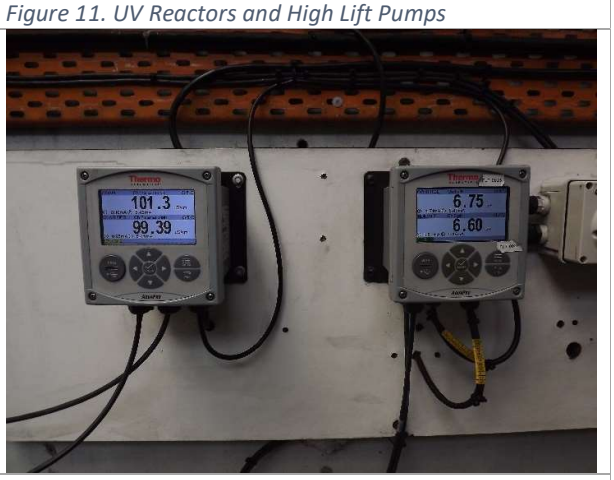


Figure 13. Dosed Raw Water Monitoring

Figure 14. Filter Monitoring

Figure 15. UV Monitoring

Figure 16. Final Water Monitoring

Figure 17. Treated Water Reservoir 1

Figure 18. Treated Water Reservoir 2

Figure 19. Bridger Glade Pump Station

6 Flow Chart Schematic of the Water Supply

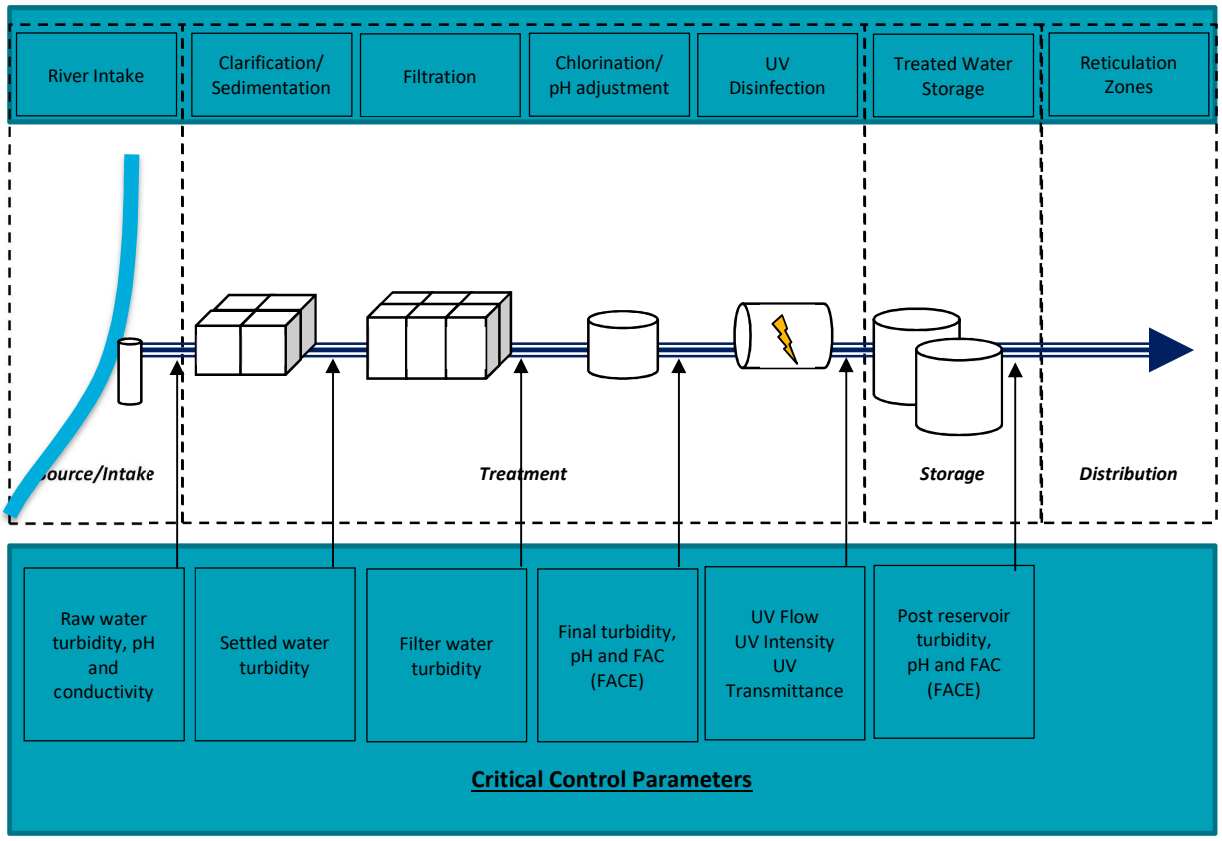


Figure 20: Critical Control Points and Control Parameters for the Whakatāne Water Supply

7 Barriers to Contamination & Critical Points

7.1 BARRIERS TO CONTAMINATION

7.1.1 Stop contamination of raw water

Source protected from contamination: Catchment risk assessments are carried out to identify activities in the catchment, with ongoing monitoring of activities also conducted.

7.1.2 Remove particles from the water

Coagulation and Sedimentation: The treatment plant uses the addition of coagulants to stabilise and flocculate contaminants to enable settling and filtration of the water removing microbiological organisms, organic material and suspended solids. Powdered activated carbon is also added to remove cyanotoxins and volatile organics which may produce odours. This process step provides a barrier to protozoan, particulate and cyanotoxins contamination.

Filtration: The treatment plant uses rapid gravity sand filters to remove remaining filterable material such as organic matter, suspended solids and microbiological organisms after coagulation and sedimentation. It also removes powdered activated carbon which has been added to remove cyanotoxins and volatile organics. This process step provides a barrier to contamination.

7.1.3 Kills germs in the water

Chlorination: The treatment plant uses chlorination to disinfect the water of non-protozoan microbiological organisms. As there is at least 30 minutes contact period before the chlorinated water is distributed to consumers, this provides a barrier to bacterial and viral contamination.

UV Disinfection: UV reactors inactivate bacteria, viruses and protozoa. This provides a barrier to microbiological contamination.

7.1.4 Prevention of recontamination after treatment

Storage Reservoirs: The reservoirs are covered to prevent unauthorised access, ingress of rainwater or contaminants, and to exclude birds and vermin. The following measures contribute to provision of a partial barrier against recontamination of water following treatment.

Reticulation: The following measures contribute to provision of a barrier against recontamination of water following treatment:

- Chlorine dosing is set at a level to ensure it is available to protect the water against microbiological contamination throughout the storage and reticulation.
- Hygiene procedures are documented and followed for all distribution system maintenance.
- Operators are trained and experienced.
- All new and replacement connections in Whakatāne have a minimum of a single untestable check valve installed at the boundary.

7.2 CRITICAL POINTS

Table 2. Critical Points

Critical Point	Description
Intake pumps	*Three pumps operation in duty/standby arrangement, total pump failure means eventual loss of supply*
Silt trap	*Failure may result in water of poorer quality passing through to the clarifiers*
Coagulation, flocculation and sedimentation	*Failure will result in reduced protozoa removal and less effective treatment in filters*
Filtration	*Failure will result in reduced particulate and protozoa removal*
Chlorine	*Failure or low dose will result in failure to control bacterial and viral contaminants* *Overdosing may exceed chemical MAV*
Lime dosing	*Failure or low dose will result in pH unsuitable for effective chlorine disinfection and coagulation.*
UV disinfection	*Failure will result in reduced microbiological (including protozoa) inactivation*
High Lift Pumps	*Failure will result in loss of supply*
Treated water storage	*Possible point for microbiological recontamination*
Distribution system connections	*Possible access point for contamination due to backflow*

7.3 CRITICAL CONTROL POINTS

In response to direction from the Havelock North inquiry (Stage 2), the Ministry of Health released advice to the water industry (via Water NZ) regarding the inclusion of critical control points (CCPs) and process control summaries in WSPs.

As per this advice, WDC has developed a specific document (*Water Supplies CCPs & Process Control Summaries*) that identifies CCPs applicable to the Whakatāne Water Supply. This document holds the CCPs and Process Control Summaries related to *all* WDC water supplies. The applicable sections within this document have been included as an appendix to this WSP (Appendix A)

The CCPs for the Whakatāne Water Supply have been determined by following available guidance material and limits determined based on manufacturer and DWSNZ requirements. The CCPs relating to this WSP will be reviewed upon the installation and optimisation of the any future water treatment plant upgrades (as referred to in the Improvement Plan section).

8 Summary of DWSNZ Compliance

Table 3. Summary of Compliance with DWSNZ

Detail	Compliance prior to 2018/2019	Elected Compliance for 2018/2019[1]
Compliance assessed against	DWSNZ 2005 (revised **2008**)	DWSNZ 2005 (revised **2008**)
Treatment Plant Compliance		
Bacteriological compliance criterion for water leaving the treatment plant	Criterion 2A	Criterion 2A
Bacterial compliance for water leaving the treatment plant has been achieved for the last 4 quarters.	*Achieved*	
Protozoa log removal requirement	4.0 log	3.0 log
Protozoa removal processes in place	Coagulation, Filtration, UV	Coagulation, Filtration, UV
Protozoa compliance for water leaving the treatment plant has been achieved for the last 4 quarters.	*Achieved*	
Cyanobacteria determinants allocated to supply	Yes	Yes
Cyanobacterial compliance has been achieved for the last 4 quarters.	*Achieved*	
Chemical determinands allocated to supply	Yes	Yes
Chemical compliance achieved for the last 4 quarters.	*Achieved*	
Radiological determinands allocated to supply	None	None
Radiological compliance achieved for the last 4 quarters.	*n/a*	*n/a*
Distribution Zone(s) Compliance		
Bacteriological compliance criterion for water in the distribution zone(s)	Criterion 6A	Criterion 6A
Bacteria compliance for water in the distribution zone has been achieved for the last 4 quarters.	*Achieved*	

[1] For future years (2019/2020 and on), compliance criteria will be elected each year for the applicable compliance period as per the changes in Section 3.1.1 of the DWSNZ (revised **2018**)

9 Risk Assessment Methodology

This WSP has been prepared in line with the guidance material provided by the Ministry of Health and included the following documents:

- Various Water Safety Plan Guides for Drinking-water Supplies
- A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies
- New Zealand Drinking-water Safety Plan Framework 2018

The following risk information tables list all risks which are applicable to the Whakatāne Water Supply and have been developed based on nationally and internationally available guidance material.

The purpose of the risk tables is to provide detailed information to be used in managing risks linked to the individual supply components. The risks tables are grouped by supply elements.

Corrective Actions and Contingency Plans have been prepared and/or referenced to provide guidance in the event that preventative measures fail to prevent the occurrence of a risk event that may present an acute risk to public health (refer to Section 12 and Appendix A).

9.1 RISK RANKING

Risk assessment of each hazard and hazardous event identified requires consideration of likelihood of the hazardous event occurring in a specified timeframe, combined with the severity of the consequences the hazard may cause.

Table 4. Likelihood Scale

Level	Descriptor (Likelihood it will happen today)	Example description
A	Almost certain	Occurs more often than once per week
B	Likely	Occurs more often than once per month and up to once per week
C	Possible	Occurs more often than once per year and up to once per month
D	Unlikely	Occurs more often than once every five years and up to once per year
E	Rare	Occurs less than or equal to once every five years

Table 5. Consequence Scale

Consequence	Description
Catastrophic	Major impact on most of the population, complete failure of systems, high level of monitoring and incident management required. Acute harm to people, declared outbreak or widespread illness.
Major	Major impact on a sub-population, systems significantly compromised and abnormal operation, high level of monitoring and incident management required. Potential acute harm to people, declared outbreak or widespread illness expected.
Moderate	Minor impact on most of the population, significant modification to normal operation but manageable, increased monitoring. Potential widespread aesthetic issues or repeated breach of Maximum Acceptable Value (MAV).
Minor	Minor impact on a sub-population, some manageable operation disruption. Potential local aesthetic issues, isolated exceedance of MAV.
Insignificant	Insignificant impact, little disruption to normal operational. Isolated exceedance of aesthetic parameter.

Table 6. Risk Level Allocation Table

		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost certain	*Medium*	*High*	*High*	*Extreme*	*Extreme*
	Likely	*Medium*	*Medium*	*High*	*High*	*Extreme*
	Possible	*Low*	*Medium*	*Medium*	*High*	*High*
	Unlikely	*Low*	*Low*	*Medium*	*Medium*	*High*
	Rare	*Low*	*Low*	*Low*	*Medium*	*Medium*

9.2 REMAINING RISK CERTAINTY

Remaining risk certainty has been included in this WSP to demonstrate how confident Council is in its risk ranking. The table below includes the categories of uncertainty and a corresponding description, that has been applied in this instance.

Table 7. Level of Uncertainty

Level of Uncertainty	Description

Certain	• There are at least five years of:
	  ○ continuous data (e.g. FAC), or
	  ○ daily monitoring data (*E. coli* monitoring), or
	  ○ monthly monitoring data (chemical), or
	  ○ inspection records,
	which have been collated and analysed, and variability is predictable.
	• There are at least five years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events, which have been collated and analysed and variability is predictable.
	• The hazardous event and preventive measures/processes involved are thoroughly understood.

Confident	• There are at least two years of:
	  ○ continuous data (e.g. FAC), or
	  ○ daily monitoring data (*E. coli* monitoring), or
	  ○ monthly monitoring data (chemical), or
	  ○ inspection records,
	which have been collated and analysed, and variability is predictable.
	• There are at least two years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events, which have been collated and analysed and variability is predictable.
	• There is a good understanding of the hazardous event and preventive measures/processes involved.

Level of Uncertainty	Description

Reliable	• There is at least one year of:
	  ○ continuous data (e.g. FAC), or
	  ○ daily monitoring data (*E. coli* monitoring), or
	  ○ monthly monitoring data (chemical), or
	  ○ inspection records,
	which have been collated and analysed, and variability is predictable.
	• There are at least two years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events, but variability is not predictable.
	• There is a good understanding of the hazardous event and preventive measures/processes involved.

Estimate	• There are limited monitoring data available. • There is a reasonable understanding of the hazardous event and preventive measures/process involved.
Uncertain	• There are limited or no monitoring data available. • The hazardous events or preventive measures/processes are not well understood.

9.3 REMAINING RISK ACCEPTABILITY

A decision on risk acceptability has also been included in the risk tables. Where a 'Remaining Risk level' is greater than 'Medium', the Water supplier has given a statement on whether that risk level is acceptable or not. This is assessed by considering the certainty of the risk and whether an improvement is required.

