Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

GISBORNE WATER SUPPLY WATER SAFETY PLAN

VERSION 1 – 10 NOVEMBER 2022

Introduction

Gisborne Water Supply Water Safety Plan

The Gisborne Water Supply Water Safety Plan is specific to the Gisborne supply. It has a thorough risk assessment and summary of the hazards, barriers, and Gisborne District Council's supporting systems.

Gisborne District Council's drinking water safety planning is structured with an overarching Organisational Water Safety Plan and individual supply specific Water Safety Plan's that incorporate individual supply specific Drinking Water Source Risk Assessments.

The Organisational Plan details aspects of water supply management that apply to all GDC supplies and includes the systems, actions, processes and documents GDC has in place. The Organisational Plan supports the individual supply plans and is read in conjunction as a hierarchy document.

This Gisborne Water Supply Water Safety Plan contributes to Gisborne District Council:

- Meeting obligations as a water supplier in the Water Services Act 2021
- Understanding the Gisborne Water Supply related risks
- Identifying and actioning improvements required for any unacceptable risks

Fourteen (14) events are identified with unacceptable risk and require improvements. These events and the corresponding improvements are in Section 6 of this plan.

Document Control

Document Development Information			
Author Name(s)	**Position & Organisation**		
Josh Tākao	Senior Compliance Advisor – Wai Comply		
Cathy Walker	Senior Advisor Drinking Water – Gisborne District Council		
Peer Reviewer			
Judith Robertson	Drinking Water Team Leader, Gisborne District Council		
Authorised for Release			
David Wilson	Lifelines Director, Community Lifelines		
	Signature 		
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V0.1	Draft	Wai Comply	12 July 2022
V1	Final	Gisborne District Council	10 November 2022

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Water Safety Plan Development

This Water Safety Plan (WSP) is a risk assessment for the **Gisborne Water Supply.** It identifies the potential hazards and hazardous events that could affect the drinking water supply, assesses the likelihood and consequences of these, and implements suitable controls to reduce the risk of the unwanted event occurring. By implementing this plan, GDC aims to ensure a safe and secure supply of drinking-water is provided for consumers.

The audience for this plan is multiple levels of GDC as the water supplier, customers and stakeholders, contractors, consultants, and regulators.

Relationship with the Organisational WSP

The GDC **Organisational Water Safety Plan** contains information about water supply management that apply to all GDC supplies. This includes the systems, actions, processes and documents GDC has in place for all supplies.

The GDC Organisational WSP is a critical supporting document to the **Gisborne Supply WSP** and is referenced throughout as the source of information, to avoid duplication.

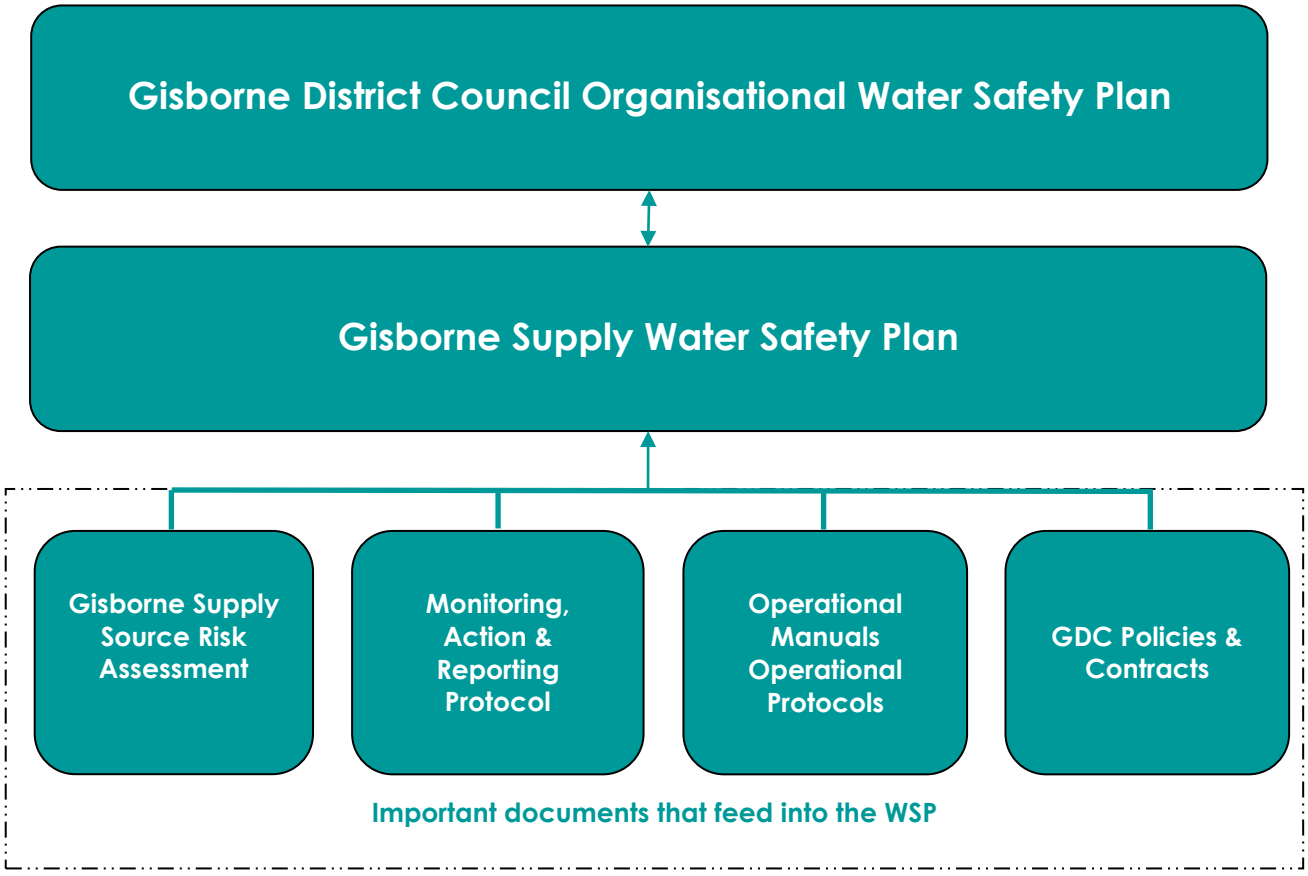


Figure 1: Gisborne WSP hierarchy of documents

WSP Review and Audit

To ensure the accuracy and validity of the risk assessment, scheduled WSP reviews and audits are required. The review and audit processes are detailed in Section 3 of the GDC Organisational WSP.

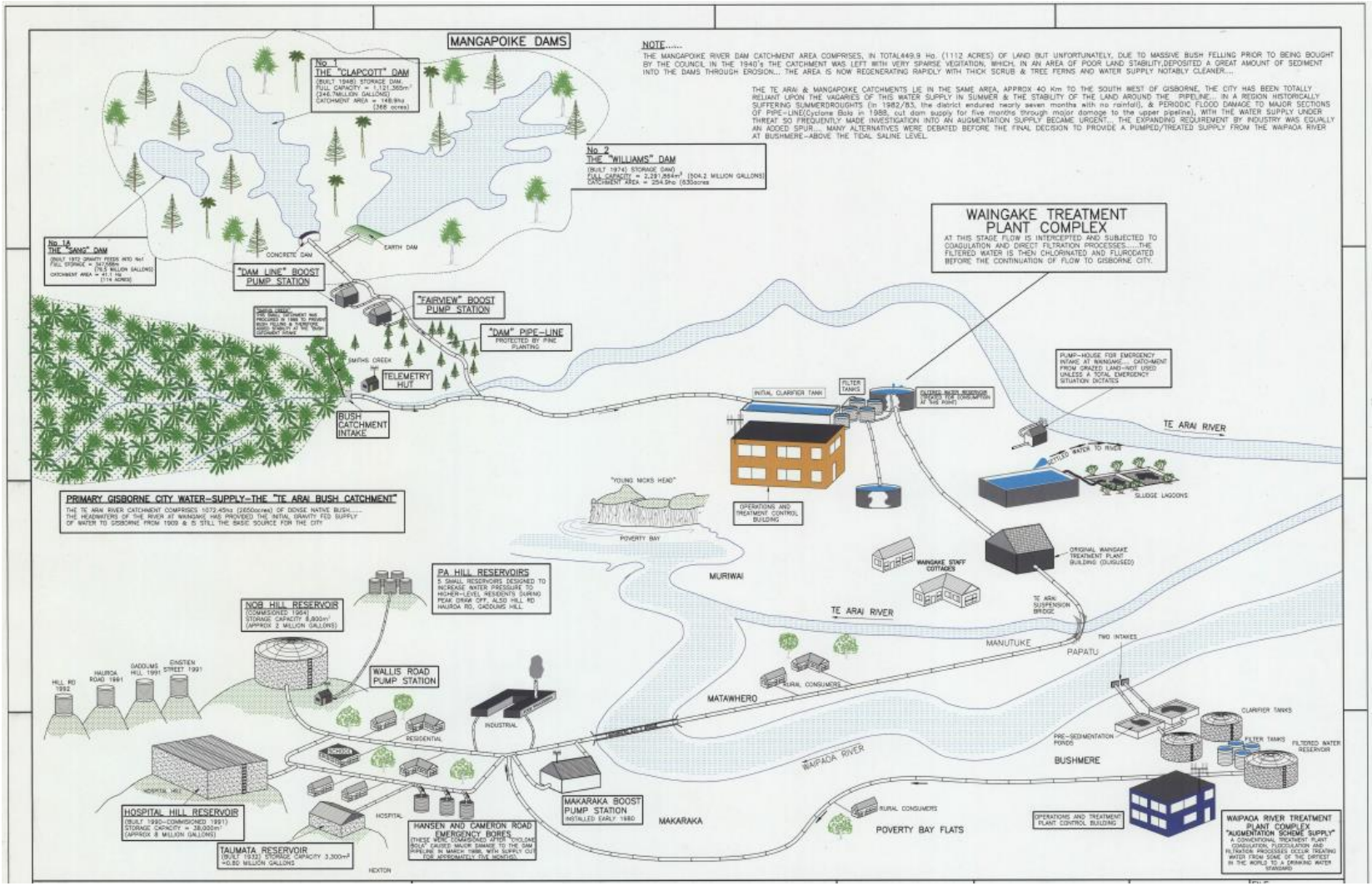
DEVELOPMENT TEAM AND DETAILS

The development of the **Gisborne Supply WSP** was done as outlined in Section 1.3 of the GDC Organisational WSP.

Development Step	Detail	Personnel Involved
Site Visit	Site inspection of Mangapoike Dams, Waingake Water Treatment Plant (WTP), Waipaoa WTP, and Gisborne Distribution Network sites on 8th and 9th December 2021.	GDC – Brett Chisholm, Ged Brown, Ralph Ogden, Paora Te Rangiita Wai Comply – Josh Takao, Grant King
Online workshop(s)	Workshop 15th December 2021 for ensuring accuracy of supply details, confirmation of hazards, planned improvements, and status of supporting systems development or review.	GDC – Judith Robertson, Janine du Plessis, Ralph Ogden, Paora Te Rangiita Wai Comply – Josh Takao, Grant King
	Workshop 16th March 2022 for ensuring accuracy of supply details, confirmation of hazards, planned improvements, and status of supporting systems development or review.	GDC – Judith Robertson, Janine Du Plessis, Ralph Ogden, Peter McKay, Paora Te Rangiita Wai Comply – Josh Takao, Grant King
Risk table assessment	Risk table completion and review by GDC staff. May and June 2022.	GDC – Cathy Walker, Peter McKay, Ralph Ogden, Judith Robertson
WSP review and adjustment	Draft Gisborne Water Supply Water Safety Plan review by GDC staff. July 2022.	GDC – Cathy Walker, Judith Robertson, Ralph Ogden

Table 1: WSP Development Steps

1 Overview of the Gisborne Water Supply



2 Control and Critical Control Points

2.1 Monitoring, Action and Reporting Protocol

A Monitoring, Action and Reporting Protocol documents the control and critical control point monitoring in the supply. Monitoring covers the source water, treatment plant and distribution zones done to manage and verify the quality of the water. The monitoring parameters, frequency and sampling sites meet the requirements in the Water Quality Assurance Rules (the Rules). The response actions are in place to ensure a safe supply of water.

2.2 Critical Control Points:

Waingake WTP:

The critical control point for bacterial disinfection is through the chlorination process. It is based on c.t. (concentration of chlorine x time water is held in a contact tank). Critical control is met by achieving a c.t. of 15 calculated using continuously monitored FAC, pH, flow and the reservoir level.

Modelling shows that at higher flows through the treatment process, the c.t critical control cannot be met. Installation of a UV disinfection facility will overcome this issue and will provide a secondary barrier treatment.

The Waingake catchment risk assessment resulted in a minimum of 3 Logs of treatment for protozal control. The critical control point for protozoal removal is through the coagulation, sedimentation and filtration process. Critical control is met by meeting turbidity level from individual filters and time requirements.

Waipaoa WTP:

The critical control point for bacterial disinfection is through the UV disinfection process. Critical control is met by meeting turbidity level, transmittance, UV dose and flow requirements.

The Waipaoa catchment risk assessment resulted in a minimum of 4 Logs of treatment for protozoal control. The first critical control point, for 3 log protozoal removal, is through the coagulation, sedimentation and filtration process. Critical control is met by meeting turbidity level from individual filters and time requirements.

The second critical control point, for a further 3 log protozoal removal, is through the UV disinfection process. Critical control is met by meeting turbidity level, transmittance, UV dose and flow requirements.

3 CATCHMENT

Barrier to contamination (Water Services Act Section 31(2)(a)): Prevent hazards entering raw water – *applies to whole catchment up to the intake/abstraction point*

A Drinking-Water Source Risk Assessment (**DWSRA**) was developed to provide a comprehensive understanding of the hazards within the catchments that provide source water to the Waipaoa and Waingake Water Treatment Plants (**WTP**).

The DWSRA investigates hazards and potential hazards in the three catchments that supply the Gisborne supply, the Mangapoike Dams, Waingake (Te Arai) Bush, and Waipaoa River. The DWSRA compliments this Gisborne supply Water Safety Plan (WSP) as the WSP provides a detailed risk assessment for each water source.

3.1 WAINGAKE WTP CATCHMENTS

Catchment Summary

See DWSRA – Description of Sources including Table 2 Waingake Supply components.

Water Quality Analysis

See DWSRA – Appendix B.

Contamination Barrier Management

SOPs and corrective actions

- MANUAL 01 Waingake_Waipaoa WTP - Quality Management System (QMS) - Version 5, September 2012 (A297912)
- MANUAL 13 Mangapoike Catchment and Dam Operations - Version 1, April 2002 (vA1350856)
- MANUAL 14 Water Supply Pump Station Operations - Version 1, November 2004 (vA1347789)
- MANUAL 06 Waingake Plant Work Instructions - Version 3, March 2011 (vA1507953)

Inspections

Inspections are outlined in Manuals above.

