WAIMAKARIRI DISTRICT COUNCIL

Water Safety Plan

Garrymere Water Supply

Prepared by Waimakariri District Council
November 2021

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Table of Contents

Table of Tables

Table of Figures

1. Introduction

This water safety plan gives an overview of the Garrymere Water Supply, which is owned, managed and operated by the Waimakariri District Council. The management of the safety of the drinking-water is a core responsibility and a high priority for the Council.

This water safety plan has been developed to ensure that a risk management approach is taken towards the safety of the drinking-water. This plan has been prepared in accordance with the New Zealand Drinking-water Safety Plan Framework (Ministry of Health, December 2020) to meet legislative requirements under the Health Act, and the Water Services Act.

1.1. Commitment to Drinking-Water Quality Management

Council staff have prepared the following commitment statement for community drinking-water supplies, which has been approved by the Council's Utilities and Roading Committee, as part of adopting this Water Safety Plan.

Waimakariri District Council
215 High Street
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UTILITIES

Drinking-water Commitment Statement Waimakariri District Council

The Waimakariri District Council is committed to managing its community drinking-water supplies to ensure that consumers receive safe, reliable and high-quality drinking-water.

We do this by actively working towards achieving and maintaining compliance with the Drinking-water Standards for New Zealand, and meeting the expectations set out in the New Zealand Drinking-Water Safety Plan Framework as required by the Health (Drinking Water) Amendment Act 2007, and other relevant legislation and standards.

Waimakariri District Council in partnership with stakeholders, nominated contractors and relevant agencies will ensure that this commitment is met by following the six fundamental principles of drinking-water safety in New Zealand, as below:

1. **Ensure a High Standard of Care**: At all points along the supply chain from source water to consumer, a high standard of care will be applied to manage water quality. This encompasses the day-to-day operation and maintenance, the identification and delivery of required upgrades, and long term strategic planning to ensure that both current and future needs are met.
2. **Importance of Protecting Source Water**: Recognises that the protection of source water is vital to ensure consumers are safe from illness and contamination.
3. **Maintain Multiple Barriers Against Contamination**: Strive to protect consumers from drinking-water contamination and illness through the use of multiple robust protective barriers that precede contamination.
4. **Change Precedes Contamination**: Acknowledges that contamination is almost always preceded by some kind of change (including processes and hazardous events). Any changes reported by monitoring methods used will be responded to using appropriate contingency and incident response plans.
5. **Ownership and Responsibility**: To promote a culture of collective ownership and responsibility for safe water supplies throughout the Waimakariri District for the protection of our community and stakeholders. Council staff at all levels will be encouraged to raise issues and develop improvements to systems, to ensure the ongoing safety of drinking-water in the District.
6. **Preventative Risk Management**: Potential threats to the quality and quantity of water are investigated, identified and managed in a timely manner. Any potential improvements in our practices resulting from corporate commitments, stakeholder expectations and regulatory requirements are to be considered and implemented.

Signed: _____ Mayor - Dan Gordon

Signed: _____ Utilities Portfolio Holder – Paul Williams

Signed: _____ Chief Executive – Jim Harland

Signed: _____ Manager, Utilities and Roading – Gerard Cleary

Date: 21 September 2021

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1.2. Supporting Principles, Plans, Strategies and Policies

The Council's commitment to safe and reliable drinking-water is embedded within the organisation through the following principles, strategies, plans, policies and bylaws. At a higher level are overarching principles that the organisation is guided by, down to water supply specific strategies, plans and policies. A list and description of each of these documents is provided in Table 1.1.