10 Risk Tables

10.1 RAW WATER SOURCE

Risk Table 1. Raw Water Source

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements[2]	Corrective Action(s) and/or Contingency Plan[3]
Microbiological Contamination	1.1	Surface runoff from farmland in the Whakatāne River catchment	**Extreme** (Almost Certain x Catastrophic)	Raw water turbidity, pH, conductivity and/or settled water turbidity outside the target ranges as per process control summary Illness in community	Coagulation, filtration, chlorination, and UV treatment Continuous monitoring and alarms in place related to specified 'Indicators' Liaising with land owners in the immediate vicinity of the two intakes.	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 03**"	Increase coagulant and / or chlorination rate Temporarily reduce plant flow rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP2** and/or **CP4**
Microbiological Contamination	1.2	Discharges from community wastewater systems, dairy effluent ponds, farmed animals or septic tank systems	**Extreme** (Likely x Catastrophic)	Raw water turbidity, pH, conductivity and/or settled water turbidity outside the target ranges as per process control summary Illness in community	Coagulation, filtration, chlorination, and UV treatment Continuous monitoring and alarms in place related to specified 'Indicators' Discharges consented by the BOPRC.	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 03**"	Temporarily reduce plant flow rate Increase coagulant and / or chlorination rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP4**
Chemical Contamination	1.3	Surface runoff containing chemical contaminants from agricultural activities. (e.g. pesticides, fertilisers etc)	**High** (Possible x Major)	Taste and/or odour complaints Information provided by public about activities within the catchment Annual chemical analysis results identify chemical contaminants more than 50% of the DWSNZ MAVs	No P2's related to agricultural activities are currently registered against the supply Coagulation and filtration treatment 24 hours storage provided in reservoirs Dioxins monitored by BoP Regional Council PAC dosing WDC notified by 1080 application companies. Full pesticide suite testing carried out (2013, 2017)	**Medium** (Unlikely x Major)	Estimate	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 01**" Improvement "**OP-IMP 02**" Improvement "**OP-IMP 03**" (a,b & c) Improvement "**OP-IMP 27**"	Increase coagulant dosing rate Increase PAC dosing rate Temporarily reduce plant flow rate Initiate **CP5**
Chemical Contamination	1.4	Industrial chemical spill	**High** (Unlikely x Catastrophic)	Reduction in visual quality of raw water Taste and/or odour complaints Chemical tests if a problem is suspected	24 hours storage provided in reservoirs PAC dosing Spill booms used at intake weir WDC notified by Police and Fire services of crashes to river.	**High** (Unlikely x Major)	Uncertain	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 01**" Improvement "**OP-IMP 03**" (c)	Increase PAC dosing Test stored water - Waste if contaminated Initiate **CP5**

[2] Priority Project number aligns with those priority projects identified within Section 11: Improvement Schedules
[3] CP reference directly aligns with those referred to within the Section 12: Contingency and Response Plans

Risk Table 1. Raw Water Source										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements[2]**	**Corrective Action(s) and/or Contingency Plan[3]**
									Improvement "**OP-IMP 02**"	
Chemical Contamination	1.5	Cyanobacteria growth in source water	**High** (Possible x Catastrophic)	Observation and monitoring as per the Cyanobacteria Management Protocol Taste and/or odour complaints	PAC dosing as required Cyanotoxin and Cyanobacteria Management Protocol is in place 4 hourly air purging of inlet structure to remove algae	**High** (Possible x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 32**"	Increase PAC dosing rate Temporarily reduce plant flow rate Initiate **CP6**
Chemical Contamination	1.6	Unauthorised intentional introduction of contaminants at inlet structure	**Medium** (Possible x Moderate)	Raw water turbidity, pH, conductivity and/or settled water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Access to inlet structure is secure River at inlet is large and fast flowing, so dilution of chemicals near inlet reduces the possible level of contamination Treatment processes will remove some chemical contaminants	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Increase PAC dosing rate Temporarily reduce plant flow rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP5**
Chemical Contamination	1.7	Accidental introduction of contaminants by staff to source water	**Medium** (Possible x Moderate)	Operator observes spill Raw water turbidity, pH, conductivity and/or settled water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Chemicals for cleaning or lubrication are suitable for potable water Chemicals are stored outside of the intake area Supply can be isolated until risk of contamination has been removed	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Increase PAC dosing rate Temporarily reduce plant flow rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP5**
Salt Water Contamination	1.8	Ingress of salt water to supply, when high tides coincide with low river level	**High** (Likely x Major)	Raw water conductivity outside the target range as per process control summary Taste and/or odour complaints	Continuous monitoring and alarms in place related to specified 'Indicators' River level monitored Intake shifted upstream from previous position	**High** (Possible x Major)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Shift to upstream intake See Appendix A for applicable process control summaries and corrective actions Initiate **CP7** and/or **CP8**
Sediment Contamination	1.9	Source water turbidity > 2000NTU	**Extreme** (Likely x Catastrophic)	Large rainfall event in catchment Raw water turbidity and/or settled water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' 24 hours storage in reticulation system. Can still treat raw water, but treated water quality may be poor – switch coagulant to PACl	**Medium** (Possible x Minor)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 03**" (c)	Increase PAC dosing rate Temporarily reduce plant flow rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP2** and/or **CP4**

10.2 ABSTRACTION

Risk Table 2. Abstraction

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Loss of Supply	2.1	Intentional vandalism or accidental damage to intake structure by floating objects in river (including manned craft)	**High** (Likely x Major)	Obvious signs of damage to structure Reduced/no flow to treatment plant	Intake structure submerged and marked with buoy Three intake options available. Main intake, floating intake and 'Nessie' intake 1.5mm Screened intake at minimum 1200mm below water's surface Log deflection device upstream	**Medium** (Possible x Moderate)	Reliable	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Shift intake to alternative intake. Repair intake structure Initiate **CP7**
Loss of Supply	2.2	Damage to intake support structure due to lack of maintenance	**High** (Likely x Major)	Obvious signs of damage to the structure Reduced/no flow to treatment plant	Maintenance carried out on structure. Temporary floating intake pumps can be installed relatively easily if required Three intake options available. Main intake, floating intake and 'Nessie' intake	**Medium** (Possible x Moderate)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Shift intake to alternative intake. Repair intake structure Switch to tankered water supply Initiate **CP7**
Loss of Supply	2.3	Drought or extreme low flows in Whakatāne River making intake ineffective	**High** (Possible x Major)	Low flows in river or prolonged drought conditions	Intake is at sufficient level to cope with known low flow events. Floating intake can be used if required.	**High** (Possible x Major)	Reliable	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Shift intake to most appropriate alternative intake Switch to tankered water supply Initiate **CP7**
Loss of Supply	2.4	Mechanical failure of intake pump/s	**High** (Possible x Major)	Reduced/no flow to treatment plant.	Greater than 24 hour's storage throughout supply Three intake pumps in place with generally operating two at a time Repair able to be affected within 24 hours	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 26**"	Switch to alternative intake pump and repair damaged intake pump Switch to tankered water supply Initiate **CP7**
Loss of Supply	2.5	Failure of pumps due to power outage	**High** (Likely x Moderate)	No flow to treatment plant	Greater than 24 hour's storage throughout supply	**Medium** (Unlikely x Moderate)	Confident	Unacceptable	Improvement "**OP-IMP 10**"	Switch to generator power supply Initiate **CP7**
Loss of Supply	2.6	Failure of pumps due to flooding of switchgear	**Medium** (Possible x Moderate)	No flow to treatment plant	Greater than 24 hour's storage throughout supply Switchgear and electrical equipment lifted above highest known recent flood level	**Medium** (Unlikely x Moderate)	Confident	Acceptable	None identified	Wait for flood waters to recede and repair switchgear Switch to tankered water supply Initiate **CP7**

Risk Table 2. Abstraction										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Loss of Supply	2.7	Failure of intake pipe	**Medium** (Possible x Moderate)	Reduced/no flow to treatment plant	Greater than 24 hour's storage throughout the supply 2nd intake pipe (Nessie) available	**Low** (Possible x Minor)	Estimate	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Switch to alternative intake pipe Repair intake pipe Switch to tankered water supply Initiate **CP7**
Loss of right to take Water	2.8	Consent to take water is not applied for in due time or is declined by Regional Council	**High** (Possible x Major)	Current water take consent is held by WDC	Current consent is valid until 2026.	**Medium** (Unlikely x Major)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 12**"	Apply for consent well in advance of consent expiry (ensuring continued take) Appeal decision
Loss of Supply	2.9	Intake blockage occurs due to debris	**High** (Possible x Major)	Reduced or restricted flow to treatment plant	1.5mm wire wedge screens are located at the intake Log deflector in place 24 hours storage throughout the supply Air backwash in place Two additional intakes available	**Low** (Unlikely x Minor)	Confident	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Switch to alternative intake Clear blockage Initiate **CP7**
Loss of Supply	2.10	Over-allocation of source water by BOPRC to other consent holders	**High** (Possible x Major)	Reduced flow to treatment plant	Existing Resource consent Make submissions to relevant resource consents to prevent over allocation	**Medium** (Unlikely x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	
Loss of Supply	2.11	Major landslip in catchment	**High** (Possible x Major)	Reduced flow to treatment plant Increased sediment loading in raw water	Continuous monitoring and alarms in place related to specified 'Indicators' 24 hours storage in reticulation	**Medium** (Rare x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Increase treatment chemical dosing rate(s) Temporarily reduce plant flow rate Initiate **CP2** and/or **CP7**

10.3 PRETREATMENT

Risk Table 3. Pretreatment

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Grit or sediment not removed	3.1	Grit chamber inflow blocked – overloaded with silt	**High** (Likely x Moderate)	Grit or increased sediment reaches clarifiers Raw water turbidity and/or settled water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Hopper bottom Grit chamber cleaned daily Hopper bottom Desludging occurs weekly Silt/sediment bled continuous from grit chamber during flood events	**Medium** (Possible x Moderate)	Reliable	Acceptable	None identified	Clear out grit chamber See Appendix A for applicable process control summaries and corrective actions Initiate **CP2** and/or **CP7**
Loss of right to discharge sediment	3.2	Consent to discharge sediment is not renewed or is declined by Regional Council	**Low** (Possible x Insignificant)	Current sediment discharge consent is held by WDC	Current consent is valid until 2026	**Low** (Unlikely x Insignificant)	Confident	Acceptable	None identified	Apply well in advance of consent expiry (ensuring continued discharge rights) Appeal decision
Chemical Contamination	3.3	Accidental introduction of contaminants by staff	**Medium** (Possible x Moderate)	Operator observes spill Raw pH and/or conductivity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Chemicals for cleaning or lubrication are suitable for potable water Chemicals are stored outside of the intake area Supply can be isolated until risk of contamination has been cleared	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Reduce treatment flow rate Isolate supply, waste contaminated water Increase PAC / coagulant / flocculant dosing rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP5**

10.4 COAGULATION & CLARIFICATION

Risk Table 4. Coagulation & Clarification

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Flocs not formed	4.1	Inadequate mixing of coagulant	**Medium** (Possible x Moderate)	Poor floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Mixing energy calculated and adequate Turbidity is monitored online in water leaving the clarifiers and filters Dose point integrity and dose line integrity checked daily 24 hours storage in reservoirs and reticulation	**Low** (Unlikely x Minor)	Confident	Acceptable	None identified	Adjust treatment plant flow rate to improve coagulant mixing See Appendix A for applicable process control summaries and corrective actions
Flocs not formed	4.2	Coagulant dose pump failure	**Medium** (Possible x Moderate)	Poor or no floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Programmed maintenance of pump Daily visual inspection of pump operation and treated water Critical dose pump spares held on site Two dose pumps – standby and duty Pump failure activates critical alarm 24 hours storage in reservoirs and reticulation	**Low** (Unlikely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 26**"	Slow or stop treatment plant flow rate Repair coagulant dose pump See Appendix A for applicable process control summaries and corrective actions
Flocs not formed	4.3	Coagulant chemical supply exhausted	**Medium** (Possible x Moderate)	Poor floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Operators at plant every work day and aware when chemical supplies are getting low Minimum two weeks supply of chemicals held in stock Delivery of chemicals is usually 3 working days after ordering. Can be delivered within 24 hours 24 hours storage in reservoirs and reticulation	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Slow or stop treatment plant flow rate Request urgent delivery of coagulant chemical See Appendix A for applicable process control summaries and corrective actions

Risk Table 4. Coagulation & Clarification									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Poor floc formation	4.4	Raw water pH too high or too low for optimal coagulation	**Medium** (Possible x Moderate)	Poor floc formation Floc carryover to the filters Raw water pH, settled water turbidity and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Pre-clarifier pH correction dosing used as required	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Adjust pH dosing as required. Modify coagulant dosing rate as appropriate See Appendix A for applicable process control summaries and corrective actions
Poor floc formation	4.5	pH dosing pump system failure	**Medium** (Possible x Moderate)	Poor floc formation Floc carryover to the filters Raw water pH, settled water turbidity and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Manual lime addition Regular calibration and maintenance of pH meter and sample lines Post lime dosing pump can be used. 24 hours storage in reservoirs and reticulation	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 26**"	Manually dose lime. Switch to post lime dosing pump Repair pH dosing pump See Appendix A for applicable process control summaries and corrective actions
Poor floc formation	4.6	pH correction chemical supply exhausted	**Medium** (Possible x Moderate)	Poor floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Operators at plant every day and aware when chemical supplies are getting low Chemicals are held in bulk (approximately 1 months' worth) at treatment plant Delivery of chemicals is usually within 3 working days after ordering. It is possible to have replacement chemicals on site within 24 hours. 24 hours storage in reservoirs and reticulation	**Medium** (Unlikely x Moderate)	Certain	Acceptable	None identified	Slow or stop treatment plant flow rate Request urgent delivery of pH correction chemical See Appendix A for applicable process control summaries and corrective actions

Risk Table 4. Coagulation & Clarification										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Flocs not formed	4.7	Plant flow varies too much – more than 100m3/hour	**Medium** (Likely x Minor)	Poor or no floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Proportional control for coagulant and polymer dose pump speed Monthly validation of dose pump response to changes in plant flow Daily review of chemical use vs. water volume 24 hours storage in reservoirs and reticulation	**Low** (Unlikely x Minor)	Certain	Acceptable	None identified	Manually control plant flow rate See Appendix A for applicable process control summaries and corrective actions
Poor flow distribution	4.8	Poor flow distribution across clarifier launders	**High** (Likely x Moderate)	Build of algae and scum causing launders to become blocked Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Launders cleaned weekly 24 hours storage in reservoirs and reticulation	**Medium** (Possible x Moderate)	Confident	Acceptable	None identified	Clean launders See Appendix A for applicable process control summaries and corrective actions
Poor floc formation	4.9	Build-up of sludge in gravilectric cones/ clarifier	**High** (Likely x Moderate)	Build-up of sludge in gravilectric cones Visual Sludge carry over from clarifiers Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Manually bleed sludge from clarifier when required Full clarifier clean every 3 – 4 months. 24 hours storage in reservoirs and reticulation	**Medium** (Possible x Moderate)	Reliable	Acceptable	None identified	Manually bleed sludge in clarifiers Adjust chemical dose rates and/or plant flow See Appendix A for applicable process control summaries and corrective actions
Flocs not formed	4.10	Inappropriate or poor quality chemicals used	**Medium** (Possible x Moderate)	No or poor floc formation. Settled and/or filtered water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Product supplier relied on to provide suitable quality chemicals Operator verifies chemicals at delivery Agreement with chemical supplier to provide the appropriate quality of chemicals used in treatment process	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 05**"	Request urgent delivery of correct &/or good quality chemicals See Appendix A for applicable process control summaries and corrective actions
Flocs not formed	4.11	Loss of chemical from bulk storage tank	**High** (Possible x Major)	Spilled chemical visible on makeup area floor No or poor floc formation Bunding around the bulk storage full	Operator at plant every day Two coagulant make up tanks, and associated delivery	**Low** (Rare x Major)	Reliable	Acceptable	None identified	Isolate spilled chemical and clean up Switch to alternative coagulant makeup tank If necessary, submit urgent order for replacement chemical