Maintenance

Inspection systems and programming are detailed in the GDC Organisational WSP (Section 7). The QMS refers to the QMS as the primary inspection and maintenance schedule. This will be supplemented by Water Outlook in future.

- Dam inspections in Manual 13.
- Dam maintenance.
- Pest control to protect dam face.
- Vegetation management.
- General pest control.
- Electric fences.

The development and implementation of a formalised Operational Maintenance Plan is an improvement item in the Organisational WSP.

Verification Monitoring and Performance Criteria[1]

Monitoring and action limits are outlined in the Monitoring, Action and Reporting Protocol.

Site[2]	Parameter	Frequency
Combined Dams Waingake River	E. coli & Total Coliforms	2 per month
Combined Dams Waingake River	Iron, Manganese, Colour, Nitrate	Monthly
Combined Dams Waingake River	Alkalinity, Antimony, Arsenic, Barium, Cadmium, Calcium, Chloride, Chromium, Copper, Lead, Magnesium, Mercury, Nickel, Sodium, Sulphate, Total Phosphorus	annually as long as <50% of MAV otherwise monthly

Summary of Catchment Hazards – Waingake WTP Catchments

The DWSRA for the Waingake catchment documents the possible sources of potential hazards. These are summarised below.

For full risk tables including risk assessment and hazardous event mitigations refer to Appendix A.

Supply Component	Hazardous Event
Waingake – Mangapoike Dams	Contamination in the source water catchments from industrial practices (road transport)
	Contamination in the source water catchments from open space activities (stormwater runoff)
	Contamination in the source water catchment from new or unknown activities (change of land use, change in access permissions)
	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)
	Contamination or loss of supply due to changes from seismic activity
	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)
	Contamination of the source water caused by ashfall from a fire or volcanic eruption
	Loss of supply due to insufficient source water availability - extended period of dry weather or drought
	Loss of supply due to unsuitable raw water quality for the treatment process (Mangapoike Dam stratification causing quality issues)
	Contamination of the source water from faecal matter from feral animals within the catchment area
Waingake – Waingake River	Contamination in the source water catchment from industrial practices (road transport)
	Contamination in the source water catchment from open space activities (stormwater runoff)
	Contamination in the source water catchments from conservation land practices (animal control,1080 drops)

[1] Monitoring required under the Rules

[2] See Water Quality Programme Protocols for sampling sites (788953)

Supply Component	Hazardous Event
	Contamination of the source water catchment from new or unknown activities (change of land use, change in access permissions)
	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)
	Contamination or loss of supply due to changes from seismic activity
	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)
	Contamination of the source water caused by ashfall from a fire or volcanic eruption
	Loss of supply due to insufficient source water availability - extended period of dry weather or drought
	Contamination of the source water from faecal matter from feral animals within the catchment area

Table 2: Catchment Hazards for Waingake Water Treatment Plant (Mangapoike Dams and Waingake Stream)

3.2 WAIPAOA WTP CATCHMENT

Catchment Summary

See DWSRA – Description of Sources including Table 6 Waipaoa Supply components.

Water Quality Analysis

See DWSRA – Appendix B.

Contamination Barrier Management

SOPs and corrective actions (non CCP)

N/A – Waipaoa Catchment is not actively managed due to the size. Risk mitigations in place further downstream (i.e., Treatment systems).

Inspections and Maintenance

N/A – The Waipaoa Catchment is not actively managed due to its size. Risk mitigation is in place further downstream (i.e., Treatment systems).

Verification Monitoring and Performance Criteria[3]

Monitoring details are outlined in the GDC Monitoring, Action and Reporting Protocol.

Site[4]	Parameter	Frequency
Waipaoa River	E. coli & Total Coliforms	2 per month
Waipaoa River	Iron, Manganese, Colour, Nitrate	Monthly
Waipaoa River	Alkalinity, Antimony, Arsenic, Barium, Cadmium, Calcium, Chloride, Chromium, Copper, Lead, Magnesium, Mercury, Nickel, Sodium, Sulphate.	annually as long as <50% of MAV otherwise monthly

[3] Monitoring required under the Rules

[4] See Water Quality Programme Protocols for sampling sites (788953)

Summary of Catchment Hazards – Waipaoa WTP

For full risk tables including hazardous event mitigations and risk assessment refer to Appendix A.

Supply Component	Hazardous Event
Waipaoa River	Contamination in the source water catchment from agricultural practices (includes pesticides, fertilisers, farm operations and grazing)
	Contamination in the source water catchment from industrial practices (road transport)
	Contamination in the source water catchments from open space activities (stormwater runoff)
	Contamination in the source water catchments from rural residential practices (fertilisers, pets/livestock, offsite and onsite sewage, weed/pest control)
	Contamination of the source water catchment from new or unknown activities (change of land use or 'non-notified activities')
	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)
	Contamination or loss of supply due to changes from seismic activity
	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)
	Contamination of the source water caused by ashfall from a volcanic eruption
	Loss of supply due to insufficient source water availability - extended period of dry weather or drought

Table 3: Catchment Hazards for Waipaoa Water Treatment Plant

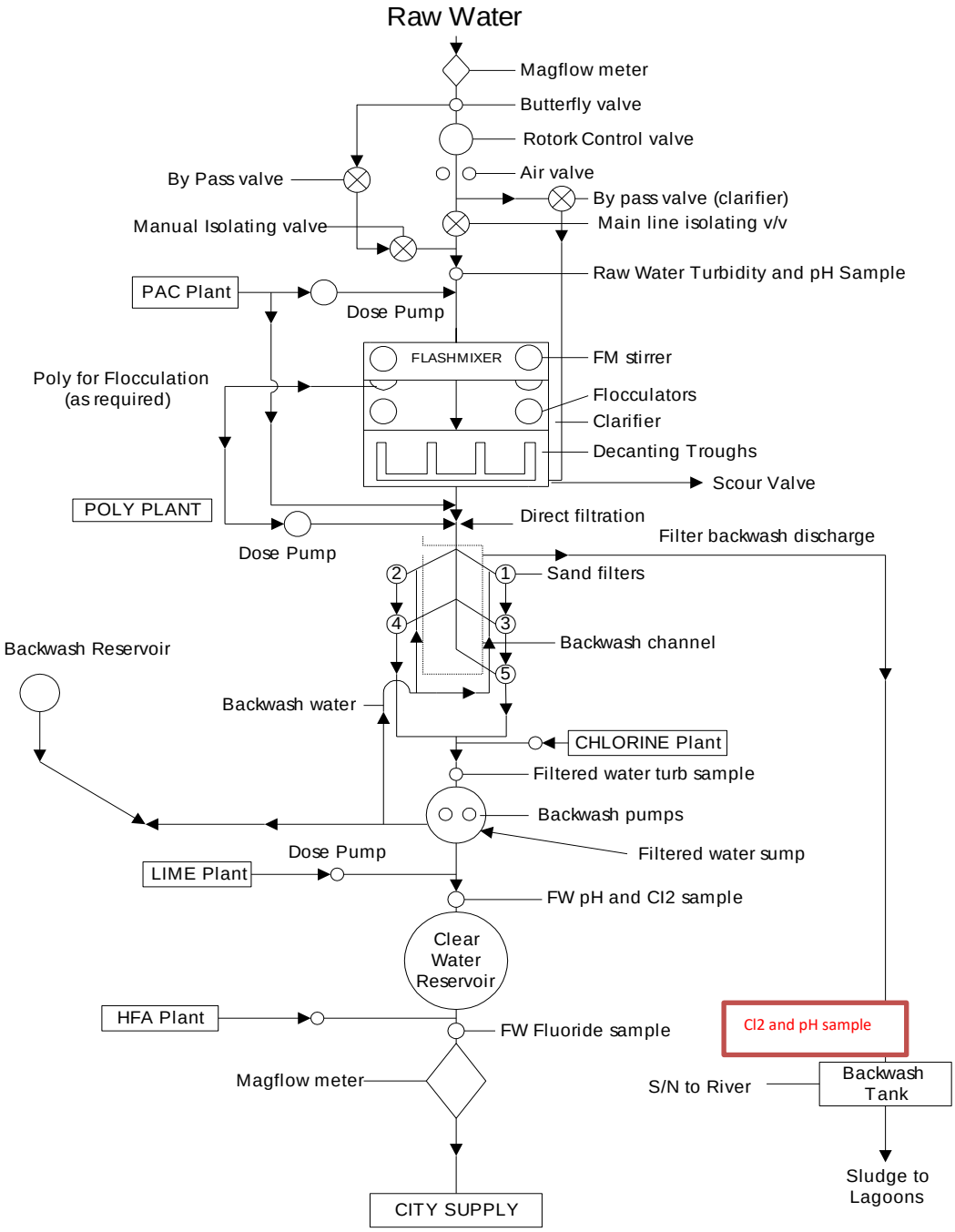
4 Treatment

Barrier to contamination (Water Services Act Section 31(2)(b-c)): Remove particles, pathogens, chemical and radiological hazards, and kill or inactivate pathogens – *applies to the intake/abstraction points through to the WTP outlets*

4.1 Waingake Water Treatment Plant

Waingake Treatment Plant Details

Waingake Flow diagram



Waingake Abstraction

Process Step	Detail(s)	Description
Clapcott (Mangapoike Dam No. 1) (Waingake WTP)	Description	Lake settlement, dam intake coarse screening. Sang dam discharges into far end of Clapcott dam for additional capacity.
	Abstraction method	Intake columns within dams. Multiple points of abstraction at differing depths.
	Control	All dams - manually operated at intake towers. Gravity flow 200-500 m^3/hr pumped up to 1200 m^3/h.
	Online Monitoring	Level
	Security	Within protected catchment area and remote site. Gates locked. Shared access with forestry staff only.
	Backup power	n/a as valves manually operated
Williams (Mangapoike Dam No. 2) (Waingake WTP)	Description	Lake settlement, dam intake coarse screening.
	Abstraction method	Intake columns within dams. Multiple points of abstraction at differing depths.
	Control	All dams - manually operated at intake towers. Gravity flow 200-500 m^3/hr pumped up to 1200 m^3/h.
	Online Monitoring	Level
	Security	Within protected catchment area and remote site. Gates locked. Shared access with forestry staff only.
	Backup power	n/a as valves manually operated
Waingake Intake (Waingake WTP)	Description	Course bar screen on concrete intake structure with screen backflush.
	Abstraction method	Full width weir to channel
	Control	Rotork valve connected to telemetry and online control systems. Open/close only.
	Online Monitoring	Flow, turbidity
	Security	Very remote site and within private property. Normal access via several ford crossing requiring 4WD.
	Backup power	Solar and UPS on some systems.

Waingake Bulk Raw Water Mains and Pump Stations

Process Step	Detail(s)	Description
Damline & Fairview Raw Water Pump Stations.	Description	Flow booster pump stations. Two pumps in duty/standby arrangement.
	Control	Rotork valve connected to telemetry and online control systems in place at both sites.
	Online Monitoring	Pressure, Flow, Valve position at both sites.
	Security	Very remote site, within private property and locked buildings at both sites.
	Backup power	UPS on some systems. Generator installed. Currently manual operation with plans to add remote control.
Raw Water Trunk Main	Description	450 mm CLMS. Largely buried. Many pipe bridges. Sections exposed to atmosphere. Cathodic protection installed. Unstable geography. Passing through forestry and grazing land. Air valves and scour points in place.
	Control	N/A
	Online Monitoring	None
	Security	Asset location well known. Marker posts installed.

Process Step	Detail(s)	Description
	Backup power	N/A

Waingake Treatment Summary

Treatment & Storage				
Treatment Plant	Plant name	Waingake WTP		
	Treatment Processes	Coagulation/Flocculation/Sedimentation; Filtration; Chlorination		
	Treatment Processes	Log reduction value (LRV) range[5]		
		Bacteria	Viruses	Protozoa
	Coagulation, Flocculation, sedimentation	0.2-2	0.1-3.4	1-2
	Rapid media filtration	0.2-4.4	0-3.5	0.4-3.3
	Gas chlorination	2	2	0
	Design capacity	31,000 m^3/day		
	Daily flow average	15,000 m^3/day		
	Chemicals added	Polyaluminium chloride (PACl), Polydadmac L3RC (Poly), Chlorine Gas, Hydrofluorosilicic Acid		
	Standby chemical dosing facilities	Lime and Sodium hexametaphosphate, PACl, Poly, Chlorine, Fluoride		
	Bypasses	Clarifier bypass exists and is used for clarifier clean (completed every 2 years). Note adjusted performance requirements enabled when clarifier clean is carried out (i.e., tighter turbidity requirements). Other bypasses available but not actively used.		
	Security	WTP is completely fenced and locked, limited access keys		
	Power Supply	Primary – Electricity network Backup/standby – Diesel generator		
Storage Reservoirs	Reservoir name	Clearwater Reservoir (CWR) (1,000 m^3), Backwash Tank (500m^3)		
	Reservoir type	Treated water (excluding Fluoridation)		
	Location	Waingake WTP site		
	Capacity	Clearwater Reservoir (1,000 m^3) Backwash Tank (500m^3)		
	Sealed	Yes		
	Vermin proof	Yes		
	Run-off directed off roof	Yes		
	Above/below ground	Both reservoirs above ground		

[5] LRVs based on Appendix 2 of the MoH WSP Handbook (Ministry of Health, 2019)

Waingake Treatment Steps Detail

Process Step	Detail(s)	Description
Coagulation and Clarification	Description	Partial coagulation, contact flocculation. Duty standby dose pumps. Twin dose lines. Pre and post clarifier sampling points.
	Control	Flow controlled by inlet flow meter
	Online Monitoring	PACL - Pump status, speed, dosage, and stroke. Transfer pump status. Poly – Pump status, speed, and stroke position. Mixer status. Poly make up system fault.
	Under/overdose controls	Day tanks for both Poly and PACl limit total volume available. 'Stubbe' pressure valves in place. Daily checks on calculated chemical consumption.
Rapid Gravity Sand Filtration	Description	Five Filters. 2.8 m of graded sand (1.4-2.8 mm). Backwash with combination air/water (10 mins air/water and 5 mins water only) with Backwash Reservoir water (500 m3).
	Control	Inlet flow control by weir height, inlet valve. Outlet flow control by float arm and outlet valve. Backwash initiated on timer, filter head loss, or turbidity.
	Online Monitoring	Individual and combined filter turbidity.
Chlorination	Description	Chlorine gas 920 kg drum. 1 x duty 1 x standby 1 x spare. Drums sitting on scales measured for weight. Duty & standby chlorinators. Duty & standby carry water pumps (inlet of CWR)
	Contact time	Waingake is limited to less than 15 minutes contact time for most flows; based on calculations.
	Control	Chlorine dosing is flow proportional
	Online Monitoring	FAC level at the filtered Water Sump outlet (FWS) and CWR outlet Chlorinator status Booster pump status
	Under/overdose controls	Daily checks on calculated chemical consumption and chlorinators. Alarms linked to FAC analysers with automated response built in ('Zero flow' at Makaraka Pump Station).
Fluoridation	Description	Hydrofluorosilicic acid. Bulk storage tank and day tank. Day tank sitting on scales measured for weight.
	Control	Variable speed/stroke dose pumps have auto speed control governed by final water flow meter and manual stroke control adjusted by the operator.
	Online Monitoring	Fluoride level analyser at the CWR outlet Day tank weight Dose pump status
	Under/overdose controls	Day tank limits total volume available. Fluoride dose pump stops when flow <150 m^3/hr. 'Stubbe' pressure valves in place.