Table 1.1: List of supporting documentation

Principles	Description
Tā mātou mauri – our principles (TRIM 180323031595)	The overarching principles which the organisation is guided by in decision making, and day to day functions.
Community Outcomes and Governance	**Description**
Community Outcomes (TRIM 210115004773)	The Local Government Act defines community outcomes as: *"Outcomes that a local authority aims to achieve in meeting the current and future needs of communities for good quality local infrastructure, local public services, and performance of regulatory functions."* These are Council's statement of what they are trying to achieve, which also helps inform the rationale for service delivery, performance measures and targets, alongside Council's strategic direction.
Governance Statement (TRIM 170112002029)	A collection of information about how the Council works. It outlines how the Council makes decisions and shows how residents can influence those processes. It also promotes local democracy by providing the public with information on ways they can influence local democratic processes.
Core Strategic and Planning Documents	**Description**
Infrastructure Strategy (TRIM 210602088763)	Demonstrates how Council will manage our major assets and address the key issues over the next 30 years. This Strategy summarises the current state of Council's infrastructure and importantly outlines the key strategic issues facing the Council and its proposed response.
Activity Management Plans (TRIM 200120006283)	Are key strategic documents that describe all aspects of the management of assets and services for an activity (including technical and financial) over the lifecycle of the asset in the most cost-effective manner to provide a specified level of service. There is a standalone document for each public water supply which the Council manages.
Long Term Plan (TRIM 201027143087)	A comprehensive statement of the Council's intentions for the next 10 years. These are reviewed every three years which involves consultation with the community. It is focused on assessing performance against levels of service and associated projects to improve this as necessary, as well as identifying projects to accommodate growth, and renew of assets, and operation and maintenance budgets for each service area.
Annual Plan (TRIM 200505051844)	This is an annual review to update budgets and work programmes laid out in the Long Term Plan. The Long Term Plan is updated every three years, and Annual Plans produced every other year, with the focus on the year ahead. This includes: • The proposed annual budget and funding impact statement for the year to which the annual plan relates. • Identification of any variation from the financial statements and funding impact statement included in the local authority's long-term plan in respect of the year. • Support the long-term plan in providing integrated decision making and co-ordination of the resources of the local authority. • Contribute to the accountability of the local authority to the community. • Consultation in the form of public submissions.

Financial Plan (TRIM 180703073580)	Outlines the key financial parameters and limits within which the Council will operate over the next 10 years. It provides a guide against which proposals for expenditure and funding may be considered, and gives a context for public disclosure of the overall effect of long term expenditure proposals on levels of service, rates, debt and investments. Every three years when the Long Term Plan is revised, a more up to date version is included in the updated Long Term Plan.
Business Continuity Plan (TRIM 191029150148)	Identifies how the organisation can keep its essential functions up and running during a time of disruption.
Bylaw	**Description**
Water Supply Bylaw 2018 (TRIM 181109132673)	To protect, promote and maintain public health and safety through the provision of water services in the Waimakariri District.
Policies	**Description**
Backflow Prevention	This policy sets out how Council is to protect its supplies from the risk of backflow, in line with obligations under the Health Act.
Water Supplies - Residential 4A-4B Zones	This policy ensures that privately developed water supplies or extensions to existing supplies are designed and constructed to the required standards.
Applications for Extension to Water Supply and Sewage Disposal	The purpose of this policy is to effectively manage and operate the extension of water and wastewater assets without putting excessive burden on existing schemes.
Transfer Surplus Water Units on Restricted Water Supplies	This policy enables water units to be allocated more efficiently on the schemes that do not have spare capacity available to supply the growing community needs.
Risk Register	The purpose of the risk register is establish a central repository for all WDC risks and to reduce loss of knowledge about how we manage specific WDC risks when staff change jobs/roles. The WSP Risk Checklist will remain a standalone document to this, however all items identified as high risk within the updated water safety plans will been uploaded to Council's risk register.
Engineering Code of Practice	The document sets out guidelines for developers and contractors to assist them in complying with the WDC District Plan, bylaws, policies and consents.
Hygiene Code of Practice (TRIM 200331041625)	This is a document sets out minimum requirements for work on any public water supply system within the district. This covers work by operational and maintenance staff, capital works, or new infrastructure constructed by developers and vested to Council. This document has been prepared based on documentation available from Watercare, Christchurch City Council, and Water New Zealand, to ensure WDC is consistent with national good practice.
Strategies	**Description**
Chlorination Strategy (TRIM 170411035457)	This strategy seeks to protect the public by ensuring all potable water supplied by Council to its customers is safe from bacterial contamination, while still respecting the community's choices regarding the level of service in regard to the degree of treatment versus aesthetic considerations.
Generator Strategy (TRIM 131219118904)	The aim of this strategy is to address generator requirements in a potential emergency events occurrence (e.g. snow, high winds, flooding, lightning, and heavy rainfall) for all 3 Waters sites. It includes details of fuel requirements and fuel storage for each generator.
Water Conservation Strategy (TRIM 200501050668)	The key aim of the Water Conservation Strategy is to provide targets, initiatives and a monitoring regime to achieve higher levels of water conservation within the WDC community water supplies.