Risk Table 4. Coagulation & Clarification

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Flocs not formed	4.12	Leaks in the supply line from the coagulant bulk storage	**Medium** (Possible x Minor)	No or poor floc formation Settled and/or filtered water turbidity outside the target ranges as per process control summary Leaks noted by operator	Continuous monitoring and alarms in place related to specified 'Indicators' Plant attended 7 days and leaks able to be fixed as detected	**Low** (Unlikely x Minor)	Estimate	Acceptable	None identified	Repair leaks in supply line from coagulant bulk storage See Appendix A for applicable process control summaries and corrective actions
Flocs not formed	4.13	Sudden raw water quality change (storm event)	**High** (Likely x Major)	Raw water turbidity and/or conductivity outside the target ranges as per process control summary Inclement weather is forecast	Continuous monitoring and alarms in place related to specified 'Indicators' Plant operator monitors the forecast for weather warnings Plant operator attends plant during flood events. Chemical dose rates adjusted if required Coagulant switched to PACl	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 04**"	Slow plant flow rate Increase dose rates of PAC/coagulant/flocculant See Appendix A for applicable process control summaries and corrective actions
Poor Settling	4.14	Uneven flow to clarifiers	**Medium** (Possible x Moderate)	Settled water turbidity outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Daily clarifier inspection Clarifiers desludged quarterly Plant flow naturally balanced between clarifiers Clarifiers cleaned as required	**Low** (Unlikely x Minor)	Confident	Acceptable	None identified	Clean launders to ensure even flow See Appendix A for applicable process control summaries and corrective actions
Intentional clarifier contamination	4.15	Intentional contamination of clarifiers by 3rd party	**Medium** (Possible x Moderate)	Discolouration of water in clarifiers Floating debris Poor floc formation	Plant including clarifiers fully fenced. Additional treatment processes in place (filtration, chlorination, and UV) following clarifiers	**Medium** (Unlikely x Moderate)	Uncertain	Unacceptable	Improvement "**CAP-IMP 05**"	Stop supply Remove visible contaminants Test for residual contamination Initiate **CP5**

10.5 FILTRATION

Risk Table 5. Filtration

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Particles not removed	5.1	Individual filter failure or inconsistent performance of an individual filter	**High** (Likely x Major)	Variation between turbidity of water leaving each filter	Continuous monitoring and alarms in place related to specified 'Indicators' First alarm alerts operator of issue, second alarm shuts down the filter Each filter able to be isolated	**Medium** (Possible x Moderate)	Confident	Acceptable	None identified	Isolate filter Inspect and repair
Particles not removed	5.2	Media loss from excessive backwashing rate or deterioration of filtration media	**High** (Likely x Moderate)	Filter water turbidities outside the target ranges as per process control summary Increased frequency of backwashing required	Continuous monitoring and alarms in place related to specified 'Indicators' Monitoring of backwash & back wash procedure check sheet Filter media depth checked 6 monthly and topped up if required All filters have been upgraded with finer nozzles, 100- 150mm Garnet base & 600mm filter sand	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Isolate filter Reduce backwashing rate Inspect and replace media See Appendix A for applicable process control summaries and corrective actions
Particles not removed	5.3	Failure of backwash	**High** (Likely x Moderate)	Filter water turbidities outside the target ranges as per process control summary Back wash procedure check sheet identifies need for remedial actions	Continuous monitoring and alarms in place related to specified 'Indicators' Supply of backwash water always available while plant is operating Manual initiation and observation of backwash First alarm alerts operator of issue, second alarm shuts down the filter Manual filter to waste facility in place Individual filters can be isolated	**Low** (Unlikely x Minor)	Confident	Acceptable	None identified	Isolate filter Inspect and if necessary, repair See Appendix A for applicable process control summaries and corrective actions
Particles not removed	5.4	Air scour blower failure	**High** (Likely x Moderate)	Filter water turbidities outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Regular backwashes carried out (2 of 6 filters per day) Back wash without air scour Critical spares retained Air scour serviced annually Replacement blower retained on site	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Repair air scour blower See Appendix A for applicable process control summaries and corrective actions

Risk Table 5. Filtration										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Particles not removed	5.5	Inability to backwash effectively due to power outage	**High** (Likely x Moderate)	Filter water turbidities outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Power failure stops water flow through the plant Greater than 24 hours water storage in system	**Medium** (Possible x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 10**"	Switch to alternative power supply (generator) Isolate filter if appropriate See Appendix A for applicable process control summaries and corrective actions
Incomplete protozoa barrier	5.6	Existing filtration inadequate for removal of particles to log level required by DWSNZ	**High** (Likely x Major)	Coagulation, flocculation and filtration processes do not meet protozoa log removal requirements of DWSNZ Filter water turbidities outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Existing coagulation, clarification and filtration provides a barrier against protozoa (log 3) UV disinfection provides additional barrier (log 3)	**Low** (Unlikely x Minor)	Certain	Acceptable	None identified	Increase chlorination rate to increase/ maintain chlorine residual
Particles not removed	5.7	Sudden flow rate changes through filters	**Medium** (Possible x Moderate)	Filter water turbidities outside the target ranges as per process control summary Change in plant rate	Continuous monitoring and alarms in place related to specified 'Indicators' Flow balancing in clarifiers	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Stop or slow treatment plant flow Check flow balancing in clarifier launders, clean if necessary See Appendix A for applicable process control summaries and corrective actions
Particles not removed	5.8	Filter control failure	**High** (Possible x Major)	Filter water turbidities outside the target ranges as per process control summary Insufficient air – valve does not close	Continuous monitoring and alarms in place related to specified 'Indicators' Ensure sufficient air available for pneumatic valves Twin air compressors installed thus reducing likelihood of air outage for valve control Filter high and low level and out flow alarms in place Switch to manual control of plant Shut down plant or individual filter on high turbidity	**Medium** (Unlikely x Moderate)	Reliable	Acceptable		Isolate filter Repair filter control See Appendix A for applicable process control summaries and corrective actions

Risk Table 5. Filtration

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Particles not removed	5.9	Turbidimeter system failure	**Medium** (Likely x Minor)	Filter water turbidities outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Flow of water to turbidimeters checked daily First alarm alerts operator of issue, second alarm shuts down the filter Turbidimeters powered from UPS as critical equipment Meters verified weekly Meters calibrated 3 monthly with further annual calibration of turbidimeter by external agency	**Low** (Unlikely x Minor)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Repair turbidimeter(s) Dose additional PAC Dose additional coagulant See Appendix A for applicable process control summaries and corrective actions
Particles not removed	5.10	Filter under drain and nozzle system failure	**High** (Likely x Major)	Filter water turbidities outside the target ranges as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Backwash pattern is regularly inspected Filter isolated possible Isolate filter causing high turbidity	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Isolate filter Repair underdrain / nozzle system See Appendix A for applicable process control summaries and corrective actions
Particles not removed	5.11	Filtered water at risk of intentional or unintentional contamination (i.e. vandalism or volcanic ash)	**Medium** (Unlikely x Major)	Discolouration of water Floating Debris on filters Items visible in top of sand filters	Plant security fenced Roof structure over filters on eastern side (closest to road)	**Medium** (Unlikely x Moderate)	Estimate	Unacceptable	Improvement "**CAP-IMP 06**"	Stop plant, recover debris Test for likely contamination Switch to tankered water supply

10.6 PH ADJUSTMENT

Risk Table 6. pH Adjustment

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
pH Adjustment too High or Low	6.1	Dosing system failure	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' On pH alarm, plant shuts down Spare pump inline which can be used for either pre-pump and post pump for lime correction dosing Full annual service (filtration technology) Critical equipment carried in stock 3 field meters available to verify pH.	**Medium** (Unlikely x Moderate)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Slow or stop plant flow rate Repair pH dosing system failure See Appendix A for applicable process control summaries and corrective actions
pH Adjustment too High or Low	6.2	Blockages in dosing system	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Dose lines flushed daily PE lines are replaced every 3-4 weeks Post lime pump can be used for pre-lime duty Full annual service (filtration technology)	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Slow or stop plant flow rate Repair /remove blockages in pH dosing system See Appendix A for applicable process control summaries and corrective actions
pH Adjustment too High or Low	6.3	Incorrect dosing rate or set point	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Check for actual set point Manual adjustment of set point	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Set pH dosing to correct rate / set point See Appendix A for applicable process control summaries and corrective actions
pH Adjustment too High or Low	6.4	pH probe failure	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary pre & post pH adjustment meters have poor or unusual correlation	Continuous monitoring and alarms in place related to specified 'Indicators' Probe checked with buffer solutions weekly Calibrate pH analysers consistent with the requirements of the DWSNZ and retain calibration records	**Medium** (Unlikely x Moderate)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Repair or replace pH probe See Appendix A for applicable process control summaries and corrective actions

Risk Table 6. pH Adjustment									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
pH Adjustment too High or Low	6.5	Localised power failure	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Plant shuts down if pre- lime pH meter power lost Plant alarm if post lime pH power lost Power supply monitored via telemetry	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 10**"	Repair power supply Switch to alternative power supply (generator) See Appendix A for applicable process control summaries and corrective actions
pH Adjustment too High or Low	6.6	Chemical supply exhausted	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Minimum of 10 days stock held at plant – visual check conducted daily	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Submit urgent chemical order See Appendix A for applicable process control summaries and corrective actions
pH outside of required range	6.7	Controller failure	**Medium** (Possible x Moderate)	Final water pH outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators'	**Medium** (Unlikely x Moderate)	Confident	Acceptable	None identified	Repair or replace controller See Appendix A for applicable process control summaries and corrective actions

10.7 CHLORINATION

Risk Table 7. Chlorination									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Inadequate Chlorination	7.1	Chlorine gas supply exhausted	**Medium** (Unlikely x Major)	Illness in community Final water FAC outside the target range as per process control summary or E. coli detected in water leaving treatment plant	Continuous monitoring and alarms in place related to specified 'Indicators' Bulk (900kg) duty and standby 70kg chlorine gas tank on auto change over with alarm set up on low weight level of drum and also have notification to operator of changeover 24hrs storage available	**Medium** (Rare x Major)	Certain	Acceptable	Improvement "**OP-IMP 04**"	Place urgent order for chlorine gas Notify community See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**

Risk Table 7. Chlorination

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Inadequate Chlorination	7.2	Dosing system failure	**Medium** (Possible x Moderate)	Final water FAC outside the target range as per process control summary or E. coli detected in water leaving treatment plant Chlorine alarm triggered	Continuous monitoring and alarms in place related to specified 'Indicators' Venturi vacuum system has low failure rate HSNO certified installation maintained Chlorine leak alarm	**Medium** (Unlikely x Moderate)	Certain	Acceptable	Improvement "**OP-IMP 04**"	Stop plant flow Repair chlorine dosing system See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**
Inadequate Chlorination	7.3	Manual set point wrong	**Medium** (Likely x Minor)	Final water FAC outside the target range as per process control summary or E. coli detected in water leaving treatment plant	Continuous monitoring and alarms in place related to specified 'Indicators' Set point Manual and FAC automatically maintained Second FAC analyser provides FAC after 30 minutes contact time and should therefore have a C.t value of at least 6 FAC testing in reticulation (0.4mg/l at end of reticulation)	**Low** (Unlikely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Reset chlorine set point See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**
Inadequate Chlorination	7.4	Inadequate C.t value during peak demand	**High** (Likely x Moderate)	Final water FAC outside the target range as per process control summary or E. coli detected in water leaving treatment plant Random testing of FAC shows FAC below 0.2mg/L during peak demand period *E. coli* / Total Coliform results exceed permitted levels Sickness in the community	Continuous monitoring and alarms in place related to specified 'Indicators' All water leaving the treatment plant passes through main storage reservoir which provides a C.t value greater than 6 Contact tank has min 30 minutes retention time up to 460m^3/h. remaining retention time provided in tanks & first reservoir Post reservoir sample line fed back to the treatment plant with alarms	**Low** (Unlikely x Minor)	Confident	Acceptable	Improvement "**OP-IMP 13**"	Reduce plant flow rate Increase chlorination rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**
Inadequate Chlorination	7.5	Chlorine demand exceeds chlorine dose due to high raw water turbidity	**High** (Likely x Major)	Settled and/or filtered water turbidity outside the target ranges as per process control summary Final water FAC outside the target range as per process control summary or *E. coli* detected in water leaving treatment plant	Continuous monitoring and alarms in place related to specified 'Indicators' High turbidity alarms, and plant shutoff, and filter to waste available Coagulation, sedimentation and filtration processes	**Medium** (Possible x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 04**"	Reduce plant flow rate Increase chlorine dose rate Increase coagulation rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**

Risk Table 7. Chlorination

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Over Chlorination	7.6	Dosing system failure	**High** (Likely x Major)	Final water FAC outside the target range as per process control summary or *E. coli* detected in water leaving treatment plant Odour and taste complaints from consumers	Continuous monitoring and alarms in place related to specified 'Indicators' Venturi vacuum system has low failure rate.	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 06**" Improvement "**OP-IMP 31**"	Stop plant Repair chlorine dosing system See Appendix A for applicable process control summaries and corrective actions Initiate **CP5**
Over Chlorination	7.7	Chlorine dose rate incorrect	**High** (Likely x Moderate)	Final water FAC outside the target range as per process control summary or *E. coli* detected in water leaving treatment plant	Continuous monitoring and alarms in place related to specified 'Indicators' Set point determined from FAC on-line monitoring Storage attenuates high chlorine dose	**Low** (Unlikely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 06**" Improvement "**OP-IMP 31**"	Stop plant Adjust chlorine dose rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP5**
Incorrect or no Chlorination	7.8	Chlorine analyser failure	**High** (Likely x Major)	Analyser stops reading Odour or taste complaints from consumers Final water FAC outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Daily colorimetric comparison to check analyser Annual service contract with filtration technology Manual checking of FAC and pH until analyser replaced or repaired Calibrate chlorine analysers consistent with the requirements of the DWSNZ and retain calibration records	**Medium** (Rare x Major)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 06**"	Repair chlorine analyser Modify PAC dosing rate See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**
Inadequate chlorination	7.9	Power failure	**High** (Likely x Moderate)	Analyser stops reading Final water FAC outside the target range as per process control summary No power to plant	Continuous monitoring and alarms in place related to specified 'Indicators' Plant shutdown – no power no flow Plant shuts down in high/ low chlorine alarm Demand restrictions can be implemented in extended power loss	**Medium** (Possible x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 10**"	Switch to alternative power supply (generator) See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**

Risk Table 7. Chlorination									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Recontamination of treated water	7.10	Intentional breach or sabotage, entry of animals to contact tank	**High** (Possible x Major)	Final water FAC outside the target range as per process control summary or *E. coli* detected in water leaving treatment plant Contact tank is leaking Complaints of taste odour issue from community Illness in the community	Continuous monitoring and alarms in place related to specified 'Indicators' Contact tank is beneath the plant. Access is via manhole within the plant, which is security controlled at three entry points Two security fences and security access to control room	**Medium** (Rare x Major)	Reliable	Acceptable	None identified	Remove foreign items from tank Repair breach or sabotage to contact tank See Appendix A for applicable process control summaries and corrective actions Initiate **CP1** and/or **CP3**

10.8 UV DISINFECTION

Risk Table 8. UV Disinfection									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Inadequate Disinfection	8.1	UV intensity insufficient due to build-up of deposits on sleeve	**Extreme** (Almost Certain x Major)	UV parameters outside the target range as per process control summary *E. coli* detected in water or illness in the community Visible build-up of deposits on sleeve	Continuous monitoring and alarms in place related to specified 'Indicators' Additional treatment processes are present (Coagulation, Filtration and chlorination) UV lamps are daily self-cleaned with rubber wiper	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 26**"	Maintain Chlorine residual in treated water See Appendix A for applicable process control summaries and corrective actions
Inadequate Disinfection	8.2	Flow rate through UV unit too rapid for effective treatment	**High** (Likely x Major)	UV parameters outside the target range as per process control summary	Continuous monitoring and alarms in place related to specified 'Indicators' Plant design Flow rate is equal to one UV unit capacity with two UV units are in place Flow rate alarm (exceedance) Chlorination provides further disinfection Alarm set on flow rates and the 2nd UV unit will start up on ½ maximum flow rate to cover increase in flows.	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Maintain chlorine residual in treated water Reduce plant flow rate See Appendix A for applicable process control summaries and corrective actions
Inadequate Disinfection	8.3	Excessive turbidity in water decreasing the effectiveness of the treatment	**Extreme** (Almost Certain x Major)	Final water turbidity and or UV parameters outside the target ranges as per process control summary *E. coli* detected in water or illness in the community	Continuous monitoring and alarms in place related to specified 'Indicators' Coagulation, flocculation and media filtration prior to the UV disinfection unit Plant still compliant with turbidity of 0.2 NTU.	**Medium** (Unlikely x Moderate)	Certain	Acceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 31**"	Maintain chlorine residual in treated water Increase coagulant dosing rate See Appendix A for applicable process control summaries and corrective actions