Parameter	Site	Results	
E. coli (dataset from 2015-2021)	Waingake	825 samples	0 samples
DWSNZ MAV		<1	>1

Barrier Management

SOPs and corrective actions

- MANUAL 01_ Waingake_Waipaoa WTP - Quality Management System - Version 5, September 2012 (A297912)
- MANUAL 05_ Trunk Water Main Emergency Response Plan - Version 4, January 2011 (vA874947)
- MANUAL 06 _ Waingake Plant Work Instructions - Version 3, March 2011 (vA1507953)
- MANUAL 07 _ Waingake Chemical Plant Work Instructions - Version 5, May 2011 (vA1475511)
- MANUAL 10 _ Waingake & Waipaoa Laboratory Manual - Version 2, September 2010 (vA875005)
- MANUAL 13 _ Mangapoike Catchment and Dam Operations - Version 1, April 2002 (vA1350856)
- MANUAL 14_ Water Supply Pump Station Operations - Version 1, November 2004 (vA1347789)

Inspections

See inspections outlined in SOPs above.

Maintenance

Set out in:

- MANUAL 11 _ Waingake and Waipaoa Calibration Work Instructions - Version 2, June 2011 (vA875006)
- Development and implementation of a formalised Operational Maintenance Plan is an improvement item in the Organisational WSP.

Verification Monitoring and Performance Criteria

The Monitoring, Action and Reporting Protocol sets out the limits and corresponding response actions.

Site	Parameter	Frequency
[6]Raw water	Turbidity, pH, conductivity	Continuous
Raw water	Turbidity	weekly[7]
Post PACl	pH	Continuous
[8]Post filter	Individual filter turbidity	Continuous
Post filter	Flow, run time, combined turbidity, head loss	Continuous
Pre reservoir	pH, chlorine, flow	Continuous
Reservoir	level	Continuous

[6] Required by the Rules
[7] Weekly manual sample verification unless required as part of event or issue response
[8] Required by the Rules

Site	Parameter	Frequency
[9]Post reservoir	FAC, pH, turbidity, flow, fluoride	Continuous
[10]Post reservoir	FAC, pH, turbidity, fluoride	weekly
	Aluminium	Based on typical range[11]

Instrumentation Standardisation and verification

Set out in MANUAL 11 _ Waingake and Waipaoa Calibration Work Instructions - Version 2, June 2011 (vA875006)

Summary of Treatment Hazards – Waingake WTP

Water Supply Component	Hazardous Event
Abstraction	Contamination at the intakes from maintenance/servicing work
	Contamination or loss of supply at the intakes or weir due to unintentional or intentional damage (vandalism)
	Loss of supply due to consents not being renewed or declined
	Loss of supply due to damage to the intakes or weir
	Loss of supply due to excessive build-up surrounding the intakes or weir
	Loss of supply due to loss of power at the intakes or weir
Raw Water Main & Pump Stations	Loss of supply due to damage to the raw water main
	Loss of supply due to raw water main failure
	Loss of supply due to damage to the pump stations
	Loss of supply due to loss of power at the pump stations
Treatment	Contamination or loss of supply due to **COAGULATION/FLOCCULATION** process failure (coagulant supply exhausted, dosing equipment failure, unsuitable quality of incoming water, incorrect dose rate, power failure)
	Contamination or loss of supply due to **FILTRATION** process failure (issue with preceding treatment process, backwash system failure, power failure, inadequate backwash reservoir level)
	Contamination due to **CHLORINE DISINFECTION** process failure - **inadequate chlorination** (issue with preceding treatment process, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, short contact time, power failure)
	Contamination due to **CHLORINE DISINFECTION** process failure - **over chlorination** (issue with preceding treatment process, dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)
	Contamination due to the chlorine reacting with raw water contaminants causing disinfection by-products
	Contamination due to **FLUORIDATION** process failure (dosing equipment failure, incorrect dose rate)
	Contamination or loss of supply due to unintentional or intentional vandalism of treatment systems
	Loss of supply due to service water system failure

[9] Required by the Rules

[10] Weekly manual sampling verification unless required as part of event or issue response

[11] To be determined from 15 samples collected over 12 months. Frequency outlined in the Rules Table 33

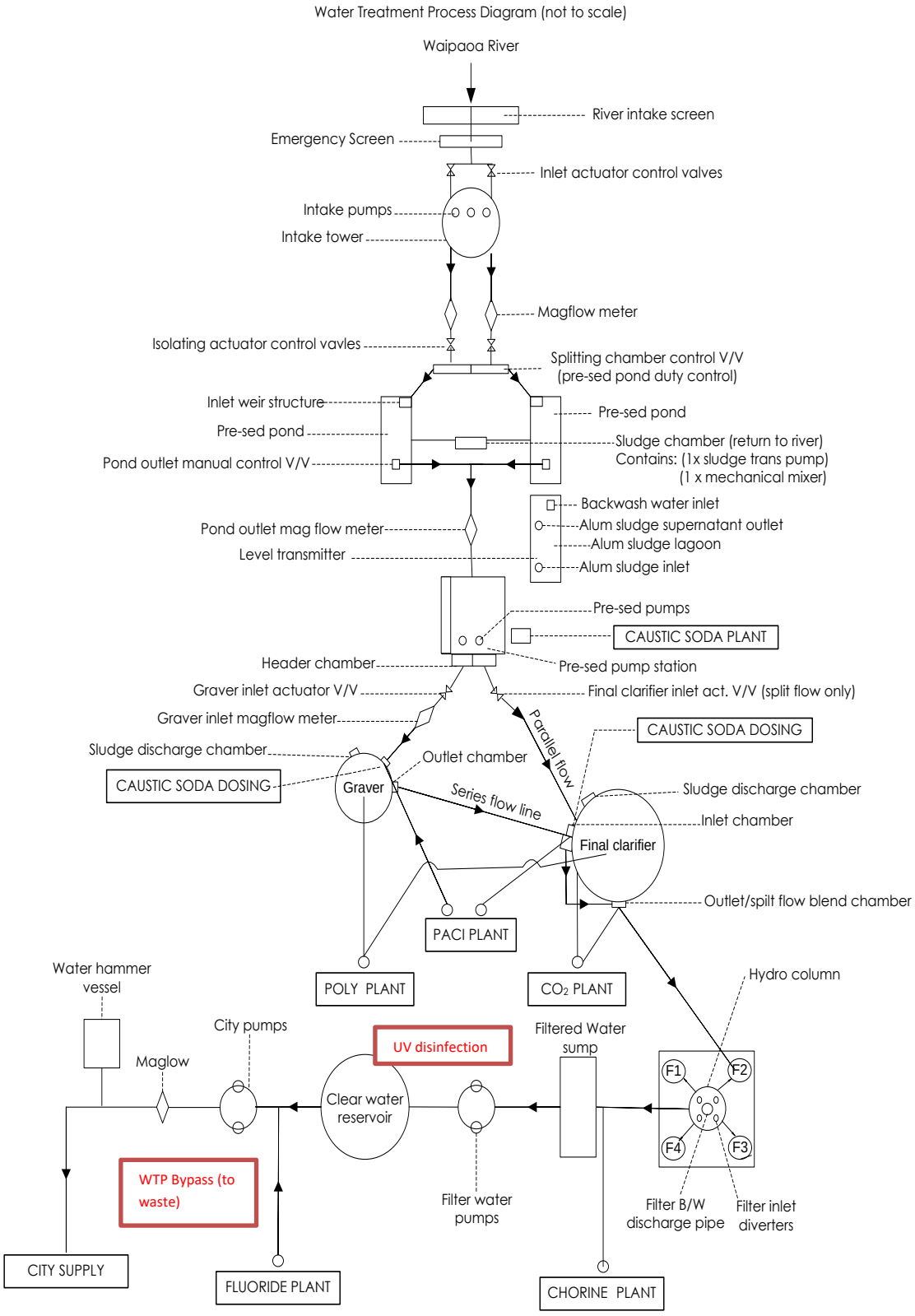
Water Supply Component	Hazardous Event
	Loss of supply due to compressed air system failure
Storage	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism
	Loss of storage capacity due to earthquake damage
	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)
	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir
	Contamination from reservoir roof leakage

Table 4: Treatment Hazards for Waingake Water Treatment Plant

4.2 WAIPAOA WATER TREATMENT PLANT

Waipaoa Treatment Plant Details

Waipaoa Flow Diagram



Waipaoa Abstraction

Process Step	Detail(s)	Description
Waipaoa River	Description	Two Johnson wedge wire screen 'tees' in river and pumped into pre-sedimentation ponds. Three pumps available for pumping. Air compressor onsite to run screen cleans.
	Abstraction method	In river intakes via pump
	Control	Pump
	Online Monitoring	Pump status and speed, flow to ponds. Intake backwash status. Pressure.
	Security	Within private property and pump station within secure intake building.
	Backup power	Connected to Waipaoa generator

Waipaoa Treatment Summary

Treatment & Storage				
Treatment Plant	Plant name	Waipaoa WTP		
	Treatment Processes	Presedimentation; Coagulation; Softening; Filtration; Chlorination; UV Disinfection		
	Treatment Processes	Log reduction value range (LRV)[12]		
		Bacteria	Viruses	Protozoa
	Presedimentation	0.7-2.2	0	1.4-2.3
	Coagulation, Flocculation, Sedimentation	0.2-2	0.1-3.4	1-2
	Rapid media filtration	0.2-4.4	0-3.5	0.4-3.3
	Gas chlorination	2	2	0
	UV Disinfection	4	4	4
	Design capacity	12,960 m^3/day		
	Daily flow average	8,640 m^3/day		
	Chemicals added	Polyaluminium Chloride (PACl), Crystalfloc B570 (Poly), Chlorine Gas		
	Standby chemical dosing facilities	Caustic Soda, Carbon Dioxide		
	Bypasses	WTP recirculation line is used during WTP start-up processes, but valves manually operated. Other bypasses exist but are not actively used.		
	Security	WTP is completely fenced and locked, limited access keys		
	Power Supply	Primary – Electricity Network Backup/standby – Diesel generator		

[12] LRVs based on Appendix 2 of the MoH WSP Handbook ((Ministry of Health, 2019)

Treatment & Storage		
Storage Reservoirs	Reservoir name (if applicable)	Clearwater Reservoir
	Reservoir type	Treated water and backwash water
	Location	Waipaoa WTP Site
	Capacity	1500m^3
	Sealed	Yes
	Vermin proof	Yes
	Run-off directed off roof	Yes
	Above/below ground	Partially below ground

Waipaoa Treatment Step Detail

Process Step	Detail(s)	Description
Presedimentation Ponds and Pump Station	Description	Two raw water presedimentation ponds and one wastewater pond. Consent is held for supernatant from wastewater pond discharges to the river and does not flow into presedimentation ponds. Ponds used in parallel. presedimentation Pump Station – Duty/standby pumps to header.
	Control	Flow to and from each pond manually operated. Split flow possible from Presed pump station to each clarifier.
	Online Monitoring	Ponds – Pond level, inflow. Presed PS – Pond outflow, turbidity.
Coagulation and Clarification	Description	Graver and final clarifier. Used either in series or parallel depending on flow requirements. Dosed with PACl and polyelectrolyte.
	Control	Flow controlled by inlet flow meter. Dose rate manually adjusted.
	Online Monitoring	PACL – Pump status, speed, dosage, and stroke. Transfer pump status. Poly – Pump status, speed, and stroke position. Mixer status. Poly make up system fault.
	Under/overdose controls	Day tanks for both Poly and PACl limit total volume available. 'Stubbe' pressure valves in place. Daily checks on calculated chemical consumption.
Water softening	Description	Sodium hydroxide (Caustic) and Carbon Dioxide used to reduce the hardness of Waipaoa River water at times when raw water levels are high. Additional option to GDC of blending Waipaoa treated water with Waingake treated water. Only used when required and monitored daily at Venturi site. Able to be used in series or parallel depending on requirements.
	Control	Dose pre-set as per 'scenario A-F' from Chemical Operations Manual.

Process Step	Detail(s)	Description
	Online Monitoring	pH level at Graver reactivator, Final Clarifier and Hydro column.
	Under/overdose controls	'Stubbe' pressure valves in place.
Rapid Gravity Sand Filtration	Description	Four filters. 2.8 m of graded sand (1.4-2.8 mm). Backwash with combination air/water (10 mins air/water and 5 mins water only) with Backwash Tank water (500 m^3).
	Control	Inlet flow control by hydro column, inlet valve. Outlet flow control by float arm and outlet valve. Backwash initiated on time, filter head loss, or turbidity.
	Online Monitoring	Individual and combined filter turbidity, valve position (inlet and outlet)
Chlorination & pH Adjustment	Description	Chlorine gas 920 kg drum. 1 x duty 1 x standby. Drums sitting on scales measured for weight. Duty & standby chlorinators.
	Contact time	Minimum of 15 at 0.5mg/l FAC and 50% reservoir level.
	Control	Chlorine dosing is flow proportional
	Online Monitoring	FAC level at the FWS outlet and CWR outlet Chlorinator status
	Under/overdose controls	Daily checks on calculated chemical consumption and chlorinators. Alarms linked to FAC level with automated response built in (City Pumps shut down)
UV disinfection	Description	Two UV reactors validated to dose at least 40 mJ/cm^2. Automatically adjusts UV intensity based on UVT levels.
	Control	UV controller.
	Online Monitoring	UV Transmittance, valve position, UV Dose, UV Fault, UV flow, total hours per reactor.
City Pumps	Description	Flow booster pump stations. Two pumps in duty/standby arrangement.
	Control	Connected to telemetry and online control systems in place.
	Online Monitoring	Pressure, flow.

Water Quality Analysis

Parameter	Site	Results	
DWSNZ MAV		<1	>1
E. coli (dataset from 2015-2021)	Waipaoa	274 samples	1 sample

Contamination Barrier Management

SOPs and corrective actions

- MANUAL 01_ Waingake_Waipaoa WTP - Quality Management System - Version 5, September 2012 (A297912)
- MANUAL 08 _ Waipaoa Plant Work Instructions - Version 3, December 2013 (vA875001)
- MANUAL 09 _ Waipaoa Chemical Plant Work Instructions - Version 2, September 2013 (vA1490869)
- MANUAL 10 _ Waingake & Waipaoa Laboratory Manual - Version 2, September 2010 (vA875005)

Inspections

See inspections outlined in SOPs above.

Maintenance

Set out in:

- MANUAL 11 _ Waingake and Waipaoa Calibration Work Instructions - Version 2, June 2011 (vA875006)
- Development and implementation of a formalised Operational Maintenance Plan is an improvement item in the Organisational WSP.