Canterbury Water Management Strategy	Council works with Environment Canterbury manage the multiple demands of the region's water, through the Canterbury Water Management Strategy

1.3. Stakeholders

1.3.1. Internal

All stakeholders who could affect or be affected by decisions or activities to do with the drinking-water supply are identified in the following tables. Table 1.2 identifies teams within Council, or elected members making up the Council or Community Boards who deal with water supply and could be affected by decisions and activities relating to drinking-water supply.

Table 1.2: Internal Stakeholders

Stakeholder	Description of Function and Responsibilities
Elected Members (Mayor, Councillors and Community Board Members)	Community Boards, Council Committees and Elected Members are communicated with through formal reports, so they can make informed decisions. They are also kept informed via briefings, staff updates, and via the Council's portfolio holder for water who meets with asset management staff regularly. There are regular meetings held for the respective groups throughout the year, as shown in Appendix 1A.
Building Unit	Ensure building consents are compliant and have officers who undertake inspections to ensure the compliance to the consents. This includes ensuring potable water supply at each property, as part of the Building Consent process, and ensuring backflow prevention devices within properties are in place at the time the building is consented.
Civil Defence Unit	Prepare Council policies, plans and procedures for response to disasters, emergency events, or natural hazards.
Planning Implementation Unit	Ensure new developments comply with the District Plan rules. These rules encompass all Council rules for planning, including water and utilities.
3 Waters Unit	Overall responsibility for asset management, capital programme development and delivery, operations, strategy and policies relating to 3 Waters services.
Project Delivery Unit	Utilities Design Team Design, tender and construction monitoring of 3 Waters infrastructure, including facilitating the development of the WSP. Development Team Ensuring all new developments are designed and constructed in accordance with the required specifications and plans. Network Planning Team Undertakes hydraulic modelling of all water supplies, capacity assessments, development of data standards, valuation reports, and general asset management assistance to the 3 Waters team.
Water Unit	Operate, maintain and construct 3 Waters infrastructure, including both facilities sites, and reticulation systems. Run an IANZ accredited laboratory for E. coli, and undertake sampling and submission to external laboratories for other parameters.
Environmental Health Officers	The Council's Environmental Services undertakes the following: • Protect public health and safety.

Stakeholder	Description of Function and Responsibilities
	• Promote and protect the natural and physical environment. • Protect the public from nuisance. • Obtains and maintain list of dialysis patients, and notifiable diseases.

1.3.2. Operations and Management Team

All staff within Council involved in the operation, maintenance and management of the supply are divided into several categories, within the following two Council departments.

Utilities and Roading Department:

The Utilities and Roading Department of Council is managed by Gerard Cleary, Manager Utilities and Roading. This department contains two relevant teams with the following level of responsibility over water supplies:

> **3 Waters Unit - Asset Management and Operational Responsibility:** The 3 Waters Unit within the Utilities and Roading Department of Council has responsibility for all functions relating to the management, operation, maintenance, compliance and reporting for the district's water supply schemes.
>
> **Project Delivery Unit - Engineering Support:** The 3 Waters Unit is supported with professional services predominantly through the Council's internal consultant the Project Delivery Unit (PDU). Where there are insufficient resources, or where specialist expertise outside of the PDU is required an external consultant may be used.

Finance and Business Support Department:

The Finance and Business Support department of Council is managed by Jeff Millward, Manager Finance and Business Support. There is one unit within this department with direct responsibilities relevant to water supply operation and maintenance:

> **Water Unit – Operation and Maintenance:** The Water Unit are engaged by the 3 Waters Unit to operate and maintain the Council's 3 Waters facilities sites. The Water Unit was formed within its current structure as a separate business unit of council in 1998. The reticulation teams and treatment operators from all the previous borough councils joined together to undertake reticulation, maintenance and operational works within the Waimakariri District. The local knowledge and in-house skills provided by the Water Unit make them invaluable for the operation of the Council's drinking-water supplies.