Risk Table 8. UV Disinfection									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Inadequate Disinfection	8.4	Power failure resulting in UV unit being unable to work	**High** (Likely x Moderate)	Telemetry indicating a power failure	24 hours storage in the system Plant stops if power supply fails	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 10**"	Switch to emergency power supply (generator) Maintain chlorine residual
Inadequate Disinfection	8.5	Mechanical failure of UV reactor components (includes seal, wiper, intensity sensor and lamp issues)	**High** (Possible x Major)	UV parameters outside the target ranges as per process control summary UV alarms activated or reactors shut down *E. coli* detected in water or illness in the community	Continuous monitoring and alarms in place related to specified 'Indicators' UV systems are regularly maintained as per Operations and Maintenance Manual Duty/standby UV setup Critical spares held onsite	**Medium** (Unlikely x Moderate)	Certain	Acceptable	Improvement "**OP-IMP 04**"	Maintain chlorine residual in treated water See Appendix A for applicable process control summaries and corrective actions

10.9 ORGANICS REMOVAL & TASTE & ODOUR CONTROL

Risk Table 9. Organics Removal & Taste & Odour Control									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Inadequate taste odour removal	9.1	Supply of PAC runs out	**Medium** (Possible x Minor)	Taste or odour complaints from community	Minimum of 400kgs PAC held at plant	**Low** (Unlikely x Insignificant)	Reliable	Acceptable	None identified	Place urgent order for PAC
Inadequate taste odour removal	9.2	Incorrect PAC in use	**Medium** (Likely x Minor)	Taste or odour complaints from community	Dose rates and PAC's trialled to determine Optimum for Whakatāne supply	**Low** (Possible x Insignificant)	Reliable	Acceptable	Improvement "**OP-IMP 05**"	Place urgent order for correct PAC Continue use of incorrect PAC until replacement arrives
Inadequate taste odour removal	9.3	PAC not used when algae present	**High** (Possible x Major)	Taste or odour complaints from community Illness from algae toxin (confirmed by Medical Officer of Health)	Follow procedures in Cyanotoxin and Cyanobacteria Management Protocol	**Medium** (Unlikely x Major)	Reliable	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**OP-IMP 32**"	Commence PAC dosing

Risk Table 9. Organics Removal & Taste & Odour Control										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Inadequate taste odour removal	9.4	PAC dosing system failure	**High** (Possible x Major)	Taste or odour complaints from community Illness from algae toxin (confirmed by Medical Officer of Health) Telemetry indicating a power failure	Daily operator inspection of dosing plant Regular maintenance & cleaning of dosing facility	**Medium** (Unlikely x Major)	Reliable	Acceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**"	Replace or repair PAC dosing system Manually dose PAC until repair completed

10.10 FLUORIDATION

Risk Table 10. Fluoridation										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Fluoride Concentration too high	10.1	Dosing system failure	**High** (Likely x Major)	WDC grab samples show elevated levels Calculated dose rates show elevated levels	Flow to plant restricted by size of dosing pipe (12mm Ø) Concentration of fluoride to plant restricted to 1% solution Dose rate calculated daily System not used until repaired	**Medium** (Unlikely x Major)	Confident	Unacceptable	Improvement "**CAP-IMP 03**" Improvement "**OP-IMP 31**"	Repair or replace Fluoride dosing system Initiate **CP5**
Fluoride Concentration too high	10.2	Incorrect fluoride solution strength	**High** (Likely x Major)	WDC grab samples show elevated levels Calculated dose rates show elevated levels	Flow to plant restricted by size of dosing pipe (12mm Ø) Concentration of fluoride to plant restricted to 1% solution Sampling of fluoridated water weekly and processed with Hills Lab Hamilton monthly Dose rate calculated daily	**Medium** (Unlikely x Major)	Reliable	Unacceptable	Improvement "**OP-IMP 05**"	Adjust dosing to compensate for Fluoride solution strength Switch solution to one of the appropriate strength
Contaminants in water supply	10.3	Contaminants in fluoride (HFA) supplied	**High** (Likely x Moderate)	Complaints received from consumers Notification of contamination received from supplier	Turn off fluoride dosing if notification is received of contaminated HFA delivery	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 05**"	Stop Fluoride dosing Order replacement supply of fluoride

Risk Table 10. Fluoridation									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Contaminants in water supply	10.4	Incorrect product in storage	**High** (Likely x Moderate)	Complaints received from consumers Notification of incorrect product received from supplier	Locked delivery HFA unloading points Electronic verification of all chemical loads is required before computer will allow download of chemical	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 05**"	Stop use of chemical supplied Place emergency order for replacement product

10.11 SUPPLY DELIVERY PUMPS – WATER TREATMENT PLANT AND BRIDGER GLADE

Risk Table 11. Supply Delivery Pumps										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Loss of Supply	11.1	Pump failure due to power outage	**High** (Likely x Major)	No pump activity Reservoir levels outside the target range as per process control summary	Greater than 24 hours storage provided in reservoirs throughout the reticulation Telemetry alarms indicate no pump activity	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**CAP-IMP 07**" Improvement "**OP-IMP 10**"	Switch to emergency power supply (generator) See Appendix A for applicable process control summaries and corrective actions Initiate **CP7**
Loss of Supply	11.2	Pump failure	**High** (Likely x Major)	No pump activity Reservoir levels outside the target range as per process control summary Loss of pressure in reticulation	Three pumps in duty/standby arrangement Pump maintenance planned and undertaken 24 hours storage available within system Pumps are standard off the shelf models and easily replaceable Alarms for reservoir level, failure to start and pump fault Vibration monitoring carried out 12 monthly	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**CAP-IMP 07**" Improvement "**OP-IMP 26**"	Switch to standby pump Repair or replace failed pump See Appendix A for applicable process control summaries and corrective actions Initiate **CP7**
Loss of Supply	11.3	Failure of telemetry between reservoirs and pumps	**Medium** (Possible x Moderate)	Excessive or reduced pump activity 'Communication lost' alarm	Telemetry includes 'Communication lost' alarm Pumps retain current status if telemetry fails Telemetry is by radio link AND cable Daily visual check of telemetry on SCADA	**Low** (Unlikely x Minor)	Certain	Acceptable	None identified	Repair telemetry between reservoirs and pumps Initiate **CP7**

Risk Table 11. Supply Delivery Pumps									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Loss of Supply	11.4	Flooding or lightning strike of telemetry and level instrumentation	**Medium** (Possible x Minor)	Excessive or reduced pump activity Empty or full reservoir alarm 'Communication lost' alarm	Lightening/ surge protectors on reservoirs If telemetry damaged 0 or 100% reservoir level shows – both alarmed Liquid probes on pump room floor – on detection of liquid, plant shut down Floor visually inspected daily	**Low** (Unlikely x Minor)	Confident	Acceptable	None identified	Repair telemetry and /or level instrumentation Control pumps manually Initiate **CP7**

10.12 STORAGE RESERVOIRS

Risk Table 12. Storage Reservoirs									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Microbiological contamination	12.1	Leakage through reservoir roof or other parts of structure or access by birds or vermin	**High** (Likely x Major)	*E. coli* in water leaving reservoir Decreased FAC in water leaving reservoir	Online testing 24/7/365 of residual chlorine in water Reservoir hatches padlocked & inspected every 3 months FAC monitoring programme includes reservoirs (3 monthly) 5 yearly structural and internal inspection of reservoirs in place	**High** (Possible x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 08**" Improvement "**CAP-IMP 09**" Improvement "**CAP-IMP 10**"	Repair leaks in reservoir Disinfect reservoir Initiate **CP1** and/or **CP3**
Microbiological	12.2	Vandalism to reservoir	**Medium** (Possible x Moderate)	*E. coli* in water leaving reservoir Decreased FAC in water leaving reservoir Reports from the public	Residual chlorine in water Hatches padlocked and checked at 3 monthly intervals Bottom 3.5m of ladder removed Reservoirs generally not fenced, but are remote	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Repair damage to reservoir Disinfect reservoir Initiate **CP1** and/or **CP3**
Microbiological contamination	12.3	Sediment accumulation within reservoirs	**Medium** (Possible x Moderate)	Visible suspended matter in water exiting reservoir Decreased FAC in water leaving reservoir Complaints from consumers	Residual chlorine in water 3 monthly testing and visual inspection of reservoirs cleaning of reservoirs undertaken as required based on visual inspection	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 26**"	Remove accumulated sediment Disinfect reservoir Initiate **CP1** and/or **CP3**

Risk Table 12. Storage Reservoirs

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Microbiological contamination	12.4	Lack of turnover in reservoirs	**High** (Likely x Moderate)	Decreased FAC in water leaving reservoir Complaints from consumers	Residual chlorine in water checked 3 monthly within 300mm surface in reservoirs Use online 24/7/365 results for residual chlorine in water 24 hours storage achieved via combined reservoir storage Isolate reservoir from supply until problem resolved Design configuration of Melville Drive reservoir reviewed and changed FAC and *E. coli* monitoring programme includes reservoirs	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Disinfect reservoir Initiate **CP1** and/or **CP3**
Microbiological Contamination	12.5	Contamination through insanitary maintenance or sampling procedures	**High** (Possible x Major)	*E. coli* in water leaving reservoir Decreased FAC in water leaving reservoir	Residual chlorine in water Access to reservoirs is restricted to trained staff Staff trained in sanitary sampling procedures Staff completed or working towards national certificate in water reticulation	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Isolate contaminated reservoir Disinfect and/ or flush affected reservoir Initiate **CP1** and/or **CP3**

10.13 RETICULATION

Risk Table 13. Reticulation

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Loss of Supply	13.1	Pipe failure	**High** (Likely x Moderate)	Complaints from consumers about loss of supply Change in flow or pressure in reticulation	WDC requires all work and materials used in reticulation to meet the specifications determined by the WDC Engineering Code of Practice No supply or reduced pressure in areas where upgrading is undertaken Scheduled maintenance or renewals Failures, maintenance and renewals are recorded in council incident reporting system, and in the GIS assessment of pipe structures Condition assessment and pipes pressure management	**Medium** (Possible x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 29**" Improvement "**OP-IMP 30**"	Repair and reinstate pipe
Loss of Supply	13.2	Excessive demand in network or inadequate system capacity	**High** (Likely x Moderate)	Complaints from consumers about low pressure or loss of supply High demand in summer 5% of fire hydrants non-compliant Change in flow or pressure in reticulation	Reservoirs store 24 hours average supply Reservoirs fill on level control – filling capacity is compromised by high demand Council levels of service for flow and pressure at point of supply are met	**Medium** (Unlikely x Moderate)	Confident	Acceptable	Improvement "**OP-IMP 14**" Improvement "**OP-IMP 29**" Improvement "**OP-IMP 30**"	Advise public of shortage of supply, Request conservation of water by consumers OR Water restrictions
Microbiological Contamination	13.3	Inadequate controls on maintenance and construction work	**High** (Likely x Major)	Complaints from consumers about taste or odour *E. coli* present in reticulation system Inadequate FAC in reticulation	Maintenance and replacement work are undertaken by trained staff, Or approved contractors, or under the direct supervision of trained staff WDC requires all work and materials used in the reticulation to meet the specifications determined by the WDC Engineering Code of Practice	**Medium** (Possible x Moderate)	Estimate	Unacceptable	Improvement "**OP-IMP 15**" Improvement "**OP-IMP 16**" Improvement "**OP-IMP 17**"	Stop work until appropriate controls are in place

Risk Table 13. Reticulation

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Chemical or Microbiological Contamination	13.4	Backflow from consumer connections	**High** (Likely x Major)	Illness in community Contaminants present in the reticulation system Taste or odour complaints from consumers	Manifold type water meter/non returns (back flow prevention - BFP) are required at new domestic supplies and toby replacements Testable devices required for industries – particularly those with high onsite water pressure FAC maintained at suitable levels throughout the reticulation Building WOF requires backflow preventers to be tested annually Program of staged replacement for domestic water meters in place	**Medium** (Possible x Moderate)	Estimate	Unacceptable	Improvement "**CAP-IMP 04**" Improvement "**CAP-IMP 11**" Improvement "**OP-IMP 16**" Improvement "**OP-IMP 18**" Improvement "**OP-IMP 19**" Improvement "**OP-IMP 26**"	Install, repair, or replace backflow preventers
Loss of Supply	13.5	Leaks in pipes	**High** (Likely x Moderate)	Contaminants present in the reticulation system Taste, odour or sickness complaints from consumers Reduced FAC in water Reports of leaks from consumers	Breaks and leaks repaired as a priority WDC provides a water main location service and supervision of contractors Majority of reticulation is uPVC and in good condition Acceptable materials determined by WDC ECOP FAC maintained at suitable levels throughout the reticulation Failures, maintenance and renewals are recorded in council asset management system (xivic) Total flow from plant monitored	**Medium** (Likely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 14**" Improvement "**OP-IMP 28**" Improvement "**OP-IMP 30**"	Repair leaks
Chemical Contamination	13.6	Inappropriate materials used for reticulation pipes and fittings	**High** (Likely x Moderate)	Contaminants present in the reticulation system Taste, odour or sickness complaints from consumers	WDC requires all work and materials used in reticulation to meet the specifications determined by the WDC engineering code of practice	**Low** (Rare x Moderate)	Reliable	Acceptable	None identified	Replace with appropriate materials

Risk Table 13. Reticulation

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Inadequate Supply	13.7	Silt or biofilm build up within reticulation pipes	**High** (Almost Certain x Minor)	Reduced flows in reticulation. Complaints from consumer about quality of water	WDC undertakes flushing in response to consumer complaints, mains breaks, low chlorine and high turbidity Routine flushing of dead ends in the network is currently being carried out in adhoc manner Engineering Code of Practice does not permit dead end mains (unless approved by the engineer) Addressed through Resource Consent process	**Low** (Unlikely x Minor)	Estimate	Acceptable	Improvement "**OP-IMP 26**"	Flush pipes with high chlorine solution Carry out pigging on affected pipes
Inadequate Supply	13.8	Poor planning of maintenance and construction work leaves consumers without water supply	**High** (Likely x Moderate)	No supply or reduced pressure in areas where upgrading is undertaken Scheduled maintenance or renewals	48 hours' notice is given for planned shutdowns of network. Customer service is kept informed Works programmed to minimise shutdowns Minimum 24 hours supply in the network (up to 3 days in winter)	**Low** (Unlikely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 29**" Improvement "**OP-IMP 30**"	Reinstate water supply
Inadequate Supply	13.9	Third party damage	**Medium** (Possible x Moderate)	No supply or reduced pressure in areas where upgrading is undertaken Scheduled maintenance or renewals taking place	Plans are made available to contractors working in the area Water main location service available Records of water services work retained on council asset management system (xivic)	**Low** (Unlikely x Minor)	Reliable	Acceptable	Improvement "**OP-IMP 28**"	Repair damage
Inadequate Supply	13.10	Deterioration in pipes and fittings	**High** (Likely x Moderate)	Reduced flows in reticulation Complaints from consumer about quality of water Leaks reported	Acceptable materials determined by WDC ECOP Records of water services work retained on asset management system Mains replacement program in place Review mains replacement program RE expected life and criticality	**Low** (Unlikely x Minor)	Estimate	Acceptable	Improvement "**OP-IMP 14**" Improvement "**OP-IMP 30**"	Upgrade, repair or replace pipes and fittings