Verification Monitoring and Performance Criteria

The Action & Reporting Protocol Critical Control Point & Process Control Summaries which sets out the limits and corresponding corrective actions.

Site	Parameter	Frequency
[13]Raw water	Turbidity	Continuous
[14]Post filter	Flow, run time, turbidity, head loss	Continuous
Pre reservoir	UV dose, UVT, pH, chlorine, flow, turbidity	Continuous
Reservoir	level	Continuous
Post reservoir	FAC	Continuous
	pH	Continuous
	Flow	Continuous
	Aluminium	Based on typical range[15]

Instrumentation Standardisation and Verification

Set out in MANUAL 11 _ Waingake and Waipaoa Calibration Work Instructions - Version 2, June 2011 (vA875006)

Summary of Treatment Hazards – Waipaoa

Water Supply Component	Hazardous Event
Abstraction	Contamination at the intakes from maintenance/servicing work
	Contamination or loss of supply at the intakes due to unintentional or intentional damage (vandalism)
	Loss of supply due to consents not being renewed or declined
	Loss of supply due to damage to the intakes
	Loss of supply due to excessive build-up surrounding the intakes
	Loss of supply due to loss of power at the intakes
Treatment	Contamination or loss of supply due to **PRESEDIMENTATION** process failure (unsuitable quality of incoming water)

[13] pH and conductivity also required under the new Rules
[14] Turbidity, flow, UV dose & UVT is required under the Rules
[15] To be determined from 15 samples collected over 12 months. Frequency outlined in the Rules Table 33

Water Supply Component	Hazardous Event
	Contamination or loss of supply due to **COAGULATION/FLOCCULATION** process failure (issue with preceding treatment process, coagulant supply exhausted, dosing equipment failure, incorrect dose rate, power failure)
	Contamination or loss of supply due to **SOFTENING** process failure (issue with preceding treatment process, caustic dosing equipment failure, incorrect dose rate, power failure)
	Contamination or loss of supply due to **FILTRATION** process failure (issue with preceding treatment process, backwash system failure, power failure, inadequate CWR level)
	Contamination due to **CHLORINE DISINFECTION** process failure - **inadequate chlorination** (issue with preceding treatment process, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, short contact time, power failure)
	Contamination due to **CHLORINE DISINFECTION** process failure - **over chlorination** (issue with preceding treatment process, dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)
	Contamination due to the chlorine reacting with raw water contaminants causing disinfection by-products
	Contamination or loss of supply due to **UV DISINFECTION** process failure (issue with preceding treatment process, UV reactor failure, power failure)
	Contamination or loss of supply due to unintentional or intentional vandalism of treatment systems
	Contamination or loss of supply due to WTP bypass system failure
	Loss of supply due to service water system failure
	Loss of supply due to compressed air system failure
Reservoirs	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism
	Loss of storage capacity due to earthquake damage
	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)
	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir
	Contamination from reservoir roof leakage

Table 5: Treatment Hazards for Waipaoa Water Treatment Plant

5 DISTRIBUTION NETWORK

Barrier to contamination (Water Services Act Section 31(2)(d)): Maintain the quality of water in the Distribution Network system – *applies to the WTP Outlets through to the customer point of supply (Toby/Meter). This includes the trunk mains, City Storage Reservoirs, pump stations and chlorine booster.*

The Gisborne supply has two zones; Gisborne Rural Zone (GIS001RU) and Gisborne City Zone (GIS001GI)

Rural Zone

The Rural Zone covers the reticulated area (pipes in blue) between the Waingake WTP and the City Zone (shown in white).

City Zone

The City Zone covers all of the customers within the reticulated services boundary area and the customers on Centennial Marine Parade.

GISBORNE SUPPLY DISTRIBUTION NETWORK

Distribution Network Summary

Process Step	Detail(s)	Description
General Distribution Network	Zone name(s)	Gisborne City, Gisborne Rural
	Zone Population	39,000 (Taumata Arowai, 2022)
	Pipe materials	274 km pipe; AC (28%), Cast iron (22%), Polyethylene (26%), Steel (17%), PVC (6%), other (1%)
	Connections	13,023
	Backflow preventers	RPZ: 305 Non-testable: 4564 with installations continuing for the next 5 years.
Treated Water Trunk Main (Waingake WTP to Makaraka PS)	Description	525 mm CLMS. Largely buried. Many pipe bridges. Sections exposed to atmosphere. Cathodic protection installed. Passing through grazing land. Air valves and multiple scour points in place. Major crossing over Waingake River and Waipaoa River.
	Online Monitoring	None
	Security	Asset location well known. Marker posts installed.
Makaraka Pump Station	Description	Flow booster pump station. Three pumps in duty/duty/standby arrangement for flows >700 m3/hr. Bermad main control valve for <700 m3/hr and 'Zero at Makaraka'. Bermad works in conjunction with bypass valve to pumps). Minimum suction pressure is 200 kPa.
	Control	Bermad valve and pumps all connected to telemetry. VSDs on each pump and manual isolation valve.
	Online Monitoring	Pressure (suction and delivery), Flow, valve position and pump status.
	Security	Secure and locked building. All fragile assets within the building.
	Backup power	None. Gravity flow up to 700 m^3/hr possible.
Ormond Rd Pump Station	Description	Flow booster pump station. One pump to boost flow to Nob Hill Reservoir.
	Control	Pump connected to telemetry. VSDs on pump and manual isolation valves available.
	Online Monitoring	Pressure (suction and delivery) and pump status.
	Security	Secure and locked cabinets and pump below ground in a suitable pit. All fragile assets adequately protected.
	Backup power	None. Gravity flow still possible.
Hillview Terrace Pump Station	Description	High level pump station for the area surrounding Hospital Hill Reservoir. Three pumps in duty/standby and another pumps for fire flows (assist).
	Control	Pumps connected to telemetry. VSDs on pumps and manual isolation valves available.
	Online Monitoring	Pressure (suction and delivery) and pump status all monitored locally (i.e., not connected to telemetry)

Process Step	Detail(s)	Description
	Security	Secure and locked building. All fragile assets within the building.
	Backup power	Standby generator onsite and connected.
High Level Pump Stations	Description	High level pump stations for the elevated areas in the Gisborne City Distribution Network (Hill Rd, Hauroa, Rd, Gaddums Hill, Pah Hill). Each pump station has a single pump that boosts flow to the upper reservoirs.
	Control	Pumps connected to local controller only based on delivery pressure level. No telemetry.
	Online Monitoring	None
	Security	Secure and locked buildings. All fragile assets within the building.
	Backup power	None
Taumata Pump Station	Description	Pump station to fill Taumata Reservoir. One old pump available. One way flow is the normal setup as Taumata Reservoir is for emergency supply ONLY.
	Control	Pump control and valves all manually operated/initiated.
	Online Monitoring	None
	Security	Secure and locked buildings. All fragile assets within the building.
	Backup power	None.
Hospital Hill Reservoir	Description	Large rectangular reservoir with two cells. Full capacity is 38,000m^3 (19,000m^3 each cell). Reservoir partially below ground with underdrains piped to a single collection point. Onsite chlorination in place to increase FAC levels of outgoing stored water (see Hospital Hill Chlorination section for further details). Operating ranges for the cells combined are 20,000 m^3 to full.
	Control	Inflow = SCADA and determined by Distribution Network network pressure , outflow = manual
	Online monitoring	Level, inflow/outflow
	Security	Sealed, vermin proof and locked access hatches.
	Backup Power	None required
Hospital Hill Chlorination	Description	Chlorine gas 70 kg cylinders. 1 x duty 1 x standby. Cylinders sitting on scales measured for weight. Duty & standby chlorinators. High and low-rate chlorinators (setpoints 1.0 and 0.8 g/m^3 respectively). Duty & standby carry water and sample pumps.
	Contact time	Minimal however chlorination used to boost base chlorine level when required.
	Control	Chlorine dosing is based on online monitoring FAC result
	Online Monitoring	FAC level at the outlet of reservoir Chlorination system status
	Under/overdose controls	Weekly calibration checks on FAC level. High rate and low-rate chlorinators ensure appropriate dose rate is used.

Process Step	Detail(s)	Description
Nob Hill Reservoir	Description	Large circular reservoir with a maximum capacity of 8,000m^3. Reservoir above ground and filled mostly by running Ormond Rd Pump Station in high demand periods, and at night in low demand periods. Around 620 kPa is required in the network for Nob Hill to fill (measured at Birrell St, Hansen Rd and Anzac St). Operating ranges are 4,000 m^3 to full.
	Control	Inflow = determined by Distribution Network pressure and in some cases the operation of the Ormond Rd Pump Station.
	Online monitoring	Level, inflow/outflow
	Security	Sealed, vermin proof and locked access hatches. Gate to access drive is locked also.
	Backup Power	None required
High Level Reservoirs	Description	Various 22.5m^3 reservoirs in the more elevated area of the Distribution Network. Some pumped and some not. Sites are Hill Rd (upper tanks), Hauroa Rd (upper and lower tanks), Gaddums Hill (upper and lower tanks), Einstein (no pump and upper tank), Pa Hill (upper tanks).
	Control	Filled by adequate Distribution network pressure or when upper tanks are at a level of <50%.
	Online monitoring	None
	Security	Sealed, vermin proof and locked access hatches.
	Backup Power	None required
Taumata Reservoir	Description	Offline emergency storage reservoir with a maximum capacity of 3,800m^3. Periodically scoured to waste and refilled. EMERGENCY ONLY.
	Control	Pump control and valves all manually operated/initiated.
	Online monitoring	None
	Security	Locked access hatches but not sealed or vermin proof.
	Backup Power	None required

Water Quality Analysis

Summary of Watercare Laboratory Services 'Annual Chemistry Screening – Campion Venturi' results from 2018-2021.

Test	MAV	GV	2018	2019	2020	2021	2022
Aluminium		0.1	0.052	0.074	0.1	0.085	0.097
Antimony	0.02		<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.01		0.0002	0.00018	0.0002	0.00024	0. 00031
Barium	0.7		0.0062	0.0088	0.01	0.0089	0.01
Boron	1.4		0.019	0.031	0.031	0.027	0.026
Bromate	0.01		<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.004		<0.00005	<0.00005	<0.00005	<0.00005	<0.0005

Test	MAV	GV	2018	2019	2020	2021	2022
Chlorate	0.8		<0.01	<0.01	<0.01	<0.01	<0.01
Chlorite	0.8		<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	0.05		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	2	1	0.00044	0.0021	0.00095	0.00092	0. 006
Cyanide	0.6		<0.005	<0.005	<0.005	<0.005	-
Fluoride	1.5		0.6	0.6	0.55	0.53	0.4
Lead	0.01		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	0.4	0.04 & 0.1	0.00077	0.0011	0.00054	<0.0005	0.00096
Mercury	0.007		<0.00005	<0.00005	<0.00005	<0.00005	<0.0005
Molybdenum	0.07		<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Nickel	0.08		<0.0001	<0.0001	<0.0001	0.00025	<0.00005
Nitrate	50		0.025	0.017	0.013	0.0076	0.031
Nitrite (long)	0.2		<0.002	<0.002	<0.002	<0.002	<0.007
Nitrite (short)	3		<0.002	<0.002	<0.002	<0.002	-
Selenium	0.01		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium	0.02		<0.00001	0.000031	0.000016	0.000018	0.000021

Summary of Verification Venturi Monitoring from 2020-2022.

	Waingake blend	Waingake & Waipaoa blend
pH	7.58	7.71
Conductivity (µS/cm at 25 °C)	191.5	359.71
Hardness ($CaCO_3$) (g/m^3)	40.56	77.14
Total Hardness ($CaCO_3$) (g/m^3)	57.2	105.25
FAC (g/m^3)	0.96	0.85
Fluoride (g/m^3)	0.57	0.57
Total Alkalinity $CaCO_3$ (g/m^3)	54.33	92.22
Temperature (°C)	14.79	19.02
Total Dissolved Solids (TDS) (g/m^3)	124.43	233.76
Langelier Saturation Index (LSI)	-0.98	-0.31
Turbidity (NTU)	0.12	0.11

Barrier Management

SOPs and corrective actions

- Fulton Hogan OMMPs – Work Packages 01-17
- EW10_02_ Scheduled Engineering Maintenance Procedure For Water Assets (A406279)
- MANUAL 01_ Waingake_Waipaoa WTP - Quality Management System - Version 5, September 2012 (A297912)
- MANUAL 05_ Trunk Water Main Emergency Response Plan - Version 4, January 2011 (vA874947)
- MANUAL 14_ Water Supply Pump Station Operations - Version 1, November 2004 (vA1347789)

Inspections

See inspections outlined in SOPs above.

Maintenance

See maintenance outlined in SOPs above. The development and implementation of a formalised Operational Maintenance Plan is an improvement item in the Organisational WSP.

Verification Monitoring and Performance Criteria

See Monitoring, Action & Reporting Protocol for monitoring required under the Rules. Also see 'GDC Water Supply Water Quality Monitoring Program Protocols (A788953)' for additional information.

Site	Parameter	Frequency
Venturi	pH, Total Alkalinity, Conductivity, Turbidity, Hardness (Ca and Total), Temperature, FAC, TDS, Fluoride, LSI	Monday-Friday
	Turbidity, FAC & pH	Continuous
	E. coli, FAC, pH, Aluminium, Temperature	Monthly
Muriwai	FAC, pH	Continuous
Dunstan Rd	FAC, pH	Continuous
Hospital Hill	FAC, pH	Continuous
Nob Hill	FAC, pH	Continuous
Distribution Sampling Points	*E. coli*, FAC, pH, Temperature	As per schedule
Reservoirs (large)	FAC	Weekly
Birrell St, Hansen Rd, Anzac Park	Network pressure	Continuous
Pump stations	See summary tables	
Rural Zone[16]	E.coli, Total Coliforms, FAC, Trihalomethanes: chloroform, bromodichloromethane, dibromochloromethane, bromoform, Haloacetic acids: dichloroacetic acid, trichloroacetic acid; Antimony, cadmium, chromium, copper, lead, mercury, nickel, zinc	
City Zone[16]		

[16] Monitoring sites are in the 'GDC Water Supply Water Quality Monitoring Program Protocols (A788953)' Monitoring frequencies are in the Monitoring, Action & Reporting Protocol

Contractor Performance criteria

Performance criteria for the distribution network is generally defined in Fulton Hogans 'work packages' (OMMPs), Fulton Hogan contract KPIs, and by the Department of Internal Affairs 'Non-Financial Performance Measures'.