The Manager of Utilities & Roading and Manager Finance & Business Support report to the Council's Chief Executive. All Council staff are accountable to the Chief Executive who is responsible to the elected officials comprising the Council (the Mayor and Councillors) who are ultimately responsible for all functions of Council, including drinking-water.

Key individual staff roles and responsibilities related to water supplies are listed in Table 1.3 and Table 1.4.

Table 1.3: Key Water Unit staff involved in the operation and management of WDC drinking-water supplies.

Staff	Role	Qualification	Responsibility
Joshua McIndoe	Water Unit Manager	National Certification in Water and Wastewater Treatment. Diploma in Business Management	Responsibility for the planning and operations and performance of the Water Unit, who are a division of the Council. Charged with the operation, repair and maintenance of the Council's water supplies; as well as running internal laboratory and external laboratory suppliers, to analyse samples taken by Water Unit staff.
Phil Drozdowski	Reticulation Supervisor	National Certificate in Water Reticulation Level 4 New Zealand Certificate in Infrastructure Works (Contract Management) Level #6	Team Leader at Water Unit responsible for operation and maintenance of water reticulation.
Darryn Williams	Technician Team Leader	National Certification in Water Treatment Level 4 NZQA US17891 Undertake sampling and site analysis for water treatment IANZ Approved Signatory	Team Leader at Water Unit responsible for team of technicians who operate the 3 Waters facilities sites throughout the district, and signatory to the Water Unit laboratory. Assistance with the preparation of the Water Safety Plan and development of the risk assessment.
Les Clarke	Water and Wastewater Technician	Grade C Certificate Water Treatment	Operation of 3 Waters facilities sites throughout the district.
Josh Palmer	Water and Wastewater Technician	National Certification in Water Treatment Level 4	Operation of 3 Waters facilities sites throughout the district.
Kirk Hindmarsh	Water and Wastewater Technician	National Certification in Water Treatment Level 4 IANZ Approved Signatory	Operation of 3 Waters facilities sites throughout the district.
Bevan Stack	Water and Wastewater Technician	National Certification in Water Treatment Level 4 IANZ Approved Signatory	Operation of 3 Waters facilities sites throughout the district.
Susan Dalzell	Laboratory Technician	NZQA US17878 US17890 Undertake sampling and site analysis for water treatment IANZ Approved Signatory	Primary water sampler and signatory at Water Unit laboratory.
Sarah Starkey	Business Support Team Leader	Post Graduate Certificate in Business, studying towards a Masters in Business	Team Leader at the Water Unit responsible for the team managing the administration and business support requirements, including but not limited to coordinating reactive and planned works, training, health and safety, stores and maintenance.

Table 1.4: Key Utilities and Roading Department Staff with Responsibilities Relating to Water Supplies.