Risk Table 13. Reticulation									
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Chemical or Microbiological Contamination	13.11	Illegal connection	**High** (Likely x Major)	Reduced flows in reticulation Complaints from consumer about quality of water	Combined Waters Bylaw 2017 aims to control this	**High** (Possible x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 04**" Improvement "**OP-IMP 07**" Improvement "**OP-IMP 08**"	Disconnect illegal connection

10.14 OTHER

Risk Table 14. Other										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Sampling Failure	14.1	Inadequate sampling programme, sample collection error, recording of results or response to transgression	**High** (Likely x Moderate)	DWSNZ compliance failure due to days of week, days between samples, insufficient samples, information gaps, positive results or sampling error Gaps in records from weekly testing regime	Sampling programme prepared checked against DWSNZ requirements Inline sampling for pH, FAC and NTU for No 3 reservoir Staff well trained and qualified BoPRC Laboratory do *E. coli* testing and inform WDC promptly if positive result is detected Results recorded in DWO	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	Improvement "**OP-IMP 20**"	Sample & report according to approved program Carry out additional sampling
Testing failure	14.2	Inappropriate testing methods	**Medium** (Possible x Moderate)	Inconsistent testing results	Service contract in place with testing laboratory specifying testing program, accreditation required, and laboratory response times & procedure Instrument calibration documented	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Retest using appropriate methods

Risk Table 14. Other										
Event	**Event No.**	**Cause**	**Unmitigated Risk**	**Indicators**	**Current Preventative Measure(s)**	**Remaining Risk Level**	**Remaining Risk Certainty**	**Remaining Risk Acceptability**	**Possible Improvements**	**Corrective Action(s) and/or Contingency Plan**
Unidentified Operational Failure of Treatment Plant	14.3	Treatment plant processes are not sufficiently monitored or alarmed	**High** (Likely x Major)	Process failure not identified before supply is contaminated Contamination identified in supply Operational near miss identified	Telemetry is in place providing remote access to online monitoring data but the speed of the internet link inhibits the ability for remote control and programming Continuous monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits are reached Plant is staffed 7 days a week, 365 days Staff come into the plant out of hours if required. Callout 24/7/365	**High** (Possible x Major)	Confident	Unacceptable	Improvement "**CAP-IMP 03**" Improvement "**OP-IMP 04**" Improvement "**OP-IMP 09**" Improvement "**OP-IMP 11"** Improvement "**OP-IMP 31**"	Monitor and alarm treatment plant processes appropriately Initiate **CP1, CP3** and/or **CP7**
Failure of Supply Equipment due to Inadequate Maintenance	14.4	Supply equipment fails due to inadequate asset information and inadequate maintenance planning	**High** (Almost Certain x Moderate)	Unexpected plant equipment failure Not having an asset register and maintenance programme	Plant staff carry out daily and monthly Preventative maintenance plans Fitter has annual PM program Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and WDC Water Treatment Plant Procedures 2012	**Medium** (Unlikely x Moderate)	Reliable	Unacceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 21**" Improvement "**OP-IMP 26**"	Repair or reset supply equipment with adequate asset information
Failure of Supply due to Unavailability of Spare Parts	14.5	Inadequate spare parts held or spare parts unavailable	**High** (Almost Certain x Moderate)	Plant is out of operation due to not having spare parts available	Spare parts are held for some things and replacement spares parts are usually available overnight 24 hour's storage in system Some critical processes are duty/standby	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Hold adequate spare parts on site for critical equipment Initiate **CP7**
Failure of Supply due to Inadequate Operating Procedures	14.6	Insufficient, inadequate out of date or incorrect manual of operational procedures	**High** (Almost Certain x Moderate)	Operational manuals not used Operational Manuals not up to date Operational manual copies are not the same	Operational Manuals are available but require review and completion.	**Medium** (Possible x Moderate)	Reliable	Unacceptable	Improvement "**OP-IMP 04**" Improvement "**OP-IMP 09**" Improvement "**OP-IMP 15**"	Update operational procedures manual

Risk Table 14. Other

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Operator Error or Mismanagement	14.7	Inadequate training, professional development and up-skilling of operators	**High** (Likely x Major)	Poor operation of plant DWSNZ compliance failure Loss of supply	Plant operators hold either a National Diploma or National Certificate in Drinking Water On-going training and up-skilling provided for operators	**Medium** (Unlikely x Major)	Reliable	Acceptable	None identified	Provide training for operators
Security Breach	14.8	Inadequate security at treatment plant allowing theft or vandalism	**High** (Possible x Major)	Obvious signs of break in, theft or vandalism	Door security alarms telemetered Treatment plant is securely fenced.	**Medium** (Unlikely x Moderate)	Reliable	Acceptable	None identified	Improve security
Injury or accident to workers	14.9	Inadequate site hazard planning	**Medium** (Likely x Minor)	Site accidents Hazard management plans are old, out of date or not used	Site hazard management plan prepared	**Low** (Unlikely x Minor)	Reliable	Acceptable	None identified	Update site hazard management plan as required.
No treated water produced or supplied	14.10	General power failure	**High** (Likely x Major)	Plant stops operating	24 hours storage	**High** (Possible x Major)	Certain	Unacceptable	Improvement "**OP-IMP 10**"	Switch to emergency power supply (generator) Initiate **CP7**
Recontamination of treated water	14.11	Structural failure of WTP buildings, Reservoirs and Strategic Pump Stations	**High** (Possible x Major)	Water not reaching reticulation Reports of illness in community Low FAC in reticulation or reservoirs Visible cracks or structural failure Full or partial Building collapse Fire on site (including bush fire)	Monitoring of chlorine levels in reticulation and at reservoirs Emergency pumping main installed to bypass reservoirs and direct feed into network. Condition assessment of treatment plant structure carried out by Structural Engineer Condition assessment of reservoirs carried out by structural engineer	**Medium** (Unlikely x Major)	Reliable	Unacceptable	Improvement "**CAP-IMP 08**" Improvement "**CAP-IMP 09**" Improvement "**CAP-IMP 10**" Improvement "**OP-IMP 13**" Improvement "**OP-IMP 26**"	Repair or replace clear water / chlorine contact tank Initiate **CP1** and/or **CP3**

Risk Table 14. Other

Event	Event No.	Cause	Unmitigated Risk	Indicators	Current Preventative Measure(s)	Remaining Risk Level	Remaining Risk Certainty	Remaining Risk Acceptability	Possible Improvements	Corrective Action(s) and/or Contingency Plan
Supply Failure	14.12	Catastrophic natural disaster or failure including earthquake, tsunami, heavy rain/ flooding, slips, volcanic eruption	**High** (Unlikely x Catastrophic)	Major natural disaster occurs i.e. Land slide, flooding, volcanic eruption, earthquake, tsunami Total plant failure is evident Warnings from Government agencies including Met Office, NIWA, Civil Defence, Regional Council or Police	Early warning from Government agencies including Metservice, NIWA, Civil Defence, Regional Council or Police (excluding earthquake) Robust secure plant structures System and people backups, monitoring and alarms	**Medium** (Rare x Major)	Estimate	Unacceptable	Improvement "**CAP-IMP 01**" Improvement "**CAP-IMP 02**" Improvement "**CAP-IMP 06**" Improvement "**OP-IMP 10**" Improvement "**OP-IMP 13**" Improvement "**OP-IMP 22**" Improvement "**OP-IMP 23**" Improvement "**OP-IMP 24**"	Initiate **CP1-CP5** and/or **CP7**
Failing to meet the requirements of the DWSNZ	14.13	Treatment processes are not sufficient to comply with the requirements of the latest DWSNZ	**Extreme** (Almost Certain x Catastrophic)	DWSNZ compliance failure	Coagulation, filtration, chlorination, and UV treatment Fully alarmed, no water processed unless MoH are informed and Boil Water notice in place. Will undertake extra manual *E. coli* and FAC in distribution zones and reservoirs	**Medium** (Unlikely x Major)	Reliable	Acceptable	Improvement "**OP-IMP 13**" Improvement "**OP-IMP 22**"	Initiate **CP1-CP6**
Failing to meet the requirements of the latest DWSNZ	14.14	Sampling and monitoring requirements are not sufficient to comply with the requirements of the latest DWSNZ	**High** (Likely x Major)	DWSNZ compliance failure	Systems, sampling and monitoring currently setup to meet the requirements of the DWSNZ 2005 (revised 2008)	**Medium** (Unlikely x Major)	Reliable	Unacceptable	Improvement "**OP-IMP 25**"	Review sampling and monitoring requirements of the latest DWSNZ

11 Improvement Schedules & Benefits of Proposed Improvements

The Manager Three Waters is responsible for implementation of the Improvement Plan within the timeframes indicated, subject to community and council approvals, funding constraints and availability of resources. The Team Leader Three Waters Asset Management & Planning is responsible for on-going review and updating of the WSP and associated Improvement Schedule.

Indicative cost estimates and implementation timeframes have been prepared for the proposed improvements. These will be carried forward to the next Asset Management Plan/Council Long Term Plan for approval and inclusion in annual budgets following the statutory public consultation process. **Implementation of the Improvement Schedule projects is ultimately subject to Council funding approval. The projects may need to be adjusted if funding approval is not granted**.

The final order of the improvement schedule is prioritised where there is the highest risk level combined with tasks required to assist with achieving compliance with the DWNSZ. The proposed improvements will provide public health benefits by reducing the risk of adverse health outcomes associated with poor drinking-water quality.

- Manager Three Waters (MTW) – Tomasz Krawczyk
- Team Leader Water Treatment Plant (TL-WTP) - Neal Yeates
- Water Treatment Plant Operator (WTP-O) – Ian Bowen / Bryan Vautier / Tasman Van der Woude
- Team Leader Three Waters Operations (TL-O) – Luke Shipton
- Team leader Three Waters Asset Management & Planning (TL-AM) – Michael Van Tilburg
- Manager Capital Projects (CPM) – Jim Finlay
- Senior Project Planner (SPP) – Nicholas Woodley

11.1 CAPITAL PROJECTS

Improvement No	Proposed works	Person responsible	Expected cost	Intended completion date	Water Supply Event(s)	Risk Event No(s)	Risk level before improvement[4]	Residual risk level following implementation of improvement
CAP-IMP 01	Investigating alternative /emergency water source (currently investigating Water Infiltration Gallery)	CPM	$700,000	June 2020	Catchment, Abstraction, Organics Removal, Other	1.1-1.6, 1.8, 1.9, 2.1-2.3, 2.7-2.11, 4.13, 9.3, 9.4, 14.12	High	Medium
CAP-IMP 02	Design, Construct and Commission Alternative Water Supply (cost include land acquisition/matters)	MTW / PM / TL-AM	$7,000,000	October 2022	Catchment, Abstraction, Organics Removal, Other	1.1-1.6, 1.8, 1.9, 2.1-2.3, 2.7-2.11, 4.13, 9.3, 9.4, 14.12	High	Low
CAP-IMP 03	Install inline fluoride analyser to allow continuous monitoring of Fluoride levels. Ensure critical alarms are adequate and activated.	TL-WTP	$30,000	December 2019	Fluoridation, Other	10.1, 14.3	High	Medium
CAP-IMP 04	Install new tanker filling point with adequate backflow protection assets	TL-AM	$30,000	July 2020	Reticulation	13.4, 13.11	High	Low
CAP-IMP 05	Investigate and if necessary, install roof &/or screen structure for clarifiers	CPM	$200,000	July 2022	Coagulation & Clarification	4.15	Medium	Low
CAP-IMP 06	Install covers &/or screens for filters to inhibit both contamination	CPM	$200,000	July 2022	Filtration, Other	5.11, 14.12	Medium	Low
CAP-IMP 07	Upgrade / renew / replace Whakatāne WTP High Lift Pumps	CPM / TL-WTP / TL-AM	$200,000	July 2022	Supply Delivery Pumps	11.1, 11.2	Medium	Low
CAP-IMP 08	Ōtarawairere Road Reservoir Upgrade	CPM / TL-AM	$50,000	December 2019	Storage Reservoirs, Other	12.1, 14.11	Medium	Low
CAP-IMP 09	Investigate options and costings for replacement and or upgrades of No. 2 and No. 3 Reservoirs to accommodate seismic and demand requirements	CPM / TL-AM	$40,000	June 2020	Storage Reservoirs, Other	12.1, 14.11	Medium	Low
CAP-IMP 10	Design, construct and commission works as indicated in investigation options of No. 2 and No. 3 Reservoirs	CPM / TL-AM	$7,000,000	June 2025	Storage Reservoirs, Other	12.1, 14.11	Medium	Low
CAP-IMP 11	Install backflow prevention devices on all connections; priority given to connections identified as high risk. Single/dual check manifolds shall be installed on residential connections as part of the meter replacement programme.	TL-AM	$120,000	October 2020	Reticulation	13.4	Medium	Low

[4] The “Risk Level before improvement” is based on the highest risk level stipulated for any of the risk items as defined in the column headed “Remaining Risk Level”

11.2 OPERATIONAL PROJECTS

Improvement No	Proposed works	Person responsible	Expected cost	Intended completion date	Water Supply Event(s)	Risk Event No(s)	Risk level before improvement	Residual risk level following implementation of improvement
OP-IMP 01	Re-establish relationship and communication with BOPRC – have chemical spill incidents in catchment reported to WDC	TL-WTP / TL-O / TL-AM	16 hours	December 2019	Catchment	1.3, 1.4	High	Medium
OP-IMP 02	WDC to liaise with pesticide application companies and make them aware of locations of water sources and to be informed of pesticide drops in vicinity of water source.	SPP / TL-AM	80 hours	October 2019	Catchment	1.3, 1.4	High	Medium
OP-IMP 03	(a) Liaise with Regional Council to list water take consent holders within vicinity and if applicable obtain monitoring results from these consent holders as a way of early warning of source contamination. (b) WDC to liaise with Waiotahi Contractors Ltd (consent holder of Blue Rock Quarry) to understanding nature of discharge to river. If possible, WDC to obtain information from BOPRC (if possible) of frequency of breaches of the consent. (c) WDC to implement a stormwater pollution prevention plan to control stormwater discharges from high risk sites.	SPP / TL-AM	32 hours	December 2019	Catchment	1.1, 1.2, 1.3	High	Medium
OP-IMP 04	WDC to review calibration and maintenance procedures of treatment plan equipment and incorporate into Operations and Maintenance manual with appropriate Standard Operating Procedures (SOP)	TL-WTP / WTP-O	8 hours + $1,000	June 2020	Coagulation & Clarification, Filtration, pH Adjustment, Chlorination, UV Disinfection, Other	4.2, 4.4-4.5, 4.10, 4.13, 5.9, 6.1, 6.3, 6.4, 7.1-7.3, 7.5-7.8, 8.1-8.3, 8.5, 14.3, 14.4, 14.6	High	Low
OP-IMP 05	Setup process to ensure certificates of analysis are provided upon delivery of chemicals for treatment	TL-WTP	8 hours	December 2019	Coagulation & Clarification, Organics Removal, Fluoridation	4.10, 9.2, 10.2-10.4	High	Medium
OP-IMP 06	Develop supply specific flushing plan to be implemented when treatment plant overdoses and include in WTP operations manual	TL-WTP / WTP-O	4 hours	May 2020	Chlorination	7.6-7.8	High	Medium
OP-IMP 07	Develop and implement a policy for identifying and dealing with illegal connections.	MTW / TL-O / TL-AM	8 hours	December 2019	Reticulation	13.11	High	Medium
OP-IMP 08	Review policy for withdrawing water from hydrants; specify the use of standpipes fitted with approved backflow preventers.	MTW / TL-O / TL-AM	8 hours	December 2019	Reticulation	13.11	High	Medium
OP-IMP 09	Ensure all plant records such as manuals, drawings, procedures, emergency response plan, etc. are controlled documents within Council corporate record system and hard copy located at the Water Treatment Plant.	TL-WTP / WTP-O	20 hours + $500	December 2019	Other	14.3, 14.6	High	Low
OP-IMP 10	Investigate the installation and/or provision of a dedicated generator for critical Whakatāne Water Supply sites (WTP and WPS's) to provide minimum flows during power outage(s) (stage 2). For the interim (stage 1), install dedicated generator plug-in point at appropriate sites and purchase mobile generator to accommodate majority of sites	TL-AM / CPM	Stage 1 $145,000 Stage 2 $250,000	Stage 1 – July 2020 Stage 2 – October 2026	Abstraction, Filtration pH Adjustment, Chlorination, UV Disinfection, Supply Delivery Pumps, Other	2.5, 5.5, 6.5, 7.9, 8.4, 11.1, 14.10, 14.12	High	Medium
OP-IMP 11	Undertake WTP site assessment to determine that all practical measures are in place via Electrical, Mechanical and Physical to avoid failure of a barrier or a contamination event. Details to be recorded of the assessment and any recommendations.	TL-WTP / WTP-O	4 hours	May 2020	Other	14.3	High	Medium
OP-IMP 12	Apply for new water take consent in accordance with requirements (at least six months prior to expiry), consent expiry 1/10/2026	SPP / TL-AM	$90,000	March 2026	Abstraction	2.8	Medium	Medium