Instrumentation Standardisation and verification

Set out in MANUAL 11 _ Waingake and Waipaoa Calibration Work Instructions - Version 2, June 2011 (vA875006)

Summary of Distribution Network Hazards

Water Supply Component	Hazardous Event
Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Contamination or loss of supply due to failure/damage to bulk treated water main
	Contamination from insanitary practices during maintenance or construction on bulk treated water mains
	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality, scour valves, air valves)
	Loss of supply due to air relief valve inoperability on the bulk treated water main
	Loss of supply due to unidentified leakage, illegal connections, unaccounted for water or high demand from the bulk treated water main
	Contamination from backflow event within bulk treated water main
	Loss of supply due to excessive demand, inadequate or excessive pressures in the bulk treated water main
	Contamination due to poor quality workmanship, inappropriate materials used or contractor damage to bulk treated water main
Distribution Network	Contamination or loss of supply due to Distribution Network failure
	Contamination from insanitary practices during inspections, sampling, maintenance, or construction within Distribution Network system
	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality)
	Loss of supply due to unidentified leakage, illegal connections or unaccounted for water
	Contamination from backflow event within Distribution Network system (including change of premise use)
	Loss of supply due to excessive demand, inadequate or excessive pressures in the network or a lack of agreed allocation to large users
	Contamination due to poor quality workmanship, inappropriate materials used for Distribution Network pipes and fittings or contractor damage to pipes
	Contamination due to extent of Distribution network (pipeline to Muriwai and Patutahi)
Distribution Network – Pump Stations	Contamination or loss of supply due to damage to the pump stations
	Loss of supply due to loss of power at the pump stations
	Contamination from insanitary practices during maintenance or construction within pump stations
	Loss of supply due to excessive demand, inadequate or excessive pressures in the network
	Contamination due to Chlorine Disinfection process failure - inadequate chlorination (issue with stored water in reservoir, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, power failure)

Water Supply Component	Hazardous Event
	Contamination due to Chlorine Disinfection process failure - over chlorination (dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)
Distribution Network – Reservoirs	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism
	Loss of storage capacity due to earthquake damage
	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)
	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir
	Contamination from reservoir roof leakage

Table 6: Distribution Network Hazards for Gisborne Distribution Network

6 General Hazards

The table below summarises hazardous events that are managed across the organisation and apply to all WSPs. They have been risk assessed once and are only included in the Gisborne Water Supply WSP Risk Assessment.

Water Supply Component	Hazardous Event
Barrier Management	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality)
	Contamination or loss of supply due to insufficient, inadequate out of date or incorrect manuals, operational procedures or Quality Management System
	Contamination or loss of supply due to inadequate critical spare parts held or unavailable
	Contamination or loss of supply due to inadequate training, professional development, up-skilling, or ongoing competency of water staff (Council and Contractors)
	Contamination or loss of supply due to inadequate staff resourcing (includes subcontractors)
	Contamination or loss of supply due to inadequate inspections, preventive maintenance or replacement of critical treatment systems and monitoring equipment causing failures
	Contamination or loss of supply due to inadequate inspections, Preventive maintenance, or replacement of critical treatment structures (intake, dams, treatment systems, reservoirs (WTP), bulk raw/treated main, reservoirs (Distribution Network)) causing failures
	Contamination or loss of supply due to inadequate water staff performance or reliability (both Council and Contractors)
	Contamination or loss of supply due to supply chain issues (i.e. chemicals, equipment)
Verification Monitoring	Contamination is not identified due to sampling and monitoring not being sufficient
	Contamination or loss or supply not identified due to inadequate data collection and reporting systems (includes PLC, SCADA, and communications systems)
	Contamination not identified or loss of supply due to critical instrumentation failure
	Contamination not identified due to incorrect setup of critical instrumentation during commissioning (span, calibration, flow rates etc.)
	Contamination not identified due to critical instrumentation drift over time
	Contamination or loss of supply due to inadequate reporting from observations, inspections or maintenance
Other	Contamination due to inadequate treatment processes
	Loss of supply due to major structural failure of critical structures (Dams, intakes, pump stations, Water Treatment Plants, Reservoirs)
	Contamination or loss of supply due to a catastrophic natural disaster or failure including earthquake, flooding, volcanic eruption, wildfire, extreme weather events.
	Contamination or loss of supply due to changes in legislation, standards, organisational policy, district plan changes, bylaws, codes of practices or any other activity
	Loss of supply due to limitations in the capacity of available sources, treatment systems, and water delivery

Table 7: General Hazards for GDC Water Supply

7 Risk Summary and Improvements

This WSP and the risk tables have been prepared as outlined in the **Gisborne District Council Organisational WSP Section 5**.

The purpose of the risk tables is to provide detailed information to be used in managing hazards linked to the individual supply components. The hazards are identified in section 4, section 5 and section 6 of this Gisborne Supply WSP.

There are 117 hazards identified and risk assessed. Fourteen (14) carry an unacceptable risk status.

An unacceptable risk is determined if the residual risk level is classified as 'High' or 'Extreme' and comes with recommended management actions.

The risks tables are grouped by supply component and a summary of all **unacceptable** residual risk and the corresponding improvements relating to the **Gisborne Water Supply** are listed below. The list of improvements are included in the Improvement Plan - Gisborne District Council Organisational WSP Appendix A.

The full risk tables for all components for the **Gisborne Water Supply** have been included in Appendix A.

ID	Supply Component	Process Step	Hazardous Event	Consideration for Residual Risk Level	Residual Risk	Improvements
4	Waingake	Catchment - Mangapoike Dams	Naturally occurring contaminants present - includes high turbidity, cyanobacteria	Sampling and inspection programme to be re-established and reviewed to ascertain current risk level. Cyanotoxin Management Plan needs updating.	Unacceptable	Review monitoring programme and align with finalised Quality Assurance Rules. Update the Monitoring, Actions and Reporting Protocol Update Cyanobacteria Management and Response Plan Waingake Transformation Programme (transition to 70% native vegetation)
13	Waingake	Catchment - Waingake River	Naturally occurring contaminants present - includes high turbidity, cyanobacteria	Sampling and inspection programme to be re-established and reviewed to ascertain current risk level. Cyanotoxin Management Plan needs updating.	Unacceptable	Review monitoring programme and align with finalised Quality Assurance Rules. Update the Monitoring, Actions and Reporting Protocol Update Cyanobacteria Management and Response Plan Waingake Transformation Programme (transition to 70% native vegetation)

ID	Supply Component	Process Step	Hazardous Event	Consideration for Residual Risk Level	Residual Risk	Improvements
19	Waipaoa	Catchment - Waipaoa River	Contamination in the source water catchment from agricultural practices (includes pesticides, fertilisers, farm operations, dairy, effluent, and grazing)	Sampling and inspection programme to be re-established and reviewed to ascertain current risk level.	Unacceptable	Review monitoring programme and align with finalised Quality Assurance Rules. Update the Monitoring, Actions and Reporting Protocol
72	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Contamination or loss of supply due to failure/damage to bulk treated water main	Pipe age, condition and accessibility. Level of supplier control over natural events and land use activity along pipeline route.	Unacceptable	Trunk main refurb – includes above ground sections and pipe bridges. Maintain stocks of critical spares.
84	Distribution Network	Distribution Network	Contamination from backflow event within Distribution Network system (including change of premise use)	Staff resourcing is limited to have a sustained focus on this area. Backflow prevention programme is incomplete for commercial and industrial activities.	Unacceptable	Increase FTE for Distribution Network protection Consolidate existing Backflow information, identify gaps and compile programme that clearly manages risk.

ID	Supply Component	Process Step	Hazardous Event	Consideration for Residual Risk Level	Residual Risk	Improvements
85	Distribution Network	Distribution Network	Loss of supply due to excessive demand, inadequate or excessive pressures in the network or a lack of agreed allocation to large users.	Large users are not limited in their use at times of higher demand. Loss of pressure Matawhero &Makaraka during peak demand. Low FAC issues in eastern area of Distribution Network system.	Unacceptable	Prepare and implement a water loss strategy. Review water supply Bylaw for types of connections and allocation limits or levels of service. New trunk main for Nob Hill. Review growth scenarios requiring additional reservoir storage. Review pressure within the Distribution Network- • Ormond Rd pump station use. • Scope pressure zoning of network. • New booster pump station at base of Nob Hill. Decommission Ormond Road pump station. • New Papatu Rd booster Pump Station (additional to the Makaraka Pump Station). Remove Pa Hill reservoirs and install a pump system for the higher area. Implementation of universal water metering.
87	Distribution Network	Distribution Network	Contamination or loss of supply due to degrading treated water supply caused by the extent of Distribution Network network including pipelines to Muriwai and Patutahi, city low FAC areas	Low FAC issues in eastern area of Distribution Network system.	Unacceptable	Increase chlorine residual in water leaving treatment plant. Gas chlorination facility at Nob Hill. Install online FAC monitors at Nob Hill, Muriwai, Dunstan Rd and Patutahi to meet new water quality assurance rules.

ID	Supply Component	Process Step	Hazardous Event	Consideration for Residual Risk Level	Residual Risk	Improvements
102	General	Barrier Management	Contamination or loss of supply due to inadequate training, professional development, up-skilling, or ongoing competency of water staff (Council and Contractors)	FH retic staff turnover high and new staff still learning GDCs requirements	Unacceptable	Update the Water staff training and competency framework to include continuous professional development and assessment of ongoing competency. Complete audits of contracted services and training for contracted staff.
103	General	Barrier Management	Contamination or loss of supply due to inadequate staff resourcing (includes subcontractors)	FH retic staff turnover high Increased work with WSP framework and environmental performance measures	Unacceptable	Increase FTE for treatment plant cadet/operator Increase FTE for technical data management and administration of WSP.
107	General	Verification Monitoring	Contamination is not identified due to sampling and monitoring not being sufficient	New quality assurance rules will require more sampling and monitoring.	Unacceptable	Review monitoring programme and align with finalised Quality Assurance Rules. Install continuous monitors (pH, turbidity & conductivity) for source water where required Install continuous FAC meters in the distribution network where required.
108	General	Verification Monitoring	Contamination or loss or supply not identified due to inadequate data collection and reporting systems (includes PLC, SCADA, Water Outlook and communications systems)	Water Outlook setup and implementation is in its mid stage. Full roll out, testing and assessing performance of system and users and increasing use for WSP management.	Unacceptable	Water Outlook implementation and continued training. Process to check critical equipment and alarms to be developed and incorporated into the QMS.
113	General	Other	Contamination due to inadequate treatment processes	Waingake WTP high flows cannot to meet new Quality Assurance Rule requirement for Ct.	Unacceptable	Waingake UV disinfection.

ID	Supply Component	Process Step	Hazardous Event	Consideration for Residual Risk Level	Residual Risk	Improvements
116	General	Other	Contamination or loss of supply due to changes in legislation, standards, organisational policy, bylaws, codes of practices	Waingake WTP high flows cannot to meet new Quality Assurance Rule requirement for C.t	Unacceptable	Waingake UV disinfection. Develop and implement a Critical Document Review programme using Water Outlook
117	General	Other	Loss of supply linked to water demand issues (expansion of network, pressure issues, leak management)	Connection of new subdivision areas. Planning for growth areas. Muriwai & Patutahi pipelines and communities connection. Pressure loss upstream of Makaraka Pump Station. Ineffective position of Ormond Rd PS. Pah Hill Reservoir land subsiding.	Unacceptable	Complete and action Water Demand and water losses strategy. - Papatu Rd Pump Station (booster and additional Makaraka PS). - New trunk mains for Nob Hill and maybe new reservoir. Dedicated fill main from Wainui Rd bridge to Nob Hill. - Remove Pa Hill reservoirs and installation of pump system for the higher area.

Table 8: Unacceptable Risks and Improvements for Gisborne Water Supply

8 IMPROVEMENTS IDENTIFIED DURING WSP PREPARATION

Supply Component	Process Step	Works to Reduce Risk
Waingake	Treatment	Waingake UV disinfection facility.
General	Barrier Management	Water Outlook implementation and continued training.
Distribution Network	Distribution Network – Pump Stations	Papatu Rd Pump Station (booster and additional to Makaraka Pump Station).
Waingake	Catchments	Waingake Transformation Programme (transition to 70% native vegetation)
Distribution Network	Distribution Network	Universal Metering and water loss reduction strategy.
Waingake	Abstraction	Sang Dam slump remediation.
General	Barrier Management	Improving seismic resilience - from Seismic Assessment (WSP-OPUS, 15 October 2020).
Distribution Network	Distribution Network	Pressure zoning and bulk metering (associate with water loss strategy)
Waingake	Abstraction	Clapcott Dam Face remediation.
General	Barrier Management	Reservoir seismic strengthening WTPs and Distribution Network. Vulnerable are Waingake and Waipaoa CWR/BW.
Distribution Network	Distribution Network	New supply main from Wainui Rd bridge to Nob Hill and potential for additional reservoir. Dedicated pump station at base of hill.
Waingake	Treatment	Filter 6 at Waingake and removal of Lime Silo.
Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Trunk main refurbishments of above ground sections and pipe bridges.
Distribution Network	Distribution Network	Gas chlorination at Nob Hill.
Distribution Network	Distribution Network – Reservoirs	Remove Pa Hill reservoirs and installation of pump system for servicing the elevated area.
General	Verification Monitoring	Transition from Hilltop to Water Outlook (source data).
General	Barrier Management	Review of solar and increased application at remote sites.
General	Verification Monitoring	Review monitoring programme and align with finalised Quality Assurance Rules.
General	Barrier Management	Process to check new critical equipment and alarms to be developed and incorporated into the QMS.
Waipaoa	Treatment	Plan for scenarios when the treatment plant/s cannot treat to normal capacity and determine operational steps that ensures compliance. Consider options with UV reactors in treatment process for higher log removal.