Staff	Role	Qualification	Responsibility
Gerard Cleary	Manager Utilities and Roading	Bachelor of Civil Engineering, Bachelor of Science (BE, BSc, CMEngNZ, CPEng)	Overall responsibility for the roading, solid waste and 3 Waters services within the district. Final level of endorsement of the Water Safety Plan before submitting to Management Team / Utilities & Roading Committee for approval.
Kalley Simpson	3 Waters Manager	Bachelor of Natural Resources Engineering (MEngNZ)	Overall responsibility for asset management, operation and maintenance of 3 Waters services within the district. Assistance with preparation of Water Safety Plan and developing the risk assessment. Reviewer of the Water Safety Plan.
Colin Roxburgh	Water Asset Manager	Bachelor of Natural Resources Engineering (CPEng, CMEngNZ)	Overall responsibility for asset management of all Council water supplies. Assistance with preparation of Water Safety Plan and developing the risk assessment. Reviewer of the Water Safety Plan.
Caroline Fahey	Water Operations Team Leader	Masters in Civil Engineering (MEngNZ)	Overall responsibility for operation and maintenance of 3 Waters services within the district. Assistance with preparation of the Water Safety Plan and developing the risk assessment.
Craig Freeman	Water Engineer	Bachelor of Science in Civil Engineering	Provide assistance to the Water Operations Team Leader and Water Asset Manager in carrying out their duties.
Daniel Wilkes	Control Systems Engineer	New Zealand Certificate of Engineering (NZCE) in Electronics and Computer Technology.	Responsible for operation and management of 3 Waters SCADA communications systems.
Jennifer McSloy	Development Manager	BA Jurisprudence (Oxon) and PGDipBA (Cant)	Overall responsibility for the Development Team. Oversees resource consent applications for subdivisions and completes the final review stage.
Sam Powrie	Land Development Auditor	Bachelor of Civil Engineering (BE Civil)	Responsible for auditing and providing high quality engineering advice to greenfield land developers within the Waimakariri. Ensures all new subdivisions are constructed to comply with the Engineering Code of Practice and other Council requirements.
Mark Andrews	Utilities Projects Team Leader	Bachelor of Mechanical Engineering (CEng MCIWEM C.WEM)	Team leader of Utilities Design Team within Council, responsible for designing and review of 3 Waters infrastructure. Reviewer of the Water Safety Plan and developing the risk assessment, prior to submission to 3 Waters team.
John Stopford	Project Delivery Unit Project Engineer	Bachelor of Mechanical Engineering (BE Mechanical)	Designer and project manager for water main renewals, pumping stations and backflow preventer renewals for medium to high hazard properties.
Claudia Button	Project Delivery Unit Graduate Engineer	Bachelor of Natural Resources Engineering (BE Natural Resources)	Water Safety Plan project coordinator and co-author of plan and risk assessment.

See Figure 1.1 for an organisational structure of all internal stakeholders departments and teams.