Improvement No	Proposed works	Person responsible	Expected cost	Intended completion date	Water Supply Event(s)	Risk Event No(s)	Risk level before improvement	Residual risk level following implementation of improvement
OP-IMP 13	Investigate increase of treated water storage to 48 hours	TL-AM	$15,000	July 2021	Chlorination, Other	7.4, 14.11-14.13	Medium	Medium
OP-IMP 14	Carry out a periodic water balance to identify levels of leakage in system.	TL-AM	8 Hours	August (annually)	Reticulation	13.2, 13.5, 13.10	Medium	Low
OP-IMP 15	Develop and implement a Council SOP (Hygiene code of practice for working on water supply systems). The document to reflect industry best practice and how Council will manage preventing cross contamination in the unlikely event that staff alternate on wastewater and water reticulation work. The Hygiene Code of Practice to include start up employment arrangements, sickness statement and medical clearance requirements.	TL-WTP/TL-O/TL-AS	$1,000	December 2019	Reticulation, Other	13.3, 14.6	Medium	Low
OP-IMP 16	Develop and implement a policy to disconnect connections not in use.	MTW / TL-O / TL-AM	8 hours	December 2019	Reticulation	13.3, 13.4	Medium	Medium
OP-IMP 17	Review staff certificates and maintain training register. Develop a training and competency system for working on reticulated network.	TL-O / TL-WTP	20 hours + $500	December 2019	Reticulation	13.3	Medium	Low
OP-IMP 18	Develop and implement a backflow prevention policy to match device to risk level of activity, including testing requirements of the devices. (including the Ohope properties that are also connected to private bore water supplies)	MTW / TL-AM	100 hours	July 2020	Reticulation	13.4	Medium	Low
OP-IMP 19	Circulate educational material to customers, especially those considered high risk, about risks of backflow prevention and ways of minimising the risk	TL-AM	8 Hours + $500	July 2020	Reticulation	13.4	Medium	Medium
OP-IMP 20	Review sampling schedule and scheduler. Include samples not related to compliance.	TL-WTP	8 hours	August 2019	Other	14.1	Medium	Low
OP-IMP 21	Where possible utilise WDC Asset Management System to maintain an up-to-date database of critical users such as dialysis patients/ hospitals/ businesses. Develop robust process for critical customer rating and updating data to maintain active list.	TL-AM	20 hours	December 2019	Other	14.4	Medium	Low
OP-IMP 22	Review 'Incident Response Plan – Three Waters Assets (Water, Wastewater and Stormwater)' document. Modify, where required to clearly define steps for each process, items to be recorded and objectives of the process, with reference to other documents.	TL-O/TL-WTP/WTP-O	40 hours	December 2019	Other	14.12-14.13	Medium	Low
OP-IMP 23	Develop a disaster management plan for the water supply which could be included as part of a wider disaster management plan for the district.	MTW / TL-O / TL-WTP	120 hours	December 2019	Other	14.12	Medium	Low
OP-IMP 24	Investigate the protection of the WTP for flooding of the river (over tops the embankment)	CPM	24 hours	June 2020	Other	14.12	Medium	Medium
OP-IMP 25	Conduct a full and thorough review of the DWSNZ 2005 (revised 2018) and determine the adequacy of the WTPs current systems, sampling and monitoring. Adjust these as necessary and implement.	TL-AM / TL-O / TL-WTP / WTP-O	16 hours	August 2020	Other	14.14	Medium	Low
OP-IMP 26	Utilise Asset Management System to schedule and/or monitor preventative maintenance. Utilise Asset Management System to schedule the maintenance, verification and calibration of treatment plant equipment.	TL-O / TL-AM	20 hours	August 2020	Abstraction, Coagulation & Clarification, UV Disinfection, Supply Delivery Pumps, Storage Reservoirs, Reticulation, Other	2.4, 4.2, 4.5, 8.1, 11.2, 12.3, 13.4, 13.7, 14.4, 14.11	Medium	Low
OP-IMP 27	Pesticide suite testing on raw water was undertaken in September 2013 and again in July 2018, a comparison of results is being undertaken and report to Toi Te Ora shall be prepared.	TL-AM	24 hours	October 2019	Catchment	1.3	Medium	Low

Improvement No	Proposed works	Person responsible	Expected cost	Intended completion date	Water Supply Event(s)	Risk Event No(s)	Risk level before improvement	Residual risk level following implementation of improvement
OP-IMP 28	WDC to develop policy and procedure whereby Third party contractors/developers are made liable for any damages to the network to increase accountability.	TL-O / TL-AM	40 hours	December 2019	Reticulation	13.5, 13.9	Medium	Low
OP-IMP 29	Identify problem pressure areas by carrying out hydraulic model network analysis coupled with customer complaint records.	TL-AM	240 hours + $35,000	June 2020	Reticulation	13.1, 13.2, 13.8	Medium	Low
OP-IMP 30	Once hydraulic models are completed utilise the hydraulic model to investigate, develop and implement a pressure optimization programme where possible for this water supply.	TL-AM	120 hours + $55,000	March 2021	Reticulation	13.1, 13.2, 13.5, 13.8, 13.10	Medium	Low
OP-IMP 31	Internal monitoring parameters verification audit. Establish in-house standard operating procedure (SOP) for testing/challenging of established set points, thus verifying alarms and plant shut down functionality. The SOP to include methodology, frequency of audit/testing, documentation/record keeping requirements and SOP review requirements (i.e. when installation of new technology/equipment).	TL-WTP / WTP-O	40 hours	December 2020	Coagulation & Clarification, Filtration, pH Adjustment, Chlorination, UV Disinfection, Fluoridation, Other	4.4, 5.9, 6.1, 6.3, 6.4, 7.3, 7.6, 7.7, 8.2, 8.3, 10.1, 14.3	High	Low
OP-IMP 32	Cyanotoxin and Cyanobacteria Management Protocol is in place but requires review. Modify the Cyanotoxin and Cyanobacteria Management Protocol with latest information and best practice practices with inclusion of frequency of document review requirements.	TL-WTP / WTP-O	16 hours	October 2019	Raw Water Source, Organics Removal & Taste & Odour Control	1.5, 9.3	Medium	Low

12 Contingency and Response Plans

Contingency Plans have been prepared to provide guidance in an event where control measures fail to prevent the occurrence of a risk event that may present acute risk to public health. The person responsible for implementation of the Contingency Plan(s) when monitoring has identified the occurrence of a risk event is also noted in the table below.

- MTW – Manager Three Waters
- TL-O – Team Leader Three Waters Operations
- TL-WTP – Team Leader Water Treatment Plant
- WTP-O – Water Treatment Plant Operator
- M-PA- Manager of Public Affairs

These Contingency Plans operate in conjunction with the Whakatāne District Council Incident Response Plan – Three Waters Assets (Water, Wastewater and Stormwater) (A1376861) and the WDC Water Supplies CCPs and Process Control Summaries documents.

Table 8. Whakatāne Water Supply Contingency Plans

Whakatāne Water Supply Contingency Plans			
Code	***Type of Event***	***Required Contingency Action***	***Person Responsible***
CP1	**Inadequate chlorination** **Indicators: Low FAC (<0.2mg/L) or no FAC reported from online treatment plant monitoring or reticulation monitoring.**	Refer to the applicable remedial actions for treated water chlorine in the WDC Water Supplies CCPs and Process Control Summaries document (copy of this in Appendix A).	TL-WTP / WTP-O
CP2	**Severe turbidity of source water and high turbidity in treated water for more than 1 minute.** **Indicators: Highly turbid water in the Whakatāne River or monitoring indicates treated water leaving the treatment plant exceeds 1NTU for more than 1 minute.**	Refer to the applicable remedial actions for treated water turbidity in the WDC Water Supplies CCPs and Process Control Summaries document (copy of this in Appendix A).	TL-WTP / WTP-O

Whakatāne Water Supply Contingency Plans			
Code	***Type of Event***	***Required Contingency Action***	***Person Responsible***
CP3	**E. coli transgression in water leaving treatment plant or distribution zone** **Indicators: *E. coli* transgression reported following routine monitoring, and sickness/illness reported in the community.**	Follow transgression response procedure in DWSNZ (refer to Figure 4.1 and/or Figure 4.2 in the DWSNZ) Immediately inform Drinking Water Assessor (DWA) Commence sampling daily for *E. coli* until 3 consecutive samples are free of *E. coli* (enumeration method required) Investigate cause, inspect plant and source, and take remedial action to eliminate source of contamination. Consider alternative water supply provisions (bottled water and/or tankers) Consider flushing the reticulation network Check "high risk" backflow prevention devices within the township If *E. coli* is found in repeat samples consult with DWA, intensify remedial action, increase disinfection, consider 'Boil Water' notice (via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News),	TL-WTP / WTP-O
CP4	**Severe microbiological contamination of source water (such that treatment is ineffective)** **Indicators: A contamination event in the catchment may be observed by or reported to WDC staff. May also be indicated by reported illness among consumers or Positive *E. coli* monitoring results from the reticulation system.**	Follow transgression response procedure in DWSNZ (refer to Figure 4.1 and/or Figure 4.2 in the DWSNZ) Immediately inform Drinking Water Assessor (DWA) Issue "Boil Water' notice via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News Investigate cause, inspect plant and source and take remedial action to eliminate source of contamination. Consider provision of emergency treatment or alternative water supply (e.g. tankered water from adjoining water supply) Consider sampling and additional disinfection of reservoirs Keep customers informed and advise once regular service is restored via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News	TL-WTP / WTP-O / MTW / M-PA

Whakatāne Water Supply Contingency Plans			
Code	***Type of Event***	***Required Contingency Action***	***Person Responsible***
CP5	**Chemical contamination of source water** **Indicators: A contamination event in the catchment may be observed by or reported to WDC staff. May also be indicated by reported water quality concerns from consumers (taste, odour, colour) or illness among consumers.**	Follow transgression response in DWSNZ (Section 8.4) Advise Drinking Water Assessor (DWA) Assess situation and advise customers regarding use/treatment/disposal of contaminated water via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News Arrange emergency water supply (tankered from adjoining water supply) if necessary Inspect the river upstream of the intake to identify source of contamination and rectify problem as quickly as possible Flush contaminated reservoirs and mains Keep customers informed and advise once regular service is restored via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News	TL-WTP / WTP-O / MTW / M-PA
CP6	**Cyanobacteria/Cyanotoxin contamination of source water**	Implement Cyanotoxin and Cyanobacteria Management Protocol and advise Drinking Water Assessor (DWA) Conduct monitoring as per the Cyanotoxin and Cyanobacteria Management Protocol If cyanotoxins in water leaving the treatment plant exceed the MAV supply drinking water from tankers (from adjoining water supply) to the community Keep customers informed and advise once regular service is restored via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News	TL-WTP / WTP-O / MTW / M-PA

Whakatāne Water Supply Contingency Plans			
Code	***Type of Event***	***Required Contingency Action***	***Person Responsible***
CP7	**Insufficient water available for abstraction and treatment or loss of ability to take water from river.** **Indicators: Observed or reported low river levels**	Advise customers to conserve water via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News) Implement demand management strategies as required Arrange emergency / alternative water supply (tankers - from adjoining water supply) if necessary. Keep customers informed and advise (as above) once regular service is restored.	TL-WTP / WTP-O / MTW / M-PA
CP8	**High Salinity levels experienced in the Raw Water source** **Indicators: Monitoring indicates raw water conductivity levels are increased. Taste and odour complaints from the public**	Refer to the applicable remedial actions for raw water conductivity in the WDC Water Supplies CCPs and Process Control Summaries document (copy of this in Appendix A). Advise customers to conserve water via press releases to local radio stations (1XX, Bayrock), local newspapers (depending on timing The Beacon, Whakatāne News, Eastern Bay News) Implement demand management strategies as required Keep customers informed and advise (as above) once regular service is restored.	TL-WTP / WTP-O

Appendix A: Whakatāne Water Supply Process Control Summaries

CRITICAL CONTROL POINT: WHAKATĀNE WTP COAGULATION/SEDIMENTATION

Coagulation/Sedimentation – Process Information	
Process Objectives	Provide a primary particle removal CCP to remove solid particles and organics.
Process Location	Dosing of Aluminium Sulphate, Poly Aluminium Chloride, Polyelectrolyte and Powdered Activated Carbon followed by four Up-flow clarifiers.
Parameters and Day-to-Day Monitoring	Raw Water Turbidity (NTU) – Continuous monitoring through turbidity meter connected to SCADA. Pre-Lime pH (pH) – Continuous monitoring through pH meter connected to SCADA. Raw Water Conductivity (µs/cm) – Continuous monitoring through conductivity meter connected to SCADA. Raw Water Turbidity (NTU) – Continuous monitoring through turbidity meter connected to SCADA.
Parameter Monitoring Points	Raw turbidity and conductivity are monitored immediately upstream of the injection point. Pre-lime pH is monitored after mixing of Alum and lime in the slow mixing chamber. Settled water turbidity is monitored upstream of the filters.
Process Records	Manual: WTP Log book, manual sampling sheets. Online: Telemetry and SCADA system to record and display data.
Process Controller	WDC water treatment plant operator on duty.
Supporting Programmes	Maintenance tasks at weekly, monthly, 3 monthly, 6 monthly and annual intervals. Scheduled validation (verification) and standardisation (calibration) of monitoring instruments. Training and competency assessment of operators in equipment operation and monitoring.

Whakatāne WTP Coagulation/Sedimentation – Performance Parameters

Coagulation/Sedimentation – Process Performance Parameters					
Limits		**Performance Parameters**			
		Raw Water Turbidity	**Pre-Lime pH**	**Raw Water Conductivity**	**Settled Water Turbidity**
SCADA Tag		AIT102	AIT404a	AIT103	AIT304
DWSNZ Monitoring Parameters		n/a			
Target Range	**Low Limit**	All limits are operator adjustable and are set depending on the quality of the incoming raw water. Hard values cannot be prescribed and will rely on the experience of the Duty Operator.			
	High Limit				
Action Limits	**Low Alarm**				
	High Alarm				
Critical Limits	**Low Low Alarm**				
	High High Alarm				
		Plant automatically shuts down when critical limits are exceeded for raw water turbidity, pre-Lime pH, raw water conductivity and settled water turbidity.			