9 REFERENCES

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APPENDICES

APPENDIX A. RISK ASSESSMENT TABLES

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
1	Waingake	Catchment - Mangapoike Dams	Contamination in the source water catchments from industrial practices (road transport)	☐	☐	☐	☐	Rare	Major	Medium	- Sampling programme in place and prepared/checked against current standards or rules. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Sites are secure with fences, locked gates or buildings in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
2	Waingake	Catchment - Mangapoike Dams	Contamination in the source water catchments from open space activities (stormwater runoff)	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
3	Waingake	Catchment - Mangapoike Dams	Contamination in the source water catchment from new or unknown activities (change of land use, change in access permissions)	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Sites are secure with fences, locked gates or buildings in place. - GDC is the landowner for the full Dams	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											catchment area and Waingake catchment is part of the QEII trust.				
4	Waingake	Catchment - Mangapoike Dams	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)	☐	☐	☐	☐	Possible	Major	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Possible	Major	**High**	**Unacceptable**
5	Waingake	Catchment - Mangapoike Dams	Contamination or loss of supply due to changes from seismic activity	☐	☐	☐	☐	Rare	Catastrophic	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
6	Waingake	Catchment - Mangapoike Dams	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
7	Waingake	Catchment - Mangapoike Dams	Contamination of the source water caused by ashfall from a volcanic eruption	☐	☐	☐	☐	Rare	Major	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Coagulation and clarification process in place (coagulant and Clarifier).	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped.				
8	Waingake	Catchment - Mangapoike Dams	Loss of supply due to insufficient source water availability - extended period of dry weather or drought	☐	☐	☐	☐	Rare	Major	Medium	- Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Response plans are up to date and available. - All consent dates and conditions are known and monitored by Water Team. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
9	Waingake	Catchment - Mangapoike Dams	Loss of supply due to unsuitable raw water quality for the treatment process (Mangapoike Dam stratification causing quality issues)	☐	☐	☐	☐	Rare	Moderate	Low	- Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Moderate	Low	Acceptable
10	Waingake	Catchment - Mangapoike Dams	Contamination of the source water from faecal matter from feral animals within the catchment area	☐	☐	☐	☐	Almost Certain	Catastrophic	Extreme	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place.	Rare	Major	Medium	Acceptable
11	Waingake	Catchment - Waingake River	Contamination in the source water catchments from conservation land practices (animal control,1080 drops)	☐	☐	☐	☐	Rare	Major	Medium	- Sampling programme in place and prepared/checked against current standards or rules. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Council works with appropriate agencies to ensure any pest control programme considers	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											drinking water related risks. Considerations include the use of Vitamin K based poisons, ensuring appropriate distances from tributaries, and the use of non-poison pest control methods. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.				
12	Waingake	Catchment - Waingake River	Contamination of the source water catchment from new or unknown activities (change of land use, change in access permissions)	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - GDC is the landowner for the full Dams catchment area and Waingake catchment is part of the QEII trust. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
13	Waingake	Catchment - Waingake River	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)	☐	☐	☐	☐	Possible	Major	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Possible	Major	**High**	**Unacceptable**
14	Waingake	Catchment - Waingake River	Contamination or loss of supply due to changes from seismic activity	☐	☐	☐	☐	Rare	Catastrophic	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
15	Waingake	Catchment - Waingake River	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Sampling programme in place and prepared/checked against current standards or rules.	Unlikely	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.				
16	Waingake	Catchment - Waingake River	Contamination of the source water caused by ashfall from a volcanic eruption	☐	☐	☐	☐	Rare	Major	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place.	Rare	Major	Medium	Acceptable
17	Waingake	Catchment - Waingake River	Loss of supply due to insufficient source water availability - extended period of dry weather or drought	☐	☐	☐	☐	Unlikely	Major	Medium	- Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Response plans are up to date and available. - All consent dates and conditions are known and monitored by Water Team. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
18	Waingake	Catchment - Waingake River	Contamination of the source water from faecal matter from feral animals within the catchment area	☐	☐	☐	☐	Almost Certain	Catastrophic	Extreme	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Coagulation and clarification process in place (coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place.	Rare	Major	Medium	Acceptable
19	Waipaoa	Catchment - Waipaoa River	Contamination in the source water catchment from agricultural practices (includes pesticides, fertilisers, farm operations, dairy, effluent, and grazing)	☐	☐	☐	☐	Almost Certain	Catastrophic	Extreme	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Presedimentation process in place. - Coagulation and clarification process in place	Possible	Major	High	Unacceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											(coagulant and Clarifier). - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.				
20	Waipaoa	Catchment - Waipaoa River	Contamination in the source water catchment from industrial practices (road transport)	☐	☐	☐	☐	Possible	Major	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Unlikely	Major	Medium	Acceptable
21	Waipaoa	Catchment - Waipaoa River	Contamination in the source water catchments from rural residential practices (fertilisers, pets/livestock, onsite sewage, weed/pest control)	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place.	Unlikely	Major	Medium	Acceptable
22	Waipaoa	Catchment - Waipaoa River	Contamination of the source water catchment from new or unknown activities (change of land use or 'non-notified activities')	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Presedimentation process in place. - Coagulation and clarification process in place	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											(coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Other PMs = Judith to determine Residual				
23	Waipaoa	Catchment - Waipaoa River	Naturally occurring contaminants present (includes cyanobacteria, chemicals, metals)	☑	☑	☑	☑	Unlikely	Major	Medium	- Sampling programme in place and prepared/checked against current standards or rules. - Source Water Risk Assessment completed in 2022 to understand catchment area, raw water quality and catchment characteristics. - Cyanotoxin Management Plan in place. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
24	Waipaoa	Catchment - Waipaoa River	Contamination or loss of supply due to changes from seismic activity	☑	☑	☑	☑	Rare	Catastrophic	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Major	Medium	Acceptable
25	Waipaoa	Catchment - Waipaoa River	Contamination or loss of supply due to surrounding areas highly susceptible to erosion (high solids loading)	☑	☑	☑	☑	Almost Certain	Catastrophic	**Extreme**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Possible	Moderate	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
26	Waipaoa	Catchment - Waipaoa River	Contamination of the source water caused by ashfall from a volcanic eruption	☐	☐	☐	☐	Rare	Major	Medium	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Engagement with Planners to ensure that Water Team is notified of catchment activities, Consent applications, or land use changes. - Presedimentation process in place. - Coagulation and clarification process in place (coagulant and Clarifier). - Softening process in place - Filtration process in place. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place.	Rare	Major	Medium	Acceptable
27	Waipaoa	Catchment - Waipaoa River	Loss of supply due to insufficient source water availability - extended period of dry weather or drought	☐	☐	☐	☐	Rare	Major	Medium	- Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Response plans are up to date and available. - All consent dates and conditions are known and monitored by Water Team. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Draft Freshwater Plan prioritises Municipal water supply takes.	Rare	Moderate	Low	Acceptable
28	Waingake	Abstraction	Contamination or loss of supply at the intakes or weir due to unintentional or intentional damage (vandalism)	☐	☐	☐	☐	Rare	Catastrophic	Medium	- Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped. - Waingake Stream: Concrete full width weir with coarse bar screen gravity feeding raw water main. Hydraulic screen flush process with no requirement for power. Controlled by rotork connected to SCADA. Open/close valve only. Monitoring for flow and turbidity. Solar backup power. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Rare	Minor	Low	Acceptable
29	Waingake	Abstraction	Loss of supply due to consents not being renewed or declined	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- All consent dates and conditions are known and monitored by Water Team. - Draft Freshwater Plan prioritises Municipal water supply takes.	Unlikely	Major	Medium	Acceptable
30	Waingake	Abstraction	Loss of supply due to damage to the intakes or weir	☐	☐	☐	☐	Rare	Moderate	Low	- Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped. - Waingake Stream: Concrete full width weir with coarse bar screen gravity feeding raw water main. Hydraulic screen flush process with no	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											requirement for power. Controlled by rotork connected to SCADA. Open/close valve only. Monitoring for flow and turbidity. Solar backup power. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.				
31	Waingake	Abstraction	Loss of supply due to excessive build-up surrounding the intakes or weir	☐	☐	☐	☐	Rare	Moderate	Low	- Mangapoike Dams: Two intake options from the Williams and Clapcott Dams. Both intakes have an intake column with coarse screen and manually operated valves. Online monitoring for lake level. Combined maximum gravity flow between 200 & 500 m3/hr (depending on lake levels) and 1,200 m3/hr if pumped. - Waingake Stream: Concrete full width weir with coarse bar screen gravity feeding raw water main. Hydraulic screen flush process with no requirement for power. Controlled by rotork connected to SCADA. Open/close valve only. Monitoring for flow and turbidity. Solar backup power. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Moderate	Low	Acceptable
32	Waingake	Raw Water Main & Pump Stations	Loss of supply due to damage to the raw water main	☐	☐	☐	☐	Possible	Major	**High**	- Raw water trunk main: 450mm CLMS from intakes to Waingake WTP. Cathodic protection in place and some sections exposed to atmosphere. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Sites are secure with fences, locked gates or buildings in place.	Rare	Moderate	Low	Acceptable
33	Waingake	Raw Water Main & Pump Stations	Loss of supply due to raw water main failure	☐	☐	☐	☐	Unlikely	Major	Medium	- Raw water trunk main: 450mm CLMS from intakes to Waingake WTP. Cathodic protection in place and some sections exposed to atmosphere. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Sites are secure with fences, locked gates or buildings in place.	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
34	Waingake	Raw Water Main & Pump Stations	Loss of supply due to damage to the pump stations	☐	☐	☐	☐	Possible	Moderate	Medium	- Damline Pump Station: Booster pump station with two pumps. Duty/standby setup. Rotork valve connected to telemetry system and used to manage gravity flow rates. Monitoring for pressure, flow, valve position. Generator installed for backup power. - Fairview Pump Station: Booster pump station with two pumps. Duty/standby setup. Manually operated. Monitoring for pressure, flow, valve position. No backup power options available. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)). - Sites are secure with fences, locked gates or buildings in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage).	Rare	Minor	Low	Acceptable
35	Waingake	Raw Water Main & Pump Stations	Loss of supply due to loss of power at the pump stations	☐	☐	☐	☐	Likely	Moderate	**High**	- Damline Pump Station: Booster pump station with two pumps. Duty/standby setup. Rotork valve connected to telemetry system and used to manage gravity flow rates. Monitoring for pressure, flow, valve position. Generator installed for backup power. - Fairview Pump Station: Booster pump station with two pumps. Duty/standby setup. Manually operated. Monitoring for pressure, flow, valve position. No backup power options available. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA	Rare	Minor	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											Notes, Maximo (FH only)). - Sites are secure with fences, locked gates or buildings in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage).				
36	Waingake	Treatment	Contamination or loss of supply due to COAGULATION/FLOCCULATION process failure (coagulant supply exhausted, dosing equipment failure, unsuitable quality of incoming water, incorrect dose rate, power failure)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake WTP: Clarifier inlet dosed with Polyaluminium chloride and Polyelectrolyte (L3RC). Partial settlement within clarifier depending on flows. Major maintenance carried out as scheduled. Duty/standby dose pumps. Dose automatically controlled by inlet flow meter. Stubbe valves in place. Daily checks on chemical consumption rates. Poly uses service water as carry water. Day tank in place for PACl. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers.	Rare	Major	Medium	Acceptable
37	Waingake	Treatment	Contamination or loss of supply due to FILTRATION process failure (issue with preceding treatment process, backwash system failure, power failure, inadequate backwash reservoir level)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake WTP: Five rapid sand Filters. Water and air backwash initiated on head loss, time, turbidity or manually (if required). Filter overflow available for unsuitable filter turbidity levels (run to waste). Monitoring for turbidity on each filter. Duty/standby backwash pumps. Backup blower kept on site. Full backwash process automated. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Unlikely	Moderate	Medium	Acceptable
38	Waingake	Treatment	Contamination due to CHLORINE DISINFECTION process failure - inadequate chlorination (issue with preceding treatment process, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, short contact time, power failure)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC and pH after the dose point (Filtered water sump) and at the reservoir outlet. Contact time demonstrated in compliance reporting. Duty/standby sample water pumps. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers.	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.				
39	Waingake	Treatment	Contamination due to CHLORINE DISINFECTION process failure - over chlorination (issue with preceding treatment process, dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)	☐	☐	☐	☐	Possible	Major	**High**	- Waingake WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC and pH after the dose point (Filtered water sump) and at the reservoir outlet. Contact time demonstrated in compliance reporting. Duty/standby sample water pumps. CCP limits and actions in place. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Rare	Major	Medium	Acceptable
40	Waingake	Treatment	Contamination due to the chlorine reacting with raw water contaminants causing disinfection by-products	☐	☐	☐	☐	Possible	Major	**High**	- Waingake WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC and pH after the dose point (Filtered water sump) and at the reservoir outlet. Contact time demonstrated in compliance reporting. Duty/standby sample water pumps. CCP limits and actions in place. - Sampling programme in place and prepared/checked against current standards or rules. - Low FAC demand, colour testing carried out.	Unlikely	Major	Medium	Acceptable
41	Waingake	Treatment	Contamination due to FLUORIDATION process failure (dosing equipment failure, incorrect dose rate)	☐	☐	☐	☐	Possible	Major	**High**	- Waingake WTP: Fluoride outlet dosed with Hydrofluosilicic acid. Duty/standby dose pumps. Dose automatically controlled by outlet flow meter. Stubbe valves in place. Monitoring for fluoride downstream of the dosing point. Day tank used to limit exposure to overdosing. If flow too low, dose pump will stop. Limits and actions in place. - Sampling programme in place and prepared/checked against current standards or rules. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e. power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
42	Waingake	Treatment	Contamination or loss of supply due to unintentional or intentional vandalism of treatment systems	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Sites are secure with fences, locked gates or buildings in place. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Rare	Catastrophic	Medium	Acceptable
43	Waingake	Treatment	Loss of supply due to service water system failure	☐	☐	☐	☐	Likely	Moderate	**High**	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Waingake WTP: Clarifier inlet dosed with Polyaluminium chloride and Polyelectrolyte (L3RC). Partial settlement within clarifier depending on flows. Major maintenance carried out as scheduled. Duty/standby dose pumps. Dose automatically controlled by inlet flow meter. Stubbe valves in place. Daily checks on chemical consumption rates. Poly uses service water as carry water. Day tank in place for PACl.	Rare	Moderate	Low	Acceptable
44	Waingake	Treatment	Loss of supply due to compressed air system failure	☐	☐	☐	☐	Likely	Moderate	**High**	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Air compressors: Duty/standby and duty/assist system. Monitored for pressure. Alarming and response actions available.	Unlikely	Moderate	Medium	Acceptable
45	Waingake	Storage	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake WTP: Two above ground reservoirs in place (Clearwater 1000m3 and Backwash 500m3). All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Moderate	Low	Acceptable
46	Waingake	Storage	Loss of storage capacity due to earthquake damage	☐	☐	☐	☐	Rare	Moderate	Low	- Waingake WTP: Two above ground reservoirs in place (Clearwater 1000m3 and Backwash 500m3). All entry hatches are sealed and secure against ingress. Monitoring for level. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Water conservation measures (water restrictions) can be implemented. Water Demand	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											Management Plan Developed and being implemented. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Response plans are up to date and available.				
47	Waingake	Storage	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)	☐	☐	☐	☐	Possible	Major	**High**	- Waingake WTP: Two above ground reservoirs in place (Clearwater 1000m3 and Backwash 500m3). All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Moderate	Low	Acceptable
48	Waingake	Storage	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- Waingake WTP: Two above ground reservoirs in place (Clearwater 1000m3 and Backwash 500m3). All entry hatches are sealed and secure against ingress. Monitoring for level. - Contractors/staff required to operate in accordance with specific procedures prepared and approved for each maintenance, entry or cleaning activity - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Major	Medium	Acceptable
49	Waingake	Storage	Contamination from reservoir roof leakage	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake WTP: Two above ground reservoirs in place (Clearwater 1000m3 and Backwash 500m3). All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Moderate	Low	Acceptable
50	Waipaoa	Abstraction	Contamination at the intakes from maintenance/servicing work	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Rare	Minor	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
51	Waipaoa	Abstraction	Contamination or loss of supply at the intakes due to unintentional or intentional damage (vandalism)	☐	☐	☐	☐	Likely	Catastrophic	Extreme	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Possible	Moderate	Medium	Acceptable
52	Waipaoa	Abstraction	Loss of supply due to consents not being renewed or declined	☐	☐	☐	☐	Unlikely	Catastrophic	High	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Draft Freshwater Plan prioritises Municipal water supply takes.	Rare	Minor	Low	Acceptable
53	Waipaoa	Abstraction	Loss of supply due to damage to the intakes (logs and other environmental)	☐	☐	☐	☐	Possible	Moderate	Medium	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Minor	Low	Acceptable
54	Waipaoa	Abstraction	Loss of supply due to excessive build-up surrounding the intakes	☐	☐	☐	☐	Likely	Moderate	High	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Possible	Minor	Medium	Acceptable
55	Waipaoa	Abstraction	Loss of supply due to loss of power at the intakes	☐	☐	☐	☐	Likely	Moderate	High	- Waipaoa River: Two pumped intakes with Johnson wedge wire screens and three pumps available (duty/standby/standby). Controlled from SCADA system. Air compressor onsite for screen cleans carried out as scheduled. Monitoring for flow to ponds, pump speed and status, intake backwash status and pressure. Backup power from Waipaoa WTP generator. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Rare	Minor	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
56	Waipaoa	Treatment	Contamination or loss of supply due to PRESEDIMENTATION process failure (unsuitable quality of incoming water)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Presed Ponds and Pump Station: Two presedimentation ponds and one wastewater pond that returns supernatant to the river. Ponds operated manually and in parallel. Monitoring includes pond level and inflow. Pump station following ponds have duty/standby pumps and pumps to header. Coagulant (PACl) dosed into header. Header can be split to each clarifier if required. Monitoring includes pond outflow and turbidity. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Rare	Minor	Low	Acceptable
57	Waipaoa	Treatment	Contamination or loss of supply due to COAGULATION/FLOCCULATION/SEDIMENTATION process failure (issue with preceding treatment process, coagulant supply exhausted, dosing equipment failure, incorrect dose rate, power failure)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa WTP: Pump station header tank dosed with Polyaluminium chloride and centre of Graver with Polyelectrolyte (B570). Considerable settlement within clarifier when optimised. Duty/standby dose pumps. Dose rate manually controlled with daily checks on chemical consumption. Stubbe valves in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Permanent chlorination and residual disinfection process in place. - Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs.	Unlikely	Major	Medium	Acceptable
58	Waipaoa	Treatment	Contamination or loss of supply due to SOFTENING process failure (issue with preceding treatment process, Caustic dosing equipment failure, incorrect dose rate, power failure)	☐	☐	☐	☐	Possible	Major	**High**	- Waipaoa WTP: Sodium hydroxide and Carbon Dioxide dosed for water softening. Stubbe valves in place. Dose rates available for 6 scenarios (A-F). Monitoring for pH at each clarifier and the hydro column. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Unlikely	Major	Medium	Acceptable
59	Waipaoa	Treatment	Contamination or loss of supply due to FILTRATION process failure (issue with preceding treatment process, backwash system failure, power failure, inadequate CWR level)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa WTP: Four rapid sand Filters. Water and air backwash initiated on head loss, time, turbidity or manually (if required). Monitoring for turbidity on each filter. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is	Unlikely	Moderate	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e. power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Permanent chlorination and residual disinfection process in place. - UV disinfection process in place.				
60	Waipaoa	Treatment	Contamination due to CHLORINE DISINFECTION process failure - inadequate chlorination (issue with preceding treatment process, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, short contact time, power failure)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC at the FWS and CWR outlet. Contact time demonstrated in compliance reporting. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e. power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - UV disinfection process in place.	Rare	Moderate	Low	Acceptable
61	Waipaoa	Treatment	Contamination due to CHLORINE DISINFECTION process failure - over chlorination (issue with preceding treatment process, dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)	☐	☐	☐	☐	Possible	Major	**High**	- Waipaoa WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC at the FWS and CWR outlet. Contact time demonstrated in compliance reporting. CCP limits and actions in place. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
62	Waipaoa	Treatment	Contamination due to the chlorine reacting with raw water contaminants causing disinfection by-products	☐	☐	☐	☐	Possible	Major	**High**	- Waipaoa WTP: Two 920kg drums of chlorine gas setup. Duty standby chlorinators with flow proportional dosing. Monitoring for FAC at the FWS and CWR outlet. Contact time demonstrated in compliance reporting. CCP limits and actions in place. - Sampling programme in place and prepared/checked against current standards or rules. - Low FAC demand, colour testing carried out.	Unlikely	Major	Medium	Acceptable
63	Waipaoa	Treatment	Contamination or loss of supply due to UV DISINFECTION process failure (issue with preceding treatment process, UV reactor failure, power failure)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa WTP: Two UV reactors validated to 40 mJ/cm2. Maintained as per manufacturers requirements. Monitoring for UVT, UVI, flow and total lamp hours. CCP limits and actions in place. - Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e. power outage). - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Permanent chlorination and residual disinfection process in place.	Rare	Moderate	Low	Acceptable
64	Waipaoa	Treatment	Contamination or loss of supply due to unintentional or intentional vandalism of treatment systems	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Sites are secure with fences, locked gates or buildings in place. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Rare	Catastrophic	Medium	Acceptable
65	Waipaoa	Treatment	Contamination or loss of supply due to WTP bypass failure	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- WTP Bypass: Manually operated main line and bypass valves to ensure final treated water meets all requirements prior to supply to Distribution Network. No valve status captured or online monitoring.	Rare	Minor	Low	Acceptable
66	Waipaoa	Treatment	Loss of supply due to compressed air system failure	☐	☐	☐	☐	Likely	Moderate	**High**	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Air compressors: Duty/standby and duty/assist system. Monitored for pressure. Alarming and response actions available.	Unlikely	Moderate	Medium	Acceptable
67	Waipaoa	Storage	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waipaoa WTP: 1,500 m3 partially below ground reservoir in place. All entry hatches are sealed and secure against ingress. Monitoring for level.	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.				
68	Waipaoa	Storage	Loss of storage capacity due to earthquake damage	☐	☐	☐	☐	Rare	Moderate	Low	- Waipaoa WTP: 1,500 m3 partially below ground reservoir in place. All entry hatches are sealed and secure against ingress. Monitoring for level. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Response plans are up to date and available.	Rare	Moderate	Low	Acceptable
69	Waipaoa	Storage	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)	☐	☐	☐	☐	Possible	Major	**High**	- Waipaoa WTP: 1,500 m3 partially below ground reservoir in place. All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Moderate	Low	Acceptable
70	Waipaoa	Storage	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir	☐	☐	☐	☐	Unlikely	Catastrophic	**High**	- Waipaoa WTP: 1,500 m3 partially below ground reservoir in place. All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Major	Medium	Acceptable
71	Waipaoa	Storage	Contamination from reservoir roof leakage	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Waipaoa WTP: 1,500 m3 partially below ground reservoir in place. All entry hatches are sealed and secure against ingress. Monitoring for level. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Moderate	Low	Acceptable
72	Distribution Network	Distribution Network – Treated	Contamination or loss of supply due to failure/damage to bulk treated water main	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS.	Unlikely	Catastrophic	**High**	**Unacceptable**