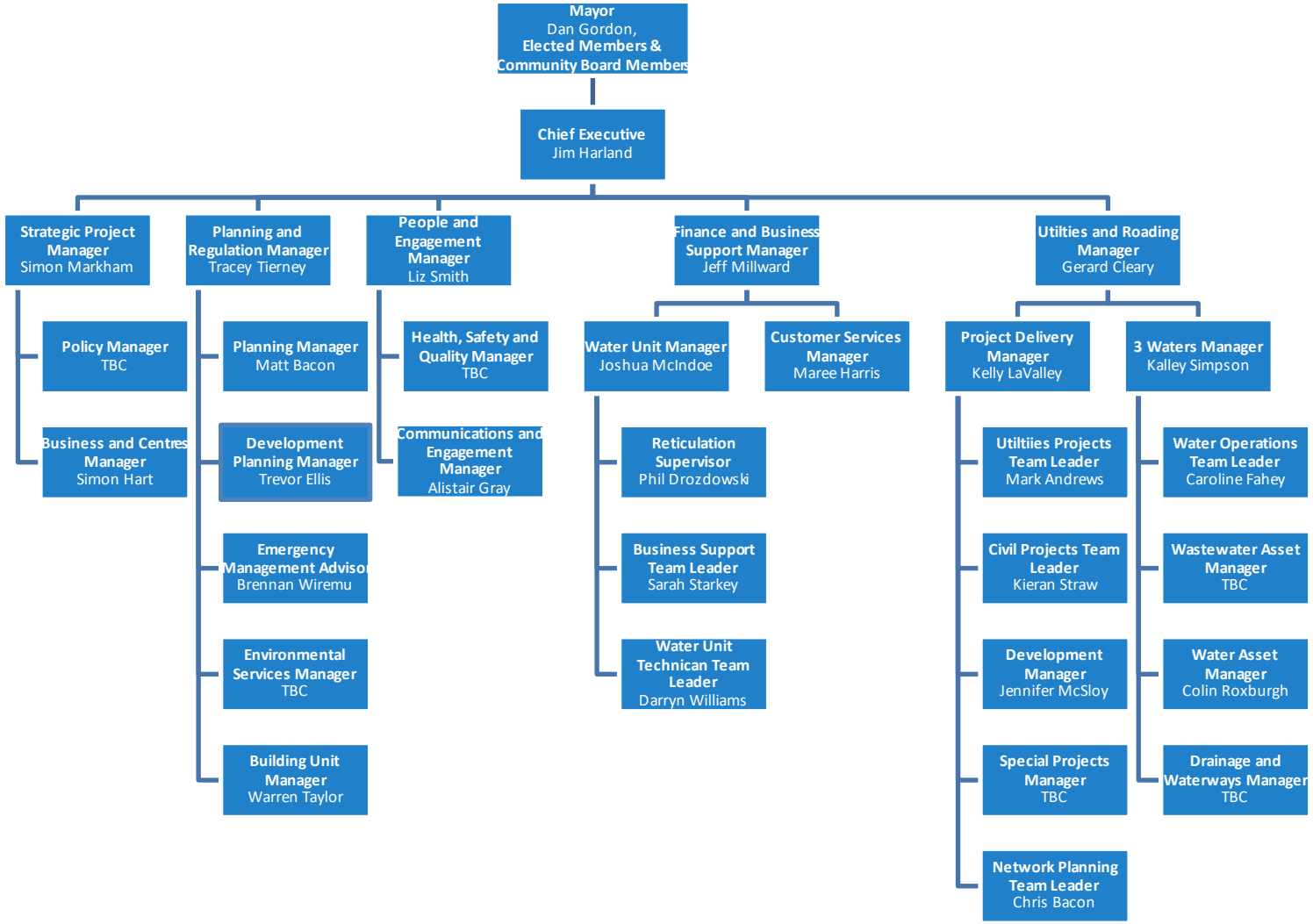

Figure 1.1: Water Safety internal stakeholders organisational chart

1.3.3. Employee Awareness and Training Processes

A key principle of drinking-water safety is to maintain a personal sense of responsibility and dedication to providing consumers with safe water. The Council's awareness and training processes support this principle by ensuring all staff are sufficiently trained to perform their roles, and have sufficient awareness and engagement with regard to the delivery of safe drinking-water.

The types of systems used to ensure that staff have adequate awareness of their responsibilities, ownership for their roles, and are competent and sufficiently trained to perform their roles are outlined below.

Awareness

There are a number of mechanisms used to raise awareness about water safety, and general water supply related matters. These include:

- **Team Meetings:** There are a number of team meetings held within teams, or between teams, to discuss matters related to water supply. Staff are made to feel confident to raise issues or highlight emerging matters, and actions assigned to follow up on issues raised as necessary. These include fortnightly water operations meetings held within the 3 Waters team, monthly 3 Waters team meetings, and monthly operational meetings held between Water Unit and 3 Waters staff.
- **Presentations:** The Utilities and Roading department conducts monthly presentations that will focus on a different topic affecting the department each month. Past presentations have included water regulation changes and water safety plans, which provided an opportunity for wider engagement within the department. Team members from one team may also be invited to present to another team on a particular topic (for example the Water Asset Manager presented to the Project Delivery Unit, following the publication of the Council's Hygiene Code of Practice for Work on Public Water Supplies). There have been internal presentations held at the Water Unit, with topics including backflow prevention, and reticulation maintenance procedures.
- **Updates:** There are weekly updates prepared in a newsletter format by email and on the staff intranet, circulated to internal staff and elected members. It provides an opportunity for Utilities and Roading staff to update wider internal stakeholders on matters relating to water supply, as well as any pressing issues to do with water safety.
- **Chief Executive Briefings:** The Chief Executive gives quarterly briefings to all staff on matters from that time period. This includes matters relating to water supplies, such as source upgrades to achieve drinking-water standard compliance, regulation changes, water safety plans, among a number of other topics.

Formal Training and Professional Development

All new Council employees are provided with training to ensure they understand the systems, roles and responsibilities of Council. A range of training is provided depending on the role of the individual. For the roles which involve water supply services (Water Unit, PDU and Asset Management), staff may be provided with the following (it is noted that the list below is far from exhaustive, however provides an example of the types of training that is available).