Whakatāne WTP Coagulation/Sedimentation – Triggers and Corrective Actions

Coagulation/Sedimentation - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Target Range	During day to day monitoring or inspection.	• Adjust raw water intake, flow control and/or chemical dosing system to achieve target range.
Action Limits	Alarms.	• Duty WTO to acknowledge the alarm, and review if filters have been or will likely be affected. • **If action limits continue to be exceeded,** attend the site and carry out a site inspection to investigate reason for parameters outside action limits: 1) Investigate effectiveness of coagulation/sedimentation process. 2) Check dosing lines and pumps. 3) Check calibration of online analysers. a. If required, re-calibrate online analysers as per the Water Treatment Plants SOP and/or the manufacturer's instructions. 4) Check/assess all essential treatment plant equipment. • Once problem is identified and resolved, notify WTPTL and log incident in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***Plant automatically shuts down when critical limits are exceeded for raw water turbidity, pre-Lime pH, conductivity and settled water turbidity.*** • Duty WTO to notify WTPTL. • **If plant continues to supply water to the scheme while performance parameters exceed the critical limit range,** carry out the following: 1) Obtain approval from WTPTL and MO before supplying water to the scheme that may not satisfy WDC performance requirements. 2) Turn alarms off manually in order to operate the plant. 3) Confirm conditions of continued operation with the WTPTL and MO and carry them out. • Set up alarms so that the plant runs automatically once performance parameters are stable within the Target Ranges. • Duty WTO to complete an incident report for the event.

CRITICAL CONTROL POINT: WHAKATĀNE WTP FILTRATION

Filtration – Process Information	
Process Objectives	Provide a primary particle removal CCP to physically trap pathogens that may have entered the system.
Process Location	One of six rapid sand filters following coagulation/sedimentation in the clarifiers.
Parameters and Day-to-Day Monitoring	Turbidity (NTU units) – Continuous monitoring through turbidity meter connected to SCADA.
Parameter Monitoring Points	Turbidity is monitored immediately downstream of each Filter.
Process Records	Manual: WTP Log book, manual sampling sheets. Online: Telemetry and SCADA system to record and display data.
Process Controller	WDC water treatment plant operator on duty.
Supporting Programmes	Maintenance tasks at weekly, monthly, 3 monthly, 6 monthly and annual intervals. Scheduled validation (verification) and standardisation (calibration) of monitoring instruments. Training and competency assessment of operators in equipment operation and monitoring. Transgression reporting to Operator and DWA if results are outside DWSNZ.

Whakatāne WTP Filtration – Performance Parameters

Filtration – DWSNZ Limits and Process Performance Parameters		
Limits		**Performance Parameters**
		Turbidity
SCADA Tag		Filter 1 =AIT302A, Filter 2 = AIT302B, Filter 3 = AIT302C, Filter 4 = AIT302D, Filter 5 = AIT302E, Filter 6 = AIT302F
DWSNZ Monitoring Parameters (Section 5.4)[5]		>0.30 NTU for >95% of 1 month
		>0.50 NTU for >98% of 1 month
		>1.00 NTU for any 3-minute period
Target Range	**Low Limit**	-
	High Limit	<0.12 NTU
Action Limits	**Low Alarm**	-
	High Alarm	0.12 NTU (>2 min)
Critical Limits	**Low Low Alarm**	-
	High High Alarm	0.20 NTU (>2 min), 0.25 NTU (>12 min), 0.15 NTU (5% of 24hr period), 0.30 NTU (2% of 24hr period)
		Filter automatically shuts down when critical limits are exceeded for filter turbidity.

[5] Plant can be monitored and controlled according to the Section 5.8 requirements of the DWSNZ to allow for 4.0 log removal, but the official log removal requirement is 3.0 log (confirmed by the DWA in June 2018).

Whakatāne WTP Filtration – Triggers and Corrective Actions

Filtration - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Target Range	During day to day monitoring or inspection.	• Adjust raw water intake, flow control and/or coagulant/polyelectrolyte system to achieve target range.
Action Limits	Alarms.	• Duty WTO to acknowledge the alarm, and review if filter to waste or a filter backwash to the affected filter has been initiated. • **If action limits continue to be exceeded**, shut down filter, attend the site and carry out a site inspection to investigate reason for turbidity outside action limits: 1) Check turbidity meter for any mechanical problems 2) Carry out manual tests to check actual turbidity readings against online analysers to determine if analyser is operating correctly. a. If required, re-calibrate online analysers as per the manufacturer's instructions. 3) Investigate effectiveness of coagulation/sedimentation process. 4) Check/assess all essential treatment plant equipment. • Consider if 3.0 log removal has been achieved by the UV reactors during the period where filtration has not been met (i.e. <1 NTU). • Once problem is identified and resolved, notify WTP-TL and/or MO and log incident in the water treatment plant log book. • Record event details, manual test results and re-calibration information in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***Filter automatically shuts down when critical limits are exceeded for filter turbidity.*** • Duty WTO to notify WTPTL. • **If non-compliant water has entered the reservoir(s)/distribution**, WTPTL to notify MO and DWA and initiate a transgression incident response in line with Figure 5.1 of the DWSNZ and the relevant Contingency Plan. Look to include the following in the response: 1) Supply of water to the scheme to be stopped while performance parameters are in the critical limit range and scheme to be supplied with compliant stored water or a backup/alternative supply. 2) Revisit Action Limit corrective actions above. • **If plant continues to supply water to the scheme while performance parameters exceed the critical limit range** carry out the following: 1) Obtain approval from WTPTL, MO and DWA before supplying water to the scheme that may not satisfy DWSNZ requirements.

Filtration - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
		2) Turn alarms off manually in order to operate the plant. 3) Confirm conditions of continued operation with the DWA and carry them out (i.e. boil water notice etc). • Setup alarms so that the plant runs automatically once performance parameters are stable within the Target Ranges. • Duty WTO to complete an incident report for the event, and the MO to develop a full transgression report.

CRITICAL CONTROL POINT: WHAKATĀNE WTP CHLORINATION (PRIMARY DISINFECTION)

Chlorination – Process Information	
Process Objectives	Provide a primary disinfection CCP to inactivate bacterial, viral and some protozoan pathogens that may have entered upstream of dosing point. Provide residual disinfection quality control point to help inactivate pathogens entering downstream of the dosing point.
Process Location	Chlorine dosing system located downstream of the filters and before UV treatment unit.
Parameters and Day-to-Day Monitoring	Turbidity (NTU) – Continuous monitoring through turbidity meter connected to SCADA. pH (pH) – Continuous monitoring through pH meter connected to SCADA. Free Available Chlorine (FAC, mg/L) – Continuous monitoring through FAC meter connected to SCADA.
Parameter Monitoring Points	All parameters (Turbidity, pH, and FAC) are monitored immediately downstream of the chlorine injection point and upstream of the UV reactor.
Process Records	Manual: WTP log book, manual sampling sheets. Online: Telemetry and SCADA system to record and display data.
Process Controller	WDC water treatment plant operator on duty.
Supporting Programmes	Periodic checks of currency of reagents and discarding of outdated reagents. Maintenance tasks at weekly, monthly, 3 monthly, 6 monthly and annual intervals. Scheduled validation (verification) and standardisation (calibration) of monitoring instruments.

Whakatāne WTP Chlorination – Performance Parameters

Chlorination – DWSNZ Limits and Process Performance Parameters				
Limits		**Performance Parameters**		
		FAC	**pH**	**Final Water Turbidity**
SCADA Tag		AIT402	AIT403	AIT304
DWSNZ Monitoring Parameters (Section 4.3.2.1)		<0.20 mg/L for >2% of 1 day	Between 7.0 and 8.0	>1.0 NTU for >5% of 1 day
		>5.00 mg/L		>2.0 NTU for any 3-minute period
Target Range	**Low Limit**	>0.50 mg/L		-
	High Limit	<1.50 mg/L	-	<0.50 NTU
Action Limits	**Low Alarm**	0.40 mg/L	6.9 (>5 min)	-
	High Alarm	1.90 mg/L	9.0	1.00 NTU (>2 min)
Critical Limits	**Low Low Alarm**	0.30 mg/L	6.4 (>5 min)	-
	High High Alarm	2.00 mg/L	10.0	2.00 NTU (>2 min)
		Plant automatically shuts down when critical limits are exceeded for FAC, pH and turbidity.		

Whakatāne WTP Chlorination – Triggers and Corrective Actions

Chlorination - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Target Range	During day to day monitoring or inspection.	• Adjust chlorine dosing rate manually until target range is achieved.
Action Limits	Alarms.	• Duty WTO to acknowledge the alarm, attend the site and carry out a site inspection to investigate reason for turbidity and/or FAC outside action limits: 1) Check Turbidity meter/rotometer/pH meter for any mechanical problems e.g.- a jammed rotometer. 2) Check if chlorine dosing is correct or if the chlorine supply is exhausted. 3) Carry out manual tests to check actual turbidity, FAC and pH readings against online analysers to determine if equipment is operating correctly. a. If required, re-calibrate online analysers as per the Water Treatment Plants SOP (Processes 11 & 13) and/or the manufacturer's instructions. 4) Check/assess all essential treatment plant equipment. • Adjust chlorine dosing rate manually until target range is achieved. • Once problem is identified and resolved, notify WTPTL and/or MO and log incident in the water treatment plant log book. • Record event details, manual test results and re-calibration information in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***Plant automatically shuts down when critical limits are exceeded for FAC, pH and turbidity.*** • Duty WTO to notify WTPTL. • **If non-compliant water has entered the reservoir(s)/distribution**, WTPTL to notify MO and DWA and initiate a transgression incident response in line with Figure 4.1 of the DWSNZ and the relevant Contingency Plan. Look to include the following in the response: 1) Supply of water to the scheme to be stopped while performance parameters are in the critical limit range and scheme to be supplied with compliant stored water or a backup/alternative supply. 2) Revisit Action Limit corrective actions above. 3) Carry out transgression sampling according to section 4.3.9 of the DWSNZ 2008. • **If plant continues to supply water to the scheme while performance parameters exceed the critical limit range,** carry out the following:

Chlorination - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
		1) Obtain approval from WTPTL, MO and DWA before supplying water to the scheme that may not satisfy DWSNZ requirements. 2) Turn alarms off manually in order to operate the plant. 3) Confirm conditions of continued operation with the DWA and carry them out (i.e. boil water notice etc). • Setup alarms so that the plant runs automatically once performance parameters are stable within the Target Ranges. • Duty WTO to complete an incident report for the event, and the MO to develop a full transgression report.

CRITICAL CONTROL POINT: WHAKATĀNE WTP UV IRRADIATION (SECONDARY PROTOZOAL REMOVAL & DISINFECTION)

UV Irradiation – Process Information	
Process Objectives	Provide a secondary protozoal removal and disinfection CCP to inactivate protozoan pathogens that may remain after primary treatment or have entered upstream of dosing point.
Process Location	UV treatment unit situated downstream of the chlorine dosing system.
Parameters and Day-to-Day Monitoring	Final Water Turbidity (NTU units) – Continuous monitoring through turbidity meter connected to SCADA. Flow (m3/hr) – Continuous monitoring through magnetic flow meter connected to SCADA. UV Intensity (UVI in W/m2) – Continuous monitoring through UV unit connected to SCADA. UV Transmissivity (UVT in %) – Continuous monitoring through 'Real UVT' analyser connected to SCADA. UV Alarm - Continuous monitoring through UV unit connected to SCADA.
Parameter Monitoring Points	Combined turbidity is monitored immediately downstream of the filters. UV parameters (Turbidity, UV Flow, UVI, UVT and UV Alarm) are monitored within or immediately downstream of the UV reactor.
Process Records	Manual: WTP log book, weekly and monthly sheets, manual sampling sheets. Online: Telemetry and SCADA system to record and display data
Process Controller	WDC water treatment plant operator on duty.
Supporting Programmes	Maintenance tasks at weekly, monthly, 3 monthly, 6 monthly and annual intervals. Scheduled validation (verification) and standardisation (calibration) of monitoring instruments.

Whakatāne WTP UV Irradiation – Performance Parameters

UV Irradiation – DWSNZ Limits and Process Performance Parameters						
Limits		**Performance Parameters**				
		Final Water Turbidity	**UV Flow**	**UV Intensity**	**UV Transmittance**	**UV Alarm**
SCADA Tag		AIT304	FT302A & FT302B	UV300AUVI1_In & UV300BUVI1_In	AIT307A	UV1_Major_Alarm & UV2_Major_Alarm & UV300A_InAlarm & UV300B_InAlarm
DWSNZ Monitoring Parameters (Section 5.16)		>1.0 NTU for >5% of 1 month	>687.8 m^3/hr **per reactor** for >5% of 1 month	<47 W/m^2 for >5% of 1 month	<93.01% for >5% of 1 month	UV Dose <40 mJ/cm^2 for >5% of 1 month
		>2.0 NTU for any 3-minute period		<37.6 W/m^2 for any 3-minute period	<88.11% for >2% of 1 month	UV Dose <32 mJ/cm^2 for any 3-minute period
					<80% for any 3-minute period	
Target Range	**Low Limit**	-	-	-	>95 %	-
	High Limit	<0.50 NTU	-	-	-	
Action Limits	**Low Alarm**	-	-	-	94 %	"Alarm"
	High Alarm	1.00 NTU (>2 min)	-	-	-	
Critical Limits	**Low Low Alarm**	-	-	47 W/m^2	90 %	"Major Alarm"
	High High Alarm	2.00 NTU (>2 min)	687.8 m^3/hr (>2 min)	-	-	
		Plant automatically shuts down when critical limits are exceeded for turbidity, UV flow, UV transmittance and UV MajorAlarm.				

Whakatāne WTP UV Irradiation – Triggers and Corrective Actions

UV Irradiation - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Target Range	During day to day monitoring or inspection.	• Adjust flow rate. • Check reactor sensor and lamps during routine checking procedures. • Check UVT, turbidity and treated water quality.
Action Limits	Alarms.	• Duty WTO to acknowledge the alarm, and changeover to the standby UV reactor. • **If the standby UV reactor does not allow the target range limits to be met**, confirm that the filter and/or chlorination systems are within their respective target ranges and shut down the UV reactors. • **If the filters and/or chlorination systems are NOT within their respective target ranges**, attend the site and carry out a site inspection to investigate reason for turbidity and/or UV parameters outside action limits: 1) Check turbidity meter for any mechanical problems. 2) Carry out manual tests to check actual turbidity and UVT readings against online analysers to determine if equipment is operating correctly. a. If required, re-calibrate online instrumentation as per the Water Treatment Plants SOP (Process 40) and/or the manufacturer's instructions. 3) Check/assess all essential treatment plant equipment. • Once problem is identified and resolved, notify WTPTL and/or MO and log incident in the water treatment plant log book. • Record event details, manual test results and re-calibration information in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***Plant automatically shuts down when critical limits are exceeded for turbidity, UV flow, UV transmittance and UV Alarm.*** • Duty WTO to notify WTPTL. • **If non-compliant water has entered the reservoir(s)/distribution (including if filters and chlorination are ineffective)**, WTPTL to notify MO and DWA and initiate a transgression incident response in line with Figure 5.2 of the DWSNZ and the relevant Contingency Plan. Look to include the following in the response: 1) Supply of water to the scheme to be stopped while performance parameters are in the critical limit range and scheme to be supplied with compliant stored water or a backup/alternative supply. 2) Revisit Action Limit corrective actions above. 3) Carry out transgression sampling according to section 4.3.9 of the DWSNZ 2008.