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
		Water Trunk Main (Waingake to Makaraka)									Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - FH: Operational procedures exist and driven by OMMPs. Project specific procedures developed when required. ISO 9001 accreditation in place. Reviews and audits conducted as per quality system. - Critical spares are available for bulk supply and treatment systems.				
73	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Contamination from insanitary practices during maintenance or construction on bulk treated water mains	?	?	?	?	Unlikely	Major	Medium	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - FH: Operational procedures exist and driven by OMMPs. Project specific procedures developed when required. ISO 9001 accreditation in place. Reviews and audits conducted as per quality system. - SOME major Distribution Network or civil works given oversight from GDC Staff regarding hygiene processes and testing.	rare	Major	Medium	Acceptable
74	Distribution Network	Distribution Network – Treated Water Trunk Main	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality, scour valves, air valves)	?	?	?	?	Possible	Moderate	Medium	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high	Unlikely	Moderate	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
		(Waingake to Makaraka)									hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).				
75	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Loss of supply due to air relief valve inoperability on the bulk treated water main	☐	☐	☐	☐	Possible	Moderate	Medium	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).	Possible	Moderate	Medium	Acceptable
76	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Loss of supply due to unidentified leakage, illegal connections, unaccounted for water or high demand from the bulk treated water main	☐	☐	☐	☐	Possible	Moderate	Medium	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).	Possible	Moderate	Medium	Acceptable
77	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Contamination from backflow event within bulk treated water main	☐	☐	☐	☐	Likely	Catastrophic	Extreme	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major	Rare	Catastrophic	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											crossings over Waingake and Waipaoa Rivers. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).				
78	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Loss of supply due to excessive demand, inadequate or excessive pressures in the bulk treated water main	☐	☐	☐	☐	Likely	Moderate	**High**	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Possible	Moderate	Medium	Acceptable
79	Distribution Network	Distribution Network – Treated Water Trunk Main (Waingake to Makaraka)	Contamination or loss of supply due to poor quality workmanship, inappropriate materials used or contractor damage to bulk treated water main during construction (repair or renewal)	☐	☐	☐	☐	Possible	Major	**High**	- Waingake Trunk Main: 525 mm CLMS trunk main from Waingake CWR outlet to Makaraka Pump Station. Location is recorded on GIS. Pressure monitoring points in place, appropriate backflow devices on known connections, high hazard backflow devices tested annually, backflow requirements outlined in Water Bylaw. Cathodic protection and repairs recently carried out on areas exposed to atmosphere and requiring repair. Air valves and scour points in place. Major crossings over Waingake and Waipaoa Rivers. - Maintenance and replacement work are undertaken by Fulton Hogan or authorised contracting companies. - GDC requires all work and materials used in Distribution Network to meet the Engineering Code of Practice. - Project planning across capital and operations team.	Unlikely	Major	Medium	Acceptable
80	Distribution Network	Distribution Network	Contamination or loss of supply due to Distribution Network failure	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Additional supply options available including operating valves, supplying from alternative reservoirs and the use of Ormond Rd pump station. - Maintenance and replacement work are undertaken by Fulton Hogan or authorised contracting companies. - 24/7 request for service system available for observations made by the public (i.e. mains break, loss of water, loss of pressure, quality complaints). - Repairs and replacements identified as necessary during testing are followed up on promptly. - Permanent chlorination and residual disinfection process in place.	Rare	Catastrophic	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
81	Distribution Network	Distribution Network	Contamination from insanitary practices during inspections, sampling, maintenance, or construction within Distribution Network system	☐	☐	☐	☐	Possible	Major	**High**	- Maintenance and replacement work are undertaken by Fulton Hogan or authorised contracting companies. - Sampling points and locations have been upgraded/amended to allow minimal contamination to occur during sampling. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Permanent chlorination and residual disinfection process in place.	Unlikely	Major	Medium	Acceptable
82	Distribution Network	Distribution Network	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality)	☐	☐	☐	☐	Likely	Moderate	**High**	- Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)). - Pipe and reservoir condition assessments conducted. - GDC is a member of the 'BeforeUdig' system used to manage contractors and the public excavating within road reserve	Unlikely	Moderate	Medium	Acceptable
83	Distribution Network	Distribution Network	Loss of supply due to unidentified leakage, illegal connections or unaccounted for water	☐	☐	☐	☐	Possible	Moderate	Medium	- Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)). - Council wide Distribution Network renewals programme is in place. - GDC requires all work and materials used in Distribution Network to meet the Engineering Code of Practice. - Hydraulic Model is in place for Gisborne Water Supply.	Rare	Moderate	Low	Acceptable
84	Distribution Network	Distribution Network	Contamination from backflow event within Distribution Network system (including change of premise use)	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)). - Council wide Distribution Network renewals programme is in place. - GDC requires all work and materials used in Distribution Network to meet the Engineering Code of Practice.	Unlikely	Catastrophic	**High**	**Unacceptable**
85	Distribution Network	Distribution Network	Loss of supply due to excessive demand, inadequate or excessive pressures in the network or a lack of agreed allocation to large users	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Hydraulic Model is in place for Gisborne Water Supply. - Makaraka Pump Station: Three booster pumps in duty/duty/standby arrangement. Main pump station governing flow from Waingake WTP. Gravity flow through Bermad up to 700 m3 and pumped when >700m3. high lift pumps controlled by SCADA setpoint. Monitoring for flow, pressure, bermad valve position and pump status. No backup power options available but can continue	Unlikely	Catastrophic	**High**	**Unacceptable**