Table 1.5: Training Examples for WDC Employees

All New Employees	Water Unit	PDU and 3 Waters
• TRIM Training – Document processing and record keeping. • New Staff Induction - Introduction to how Council operates, and all of the	• A list of specific Water Unit training can be found in Appendix 1B. • Competency Training (specific to role). This is recorded in a competency	• Engineering New Zealand Chartership pathway. Staff working towards becoming chartered engineers are assigned or select mentors within the department, and have regular

All New Employees	Water Unit	PDU and 3 Waters
different departments and functions of Council. • Bus tour of district and facilities. • Health & Safety Induction - How to keep safe at work, and who to talk to about near misses and accidents • Privacy Training – Guidelines on how to treat information regarding customers. • Promapp Training – Refer to water safety awareness section below. • Waimap Training – Asset management software training.	register to ensure staff undertaking a given task are sufficiently competentto complete it, see Section 4.1.5. • Attendance at conferences and workshops (i.e. Water New Zealand, IPWEA, WIOG).	meetings to guide their career, and work towards Chartership. • Ngāi Tūāhuriri Workshop • Principals and trends water treatment • Three Waters Reform / Taumata Arowai meetings • Engineering New Zealand webinars / workshops • Attendance at conferences and workshops (i.e. Water New Zealand, IPWEA, WIOG, Engineering NZ).

While training is provided across a number of areas of the business, it has been identified that a more formalised approach to training in the Water Safety Plan itself is required. This includes training relevant staff in the contents of the Water Safety Plan that they are involved in, and in the relevant features of the Incident Response Plans. While those staff impacted by these activities are involved in the preparation of these documents, a formal training register is required to ensure the same level of awareness is transferred to any new staff members.

IMPROVEMENT PPI1: Include Water Safety Plan processes and Incident Response Plan training in training register, and ensure all relevant staff are sufficiently trained

1.3.4. External Stakeholder Engagement

WDC work continuously with external stakeholders to assist with the management of our drinking-water supplies. Key external stakeholders, and the methods used to engage with these groups with respect to drinking-water is outlined below:

Table 1.6: External stakeholders

Stakeholder	Communications/ Engagement Plan
Residents / Scheme Members	Residents and property owners connected to a Council water scheme are communicated with through a series of channels, discussed in Section 1.3.
Water Supply Advisory Group (WSAG)	For some water schemes, WSAGs are formed when changes regarding the water scheme are proposed. WSAGs make recommendations to Council, after working with staff and elected members on proposals. Customers on these schemes typically have a strong sense of ownership for their water supply, so consultation is an important stage of the process. Schemes with active or recently active WSAGs include: • Cust • Garrymere • Poyntzs Road • Summerhill • West Eyreton
Environment Canterbury (ECan)	ECan are communicated with in the following ways: • **New Consents or Renewal of Consents:** This is through the submission of resource consent applications by Council to ECan. This will often be preceded by a preliminary meeting or meetings to discuss the activity that is proposed. • **Compliance with Existing Consents:** Council submits data to demonstrate compliance with water take consents, or informs ECan of any known breaches of consent.