UV Irradiation - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
		• **If plant continues to supply water to the scheme while performance parameters exceed the critical limit range** carry out the following: 1) Obtain approval from WTPTL, MO and DWA before supplying water to the scheme that may not satisfy DWSNZ requirements. 2) Turn alarms off manually in order to operate the plant. 3) Confirm conditions of continued operation with the DWA and carry them out (i.e. boil water notice etc). • Set up alarms so that the plant runs automatically once performance parameters are stable within the Target Ranges. • Duty WTO to complete an incident report for the event, and the MO to develop a full transgression report.

CRITICAL CONTROL POINT: WHAKATĀNE POST RESERVOIR MONITORING

Reservoir Monitoring – Process Information	
Process Objectives	Provide residual disinfection quality control point to help inactivate pathogens entering downstream of the dosing point.
Process Location	Chlorine dosing system located downstream of the filters and before UV treatment unit.
Parameters and Day-to-Day Monitoring	Turbidity (NTU) – Continuous monitoring through turbidity meter connected to SCADA. pH (pH) – Continuous monitoring through pH meter connected to SCADA. Free Available Chlorine (FAC, mg/L) – Continuous monitoring through FAC meter connected to SCADA.
Parameter Monitoring Points	All parameters (Turbidity, pH, and FAC) are monitored downstream of the reservoir outlet.
Process Records	Manual: WTP Log book, manual sampling sheets. Online: Telemetry and SCADA system to record and display data.
Process Controller	WDC water treatment plant operator on duty.
Supporting Programmes	Periodic checks of currency of reagents and discarding of outdated reagents. Maintenance tasks at weekly, monthly, 3 monthly, 6 monthly and annual intervals. Scheduled validation (verification) and standardisation (calibration) of monitoring instruments. Lab verification checks for *E. coli* with transgression reporting to Operator and DWA if results are outside DWSNZ.

Whakatāne WTP Post Reservoir Monitoring – Performance Parameters

Post Reservoir Monitoring – DWSNZ Limits and Process Performance Parameters				
Limits		**Performance Parameters**		
		Post reservoir FAC	**Post reservoir pH**	**Post reservoir Turbidity**
SCADA Tag		AIT303	AIT305	AIT301
DWSNZ Monitoring Parameters (Section 4.3.2.1)		<0.20 mg/L for >2% of 1 day	Between 7.0 and 8.0	>1.0 NTU for >5% of 1 day
		>5.00 mg/L		>2.0 NTU for any 3-minute period
Target Range	**Low Limit**	>0.50 mg/L	-	-
	High Limit	<1.80 mg/L	-	<0.50 NTU
Action Limits	**Low Alarm**	0.50 mg/L (>2 min)	6.9 (>2 min)	-
	High Alarm	1.80 mg/L (>2 min)	8.5 (>2 min)	1.00 NTU (>2 min)
Critical Limits	**Low Low Alarm**	0.30 mg/L (>2 min)	6.6 (>2 min)	-
	High High Alarm	2.00 mg/L (>2 min)	10.0 (>2 min)	2.00 NTU (>2 min)
		No automated plant or reservoir shutdown is linked to these alarms. Manual intervention required by the Duty TPO.		

Whakatāne WTP Reservoir Monitoring – Triggers and Corrective Actions

Reservoir Monitoring - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Target Range	During day to day monitoring or inspection.	• Adjust chlorine dosing rate manually until target range is achieved.
Action Limits	Alarms.	• Duty WTO to acknowledge the alarm, attend the site and carry out a site inspection to investigate reason for turbidity and/or FAC outside action limits: 1) Check Turbidity meter/ rotometer / pH meter for any mechanical problems e.g.- a jammed rotometer. 2) Check if chlorine/fluoride dosing is correct or if the supply is exhausted. 3) Carry out manual tests to check actual turbidity, FAC and pH readings against online analysers to determine if equipment is operating correctly. a. If required, re-calibrate online analysers as per the Water Treatment Plants SOP (Processes 11 & 13) and/or the manufacturer's instructions. 4) Check/assess all essential treatment plant equipment. • Adjust chlorine dosing rate manually until target range is achieved. • Once problem is identified and resolved, notify WTPTL and/or MO and log incident in the water treatment plant log book. • Record event details, manual test results and re-calibration information in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***No automated plant or reservoir shutdown is linked to these alarms. Manual intervention required by the Duty TPO.*** • Duty WTO to notify WTPTL. • **If non-compliant water has entered the distribution**, WTPTL to notify MO and DWA and initiate a transgression incident response in line with Figure 4.1 of the DWSNZ and the relevant Contingency Plan. Look to include the following in the response: 1) Revisit Action Limit corrective actions above. 2) Carry out transgression sampling according to section 4.3.9 of the DWSNZ 2008. 3) Confirm conditions of continued operation with the DWA and carry them out (i.e. boil water notice etc). • Duty WTO to complete an incident report for the event, and the MO to develop a full transgression report.

Appendix B: Report on adequacy of a Drinking Water Supply's Water Safety Plan

CNIDWAU
Central North Island Drinking Water Assessment Unit

IANZ
ACCREDITED INSPECTION BODY

Report on adequacy of a Drinking Water Supply's Water Safety Plan

Drinking Water Supply
Whakatāne (WHA005)

Central North Island Drinking Water Assessment Unit – Toi Te Ora
PO Box 2120
Tauranga 3110

Report Identifier
WHA005_Whakatāne_WSPadequacy_030719_v1

Executive Summary

Water Safety planning is internationally recognised as the most effective means of consistently ensuring the safety of a drinking-water supply Six principles underpin the foundation of effective water safety planning:

1. A high standard of care must be embraced
2. Protection of source water is of paramount importance
3. Maintain multiple barriers against contamination
4. Change precedes contamination
5. Suppliers must own the safety of drinking water
6. Apply a preventive risk management approach

Under the Health Act, this supply falls into the category of a large drinking water supply. Section 69Z of the Act requires that the supply have an approved and implemented water safety plan.

Non-conformances: These are areas of the WSP that must be corrected or amended before the plan can be approved. These relate directly to, or give practical effect to the requirements of the Health Act.

Recommendations – These are areas of the WSP where suggestions for improvement have been made that are not mandatory requirements. They do not affect approval of the plan.

The Whakatāne public water supply Water Safety Plan (WSP) comprehensively sets out details of the water supply including descriptions, control points and critical control points, risk identification and assessment information, planned improvements, and corrective actions and contingency plans.

Whakatāne District Council's (WDC) adoption of a more comprehensive approach to water safety planning is commendable and acknowledged by the Bay of Plenty and Lakes District Health Boards.

The Whakatāne WSP version 5.05 was received on 05 March 2019 after the pervious WSP expired in mid-2018. An adequacy report was issued with a number of non-conformances and recommendations made. Version 6.01 was received 01 July 2019 along with a catchment risk assessment. WDC replaced this with version 6.02 after minor changes were made. Following a teleconference with WDC to discuss how the non-conformances can be cleared WDC updated the WSP as version 6.03 which was received 17 July 2019.

It is noted that with regards to risks that remain unacceptable and have associated planned improvements a large number hinge on the successful investigation and commissioning of a new water source. These include a number of risks that relate to a loss of supply caused by landslips, over-allocation, intake failure and drought, and contamination from chemical spills and cyanobacteria. Other significant risks that remain unacceptable relate to contamination of reservoirs due to the risk of leakage and structural failure.

The WSP for Whakatāne public water supply has been approved with four recommendations.

Description of drinking water supply

The WSP describes a WDC owned and operated public water supply consisting of a surface water river source (Whakatāne River). Treatment consists of Clarification/ Sedimentation, rapid sand filtration, gas chlorine, pH adjustment, UV disinfection and fluoridation. Chlorine residual disinfection is maintained in the reticulation. Storage consists of nine reservoirs with a combined capacity of 2,548m3. The population supplied is approximately 21,000 people. Known issues include the quality and changeability of the source water, river inundation and flooding at the treatment plant and the risks of saline intrusion and cyanobacteria for this lowland river intake.

The population figure references the drinking-water register.

Recommendation 1: WDC to include a brief description of the population calculation methodology in the WSP and ensure that the register is updated if population changes significantly.

Adequacy of risk assessment methodology

Risk assessment methodology is based on the Ministry of Health Guides and incorporates aspects of the new WSP framework and the framework handbook. The methodology, scope and description of the water supply, including identification and description of critical points and critical control points is adequate.

Adequacy of risk identification and analysis

The risk identification and analysis is adequate. Common public health risks have been identified. The previous WSP version 5.05 lacked evidence of an adequate catchment risk assessment. WDC have since developed a catchment risk assessment for the Whakatāne River source and updated the WSP with additional risk information and preventative measures. Therefore non-conformance 1 made in the previous adequacy report related to a lack of evidence of a catchment risk assessment has been adequately resolved.

The previous WSP version 5.05 non-conformance 2 relating to possible errors in the risk tables has been adequately resolved.

It is noted that with regards to risks that remain unacceptable and have associated planned improvements a large number of risks hinge on the successful investigation and commissioning of a new water source. These include a number that relate to a loss of supply caused by landslips, over-allocation intake failure and drought, and contamination from chemical spills and cyanobacteria. Other significant risks that remain unacceptable relate to contamination of reservoirs due to the risk of leakage and structural failure.

Adequacy of control measures

Preventative or control measures have been identified for most public health risks/events and are considered to be adequate. Critical Points have been clearly identified. Filtration, chlorination and UV have been identified as the current operational Critical Control Points. Continuous free available chlorine, pH and turbidity, and UV Flow UV Intensity and UV Transmittance have been identified as the monitored and alarmed parameters. Critical limits for these parameters are clearly listed. Corrective actions associated with each critical limit are included and considered adequate for this large supply. Preventative measures, indicators and corrective actions for non-Critical Control Point risks are considered adequate.

The previous WSP version 5.05 non-conformance 3 relating stocks of lime held and monitoring of fluoride have been corrected therefore non-conformance 3 has been adequately resolved.

The previous WSP version 5.05 non-conformance 4 related to insufficient detail on the preventative measures of set points, alarms and auto-shutdowns. The June Version 6.02 WSP was updated to include additional detail to risk number 14.3 around continuous monitoring, triggering of alarms, and automatic plant shut down limits (critical limits). WDC also added the WDC-wide improvement item: site assessment to determine that all practical measures are in place via Electrical, Mechanical and Physical to avoid overdosing.

However, this was insufficient to demonstrate how these set points, alarms and auto-shutdowns were being verified as an ongoing investigation or after significant changes. Following a telephone discussion WDC updated the WSP to version 6.03 with an additional improvement added to address the verification of set points, alarms and automatic shutdowns. Therefore non-conformance 4 has been adequately resolved.

The previous WSP version 5.05 non-conformance 5 (listed incorrectly as non-conformance 4) regarding listed preventative measures worded as planned improvements has been adequately resolved. It was noted that there has been a change in the wording from annual flushing in version 5.05 to adhoc flushing in this latest version with the addition of the planned improvement to utilise the asset management system to schedule and/or monitor preventative maintenance. It is presumed that this planned improvement will capture necessary flushing activities.

The water safety plan doesn't make reference to UV lamp breakage as a risk or what preventative or corrective actions are in place to manage this. WDC have verbally communicated that such procedures are in place, therefore they should be included or referenced in the water safety plan.

Recommendation 2: Include preventative measures for UV lamp breakages and include or link to UV lamp breakage procedures in the WSP.

The previous WSP version 5.05 made reference to a June 2018 draft cyanobacteria protocol. Previous assessments of the cyanobacteria protocol by the drinking water assessor raised questions about the roles and responsibilities between WDC and Bay of Plenty Regional Council (BOPRC) and whether the protocol met the requirements of the Guidelines for Drinking-water Quality Management for New Zealand Chapter 9: Cyanobacterial compliance.

Following a telephone discussion regarding cyanobacteria protocol WDC updated the WSP to version 6.03 with an additional improvement added to review the cyanobacterial protocol.

Recommendation 3: WDC to ensure that cyanobacteria protocol review clarify and documents the roles of WDC and BOPRC with regards to sampling and to ensure it meets the requirements of the guidelines for Drinking-water Quality Management for New Zealand Chapter 9: Cyanobacterial compliance.

Adequacy of improvement schedule

An improvement schedule is included and appears to be aimed at addressing preventative measures, monitoring or corrective actions that require improvement. Many improvement schedule items cover multiple council-owned water supplies. The scope and detail of the improvement item is considered adequate.

Improvement item OP-IMP 15."Develop a training and competency system" only specifies reticulation workers.

Recommendation 4: Competency system should include all relevant/critical staff e.g., plant operators. WDC to review and correct or advise the DWA.

The previous WSP version 5.05 improvement item OP-IMP 18 timing was listed as quarterly and it was not clear when this started or when it is planned to occur. This latest version provides a specific month, therefore the non-conformance is resolved. It is presumed that the activity still reoccurs.

Decision

WSP for Whakatāne has been approved.

It is expected that the water supplier begin to implement this WSP within one month.

The Health Act sets out the maximum expiry of a WSP however due to the transition to the new WSP framework it is expected that plans approved now may need to be updated to include elements of the new framework that are absent or deficient. Therefore the approval of this WSP is subject to the DWA requiring its alteration (to meet the new WSP framework) within a specified period of time in consultation with WDC.

Please be aware that if significant changes are made to either the processes used to treat water or to the raw water source, the WSP must be revised and re-submitted for approval by a drinking water assessor.

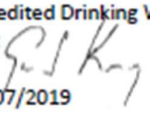
Information in this report will be provided to the Ministry of Health (in accordance with requirements of Section 69ZZZB of the Health Act).

Attachments
Nil.

Completed 18 July 2019.

Grant King
Drinking Water Assessor
Central North Island Drinking Water Assessment Unit – Toi Te Ora

Assessment Report Information

Report identifier	WHA005_Whakatāne_WSPadequacy_030719_v1
Drinking Water Assessment Unit (Inspection Body)	Central North Island Drinking Water Assessment Unit – Toi Te Ora PO Box 2120 Tauranga 3110 07 5773788
District Health Board	Bay of Plenty District Health Board
Drinking Water Assessor	Grant King
Assessment Date	03/07/2019
Description of assessment work	Assessment of adequacy of Water Safety Plan for Supply: WHA005 Whakatāne Zone: WHA005OH Ohope Zone: WHA005WH Whakatāne Plant: TP00323 Whakatāne Plant Source: S00217 Whakatāne River
Equipment Used	Nil.
Water Supply Owner / Person Responsible	Whakatāne District Council Tomasz Krawczyk
Assessment method	Standard assessment as per Scope Procedure 3 Standard specified in Health Act 1956
Documents and Information	• Drinking Water Standards for New Zealand 2005 (revised 2018) • Whakatāne Water Supply Water Safety Plan. Version 5.05, March 2019 (A1422915) • Whakatāne Water Supply Water Safety Plan. Version 6.01, June 2019 (A1422915) • Whakatāne Water Supply Water Safety Plan. Version 6.02, June 2019 (A1422915) • Whakatāne Water Supply Water Safety Plan. Version 6.03, July 2019 (A1422915) • 20190628_Whakatane River Catchment Risk Assessment (June 2019) • 20190314_Whakatane_WSP_Ade_report_final
Site of Assessment	Central North Island Drinking Water Assessment Unit – Toi Te Ora 510 Cameron Road, Tauranga
Omissions from proposed assessment	Nil
Sub-contracted work	Nil
Document checked by:	Cameron Huxley IANZ Accredited Drinking Water Assessor Date: 19/07/2019
Release of report authorised by:	Grant King IANZ Accredited Drinking Water Assessor Signature:  Date: 19/07/2019

If you do not agree with the findings of this report a written appeal must be lodged with the *Peter Wood, Technical Manager, Central North Island Drinking Water Assessment Unit, C/- MidCentral Public Health Service, PO Box 11-036, Palmerston North 4442* within 2 months of receipt of this report. The Technical Manager will arrange for a review to be undertaken using the Ministry of Health appeals procedure.