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											to operate under gravity. - Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - Ormond Rd Pump Station: Single booster pump in place to boost flow to Nob Hill Reservoir and the eastern side of the city Distribution Network. Monitoring for pressure and pump status. No backup power options available.				
86	Distribution Network	Distribution Network	Contamination due to poor quality workmanship, inappropriate materials used for Distribution Network pipes and fittings or contractor damage to pipes	☐	☐	☐	☐	Possible	Major	**High**	- Maintenance and replacement work are undertaken by Fulton Hogan or authorised contracting companies. - GDC requires all work and materials used in Distribution Network to meet the Engineering Code of Practice. - SOME major Distribution Network or civil works given oversight from GDC Staff regarding hygiene processes and testing. - GDC is a member of the 'BeforeUdig' system used to manage contractors and the public excavating within road reserve	Rare	Major	Medium	Acceptable
87	Distribution Network	Distribution Network	Contamination or loss of supply due to degrading treated water supply caused by the extent of Distribution Network network (pipeline to Muriwai and Patutahi, low FAC areas)	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Hospital Hill Chlorination: Two 70 kg cylinders of chlorine gas setup. Duty standby chlorinators with high rate and low rate setpoint dosing. Monitoring for FAC at the reservoir outlet. Duty/standby carry water and sample pumps. Reservoir outflow is dosed to achieve a fixed setpoint. PLC setup to ensure that overdosing. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Hydraulic Model is in place for Gisborne Water Supply.	Unlikely	Catastrophic	**High**	**Unacceptable**
88	Distribution Network	Distribution Network – Pump Stations	Contamination or loss of supply due to damage to the pump stations	☐	☐	☐	☐	Possible	Major	**High**	- Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - PLCs are setup to allow plants to continue operating in its last status if comms are lost. - Sites are secure with fences, locked gates or buildings in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Makaraka Pump Station: Three booster pumps in duty/duty/standby arrangement. Main pump station governing flow from Waingake WTP. Gravity flow through Bermad up to 700 m3 and pumped when >700m3. high lift pumps controlled by SCADA setpoint. Monitoring for flow, pressure, bermad valve position and pump status. No backup power options available but can continue to operate under gravity. - Ormond Rd Pump Station: Single booster pump in place to boost flow to Nob Hill Reservoir and the eastern side of the city Distribution Network. Monitoring for pressure and pump status. No backup power options available.	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Hillview Terrace Pump Station: Three booster pumps in duty/assist/standby arrangement. Monitoring for pressure and pump status but does not feed into SCADA system. Standby generator onsite and permanently connected.				
89	Distribution Network	Distribution Network – Pump Stations	Loss of supply due to loss of power at the pump stations	☐	☐	☐	☐	Likely	Major	**High**	- PLCs are setup to allow plants to continue operating in its last status if comms are lost. - Generator connection available. - Makaraka Pump Station: Three booster pumps in duty/duty/standby arrangement. Main pump station governing flow from Waingake WTP. Gravity flow through Bermad up to 700 m3 and pumped when >700m3. high lift pumps controlled by SCADA setpoint. Monitoring for flow, pressure, bermad valve position and pump status. No backup power options available but can continue to operate under gravity. - Ormond Rd Pump Station: Single booster pump in place to boost flow to Nob Hill Reservoir and the eastern side of the city Distribution Network. Monitoring for pressure and pump status. No backup power options available. - Hillview Terrace Pump Station: Three booster pumps in duty/assist/standby arrangement. Monitoring for pressure and pump status but does not feed into SCADA system. Standby generator onsite and permanently connected.	Unlikely	Major	Medium	Acceptable
90	Distribution Network	Distribution Network – Pump Stations	Contamination from insanitary practices during maintenance or construction within pump stations	☐	☐	☐	☐	Possible	Major	**High**	- Maintenance and replacement work are undertaken by Fulton Hogan or authorised contracting companies. - Sampling points and locations have been upgraded/amended to allow minimal contamination to occur during sampling. - Adequately trained staff for operations and maintenance (includes internal and external staff and trainees). - Permanent chlorination and residual disinfection process in place.	Rare	Major	Medium	Acceptable
91	Distribution Network	Distribution Network – Pump Stations	Loss of supply due to excessive demand, inadequate or excessive pressures in the network	☐	☐	☐	☐	Likely	Moderate	**High**	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Makaraka Pump Station: Three booster pumps in duty/duty/standby arrangement. Main pump station governing flow from Waingake WTP. Gravity flow through Bermad up to 700 m3 and pumped when >700m3. high lift pumps controlled by SCADA setpoint. Monitoring for flow, pressure, bermad valve position and pump status. No backup power options available but can continue to operate under gravity. - Ormond Rd Pump Station: Single booster pump in place to boost flow to Nob Hill Reservoir and the eastern side of the city Distribution Network. Monitoring for pressure and pump status. No backup power options available. - Hillview Terrace Pump Station: Three booster pumps in duty/assist/standby arrangement.	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											Monitoring for pressure and pump status but does not feed into SCADA system. Standby generator onsite and permanently connected.				
92	Distribution Network	Distribution Network – Pump Stations	Contamination due to Chlorine Disinfection process failure - inadequate chlorination (issue with stored water in reservoir, chlorine gas supply exhausted, dosing equipment failure, incorrect dose rate, service water issue, power failure)	☐	☐	☐	☐	Possible	Major	**High**	- Hospital Hill Chlorination: Two 70 kg cylinders of chlorine gas setup. Duty standby chlorinators with high rate and low rate setpoint dosing. Monitoring for FAC at the reservoir outlet. Duty/standby carry water and sample pumps. Reservoir outflow is dosed to achieve a fixed setpoint. PLC setup to ensure that overdosing. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Sampling programme in place and prepared/checked against current standards or rules.	Unlikely	Moderate	Medium	Acceptable
93	Distribution Network	Distribution Network – Pump Stations	Contamination due to Chlorine Disinfection process failure - over chlorination (dosing equipment failure, incorrect dose rate, other contamination during servicing maintenance)	☐	☐	☐	☐	Possible	Major	**High**	- Hospital Hill Chlorination: Two 70 kg cylinders of chlorine gas setup. Duty standby chlorinators with high rate and low rate setpoint dosing. Monitoring for FAC at the reservoir outlet. Duty/standby carry water and sample pumps. Reservoir outflow is dosed to achieve a fixed setpoint. PLC setup to ensure that overdosing. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Sampling programme in place and prepared/checked against current standards or rules.	Rare	Moderate	Low	Acceptable
94	Distribution Network	Distribution Network – Reservoirs	Contamination due to the integrity of reservoir being compromised - access by birds or vermin, or vandalism	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - Permanent chlorination and residual disinfection process in place. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Hospital Hill Chlorination: Two 70 kg cylinders of chlorine gas setup. Duty standby chlorinators with high rate and low rate setpoint dosing. Monitoring for FAC at the reservoir outlet. Duty/standby carry water and sample pumps. Reservoir outflow is dosed to achieve a fixed setpoint. PLC setup to ensure that overdosing.	Rare	Catastrophic	Medium	Acceptable
95	Distribution Network	Distribution Network – Reservoirs	Loss of storage capacity due to earthquake damage	☐	☐	☐	☐	Rare	Major	Medium	- Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Unlikely	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Response plans are up to date and available.				
96	Distribution Network	Distribution Network – Reservoirs	Contamination or loss of supply due to a minor structural failure of reservoirs (including not being detected)	☐	☐	☐	☐	Possible	Major	**High**	- Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Major	Medium	Acceptable
97	Distribution Network	Distribution Network – Reservoirs	Contamination from insanitary practices during inspections, observations, or maintenance of reservoir	☐	☐	☐	☐	Possible	Catastrophic	**High**	- Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - Contractors/staff required to operate in accordance with specific procedures prepared and approved for each maintenance, entry or cleaning activity - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Catastrophic	Medium	Acceptable
98	Distribution Network	Distribution Network – Reservoirs	Contamination from reservoir roof leakage	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Distribution Reservoir storage available: Hospital Hill 38,000m3. Nob Hill 8,000m3. Several small high-level reservoirs. - Permanent chlorination and residual disinfection process in place. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Rare	Catastrophic	Medium	Acceptable
99	General	Barrier Management	Loss of supply due to inaccurate/insufficient asset information (material, location, condition, criticality)	☐	☐	☐	☐	Possible	Major	**High**	- Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).	Rare	Major	Medium	Acceptable
100	General	Barrier Management	Contamination or loss of supply due to insufficient, inadequate out of date or incorrect manuals, operational procedures or Quality Management System	☐	☐	☐	☐	Likely	Moderate	**High**	- GDC: Operational procedures exist in QMS for water treatment staff and SOPs for sampling/monitoring staff. These documents continue to be reviewed and updated. Reviews and audits as per quality system. - FH: Operational procedures exist and driven by OMMPs. Project specific procedures developed when required. ISO 9001 accreditation in place. Reviews and audits conducted as per quality system.	Rare	Moderate	Low	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
											- Commissioning planning and commissioning offline undertaken where possible				
101	General	Barrier Management	Contamination or loss of supply due to inadequate critical spare parts held or unavailable	☐	☐	☐	☐	Possible	Moderate	Medium	- Critical spares are available for bulk supply and treatment systems. - Non-critical spare parts are held for some things and replacement spares parts are usually available overnight. - Standardisation of assets where possible. - Some preferred supplier arrangements are in place, contractor ensures inventory of high use stock, and critical spare lists held by GDC and contractor.	Rare	Minor	Low	Acceptable
102	General	Barrier Management	Contamination or loss of supply due to inadequate training, professional development, up-skilling, or ongoing competency of water staff (Council and Contractors)	☐	☐	☐	☐	Almost Certain	Major	**Extreme**	- External staff competency assessment for crucial support roles that contractors perform. - On-going training and up-skilling are provided for operators and the maintenance staff. - Contracts/service level agreements in place for specialised but critical aspects of the water supply operation (includes sampling, lab testing, chemical supply, I&E services, equipment servicing and maintenance).	Possible	Major	**High**	**Unacceptable**
103	General	Barrier Management	Contamination or loss of supply due to inadequate staff resourcing (includes subcontractors)	☐	☐	☐	☐	Possible	Major	**High**	- Adequately trained staff for operations and maintenance (includes internal and external staff and trainees).	Possible	Major	**High**	**Unacceptable**
104	General	Barrier Management	Contamination or loss of supply due to inadequate inspections, preventive maintenance or replacement of critical treatment systems and monitoring equipment causing failures	☐	☐	☐	☐	Likely	Major	**High**	- Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage).	Unlikely	Major	Medium	Acceptable
105	General	Barrier Management	Contamination or loss of supply due to inadequate inspections, Preventive maintenance, or replacement of critical treatment structures (intake, dams, treatment systems, reservoirs (WTP), bulk raw/treated main, pump stations, reservoirs (Distribution Network)) causing failures	☐	☐	☐	☐	Unlikely	Moderate	Medium	- Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate. - Condition assessments of critical infrastructure carried out as per schedule.	Unlikely	Major	Medium	Acceptable
106	General	Barrier Management	Contamination or loss of supply due to supply chain issues (i.e., Chemicals, equipment)	☐	☐	☐	☐	Possible	Major	**High**	- Critical suppliers are communicated with regularly and updates are received when supply is expected to be low. Early ordering where possible. Shared inventory with other WTPs, GDC Pool and neighbouring Water Suppliers. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs.	Unlikely	Major	Medium	Acceptable
107	General	Verification Monitoring	Contamination is not identified due to sampling and monitoring not being sufficient	☐	☐	☐	☐	Likely	Major	**High**	- Sampling programme in place and prepared/checked against current standards or rules. - On-line monitoring, telemetry to major sites for critical aspects of supply operation.	Possible	Major	**High**	**Unacceptable**

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
108	General	Verification Monitoring	Contamination or loss or supply not identified due to inadequate data collection and reporting systems (includes PLC, SCADA, Water Outlook and communications systems)					Likely	Major	**High**	- On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Instrumentation and SCADA system supported and maintained by competent specialist contractor. - Critical I&E changes (i.e., PLC) are limited to selected staff only and hardcoding has been setup on critical setpoints. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage).	Possible	Major	**High**	**Unacceptable**
109	General	Verification Monitoring	Contamination not identified or loss of supply due to critical instrumentation failure (normal calibration)					Likely	Moderate	**High**	- Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Instrumentation and SCADA system supported and maintained by competent specialist contractor. - Critical I&E changes (i.e. PLC) are limited to selected staff only and hardcoding has been setup on critical setpoints. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e. power outage). - Regular inspection and maintenance programme in place with specialist contractors engaged where appropriate.	Unlikely	Moderate	Medium	Acceptable
110	General	Verification Monitoring	Contamination not identified due to incorrect setup of critical instrumentation during commissioning (span, calibration, flow rates etc.)					Unlikely	Moderate	Medium	- Commissioning planning and commissioning offline undertaken where possible - Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures.	Unlikely	Moderate	Medium	Acceptable
111	General	Verification Monitoring	Contamination not identified due to critical instrumentation drift over time					Possible	Moderate	Medium	- Verification (validation) and standardisation (calibration) of online instrumentation carried out as per manufacturers recommendations and GDC procedures.	Unlikely	Moderate	Medium	Acceptable
112	General	Verification Monitoring	Contamination or loss of supply due to inadequate reporting from observations, inspections or maintenance					Likely	Moderate	**High**	- Record keeping and reporting systems are available and utilised (Objective, Ozone, IPS, Plant Diary, GIS, Water Outlook, Hilltop, Vault, SCADA Notes, Maximo (FH only)).	Unlikely	Moderate	Medium	Acceptable
113	General	Other	Contamination due to inadequate treatment processes					Likely	Catastrophic	**Extreme**	- Council reviews legislation, standards, policies, bylaws and service requirements during the 3 yearly development of the Water Asset Management Plan and Long Term Plan.	Possible	Major	**High**	**Unacceptable**
114	General	Other	Loss of supply due to major structural failure of critical structures (Dams, intakes, pump stations, Water Treatment Plants, Reservoirs)					Rare	Major	Medium	- Condition assessments of critical infrastructure carried out as per schedule. - On-line monitoring, telemetry to major sites for critical aspects of supply operation. - Robust and detailed alarm system is in place to notify staff of any exceedance of limit or unexpected status change (i.e., power outage).	Rare	Major	Medium	Acceptable

ID	Supply Component	Process Step	Hazardous Event	Hazard Type				Maximum (Unmitigated Risk)			Existing Preventive Measures	Residual (Mitigated) Risk			
				Biological	Chemical	Physical	Radiological	Likelihood	Consequence	Risk Level	Description	Likelihood	Consequence	Risk Level	Residual Risk Acceptability
115	General	Other	Contamination or loss of supply due to a catastrophic natural disaster or failure including earthquake, flooding, volcanic eruption, wildfire	☐	☐	☐	☐	Rare	Catastrophic	Medium	- Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented. - Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Response plans are up to date and available. - Actively engaged with emergency response organisations.	Rare	Catastrophic	Medium	Acceptable
116	General	Other	Contamination or loss of supply due to changes in legislation, standards, organisational policy, bylaws, codes of practices or any other	☐	☐	☐	☐	Likely	Catastrophic	**Extreme**	- Council reviews legislation, standards, policies, bylaws and service requirements during the 3 yearly development of the Water Asset Management Plan and Long Term Plan.	Possible	Major	**High**	**Unacceptable**
117	General	Other	Loss of supply linked to water demand issues (expansion of network, pressure issues, leak management)	☐	☐	☐	☐	Likely	Major	**High**	- Bulk supply available from a combination of Waingake (Including Waingake River or Mangapoike Dams) or Waipaoa WTPs. - Water conservation measures (water restrictions) can be implemented. Water Demand Management Plan Developed and being implemented.	Possible	Major	**High**	**Unacceptable**

Variable	Units	MAV (GV)	2022	2019	2017
Chloride			12.7		
Nitrate (as N)			0.0071		
Nitrite (as N)			<0.002		
Sulphate			4.9		
Bromate			<0.005		
Bromide			0.012		
Chlorate			<0.01		
Chlorite			<0.005		
Ammoniacal Nitrogen (as N)	mg/L	n/a	<0.005		
Conductivity (@25°)	mS/m	n/a	20.0		
Dissolved Oxygen			11.0		
Dissolved Reactive Phosphorus (as P)			0.004		
Fluoride	mg/L	1.5	0.4		
Molybdate Reactive Silica (as SiO2)	mg/L	n/a	10.2		
Nitrate (as NO3) + Nitrite (as NO2)			0.031		
Nitrate (as NO3)			0.031		
Nitrate (as N) + Nitrate (as N)			0.007		
Nitrite (as NO2)		<0.007			
pH (at room temp c. 20 °C)	pH unit	(7.0-8.5)	7.6		
Total Alkalinity (as CaCO3)	mg/L	(100-300)	48		
Total Cyanide	mg/L	0.6	<0.005		
Total Dissolved Alkalinity (as CaCO3)			42		
Turbidity	NTU	(4)	0.25		
UVT at 254 nm	abs units	n/a	66.3		
Metals (Total) Antimony, Beryllium, Cadmium, Chromium, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Tin, Zinc	mg/L		ND	ND	ND
Aluminium			0.097		
Arsenic	mg/L	0.01	0.00031		
Barium	mg/L	1.5	0.01		
Boron	mg/L	2.4	0.026		
Calcium Calcium (as CaCO3)	mg/L	See total hardness	18 -		
Copper	mg/L	(2)	0.006		
Iron	mg/L	(0.3)	0.0027		
Lithium	mg/L	n/a	0.0031		
Magnesium Magnesium Hardness (as CaCO3)	mg/L	See total hardness	1.7 -		
Manganese	mg/L	0.4 (0.10)	0.00096		
Potassium			0.84		
Sodium			9.9		
Total Hardness (as CaCO3)			51		
Uranium			0.000021		