Stakeholder	Communications/Engagement Plan
	• **Activities within Community Drinking-water Protection Zone (CDWPZ):** If an activity is proposed within a CDWPZ, ECan will consult with Council on how the proposal may affect the water supply. • **General Discussion on Regional Issues:** These are discussed between key Council and ECan staff via the Canterbury Drinking-water Reference Group (CDWRG), or informally via email or phone communications between staff. • **Operational Meetings:** ECan's key compliance offer operating in the region meets and liaises regularly with relevant staff, and has attended 3 Waters team meetings.
Taumata Arowai	While the new drinking-water regulator is yet to be formally established, staff are in contact with the Taumata Arowai, including participating on the Local Authorities Drinking Water Reference Group.
Drinking-water Assessors (DWAs)	The DWAs communicate and works with Council in the followings ways: • **WSP Preparation and Submission:** Council prepares WSPs for each scheme and submits them to the DWA for assessment. The DWA reviews the plan for compliance, and reports back to Council with any required changes or clarifications. • **Implementation Assessment of WSP:** The DWA assesses that Council is implementing each WSP, including requesting information from Council, and visiting the scheme. This results in a report being presented to Council, which may include recommendations or corrective actions being required. • **Assessing Treatment System or Secure Bore:** If a new treatment system is modified, or a new source is constructed, the Council will submit information to the DWA to demonstrate compliance of the infrastructure with the relevant section of the DWSNZ. The DWA will then report back to Council to confirm whether the infrastructure complies, or whether any changes to the WSP are required. • **In Response to a Transgression or Event:** If there is an event or transgression that occurs on any scheme, the Council will communicate with the DWA in accordance with the relevant incident plan, and agree on any necessary remedial actions. • **General Advice:** The Council may contact the DWA for any other clarification of either the Health Act or DWSNZ on an as required basis.
Canterbury District Health Board	In addition to the engagement with the DWA (as described above), there is some engagement with the CDHB more generally. Public Health Analysts at the CDHB forward notifiable disease information to Council staff on a weekly basis, which is monitored for any trends within the district. These are saved in TRIM under ENV-03-14. WDC is also notified of dialysis patients within the district, again with information available with Council's record system (ENV-03-17).
Fire and Emergency New Zealand (FENZ)	Council communicates with FENZ in the following ways: • **Updating Gazetted Firefighting Zone Boundaries:** As schemes grow or zones are adjusted, Council provides information to FENZ to update their systems. • **Fire Hydrant Audits:** From time to time FENZ may carry out audits or testing on fire hydrants. In this event any defects found will be passed on to Council staff to rectify. • **Capital Works:** The fire service are notified during capital works when hydrants become unavailable, or during water shut downs.
High Risk Users	The Water Unit hold a list of residents who use dialysis machines, and are therefore reliant on the water supply system. This list is available on Water Unit staff members' tablets so that they are aware it any shutdown affects one of these customers. The most up to date dialysis patients list can be found in TRIM folder ENV-03-17. There is scope to extend this information to other critical customers in the future.
Te Ngāi Tūāhuriri Rūnanga	Te Rūnanga o Ngāi Tahu are the overarching tribe representing the majority of the South Island. Te Ngāi Tūāhuriri Rūnanga are the local Rūnanga for the Waimakariri District, who are one of 18 Papatipu Rūnanga within Ngāi Tahu. There are culturally significant sites within the Waimakariri such as the Tuahiwi Marae and Kaiapoi Pa.

Stakeholder	Communications/Engagement Plan
	Council ensures all staff are informed of the history of the land through cultural training. As a minimum, all staff go on the bus tour to see the Marae, and those staff who undertake work directly with Ngāi Tahu, are encouraged to undertake a workshop with Te Ngāi Tūāhuriri Rūnanga. Ngāi Tahu operate an environmental management advisory consultancy called Mahaanui Kurataiao Ltd, who WDC engage for advice regarding projects that may have cultural implications. WDC strive to protect and uphold tāngata whenua values on all projects.
Te Kōhaka o Tūhaitara Trust	Te Runanga o Ngāi Tahu and WDC have a trust in place for the management and administration of Tūtaepatu Reserve and recreational lands in Woodend and Waikuku. Refer to the draft statement of intent for more information.
Department of Conservation (DOC)	Oxford Urban and Rural No.2 is the only WDC water supply with a CDWPZ within DOC land. The Coopers Creek well (backup) obtains water from a river source which has part of its catchment within DOC land. DOC are aware of the protection zone within their land, and have agreed to notify staff of any activities DOC carry may out which could affect the source, so that Council can react as required to ensure the source is protected (TRIM 210202016306).
Camping Grounds	Three camping grounds within the Waimakariri District are connected to Council's water supply: • Waikuku Motor Camp – Waikuku Water Supply • Kairaki Beach Motor Camp – Kaiapoi Water Supply • Pineacres Holiday Park – Kaiapoi Water Supply These are included in the critical users spreadsheet. During an event on these water schemes, the camping ground service will be contacted to relay information to the users.
Hospitals & Medical Centres	The Council holds a list of contact details for critical customers connected to council owned water supplies within the district. This list includes hospitals, schools, pre-schools, veterinary services, police stations, fire stations and camping grounds. The purpose of this spreadsheet is to enable quick identification of key users, such that they can be contacted directly if there is to be an issue relating to their water supply (TRIM 210303035519).
Schools / Pre-schools	
Plunkett	
Police	
Veterinary Clinics and Services	
Social Services	
Maintenance Contractors	Nairn Electrical are engaged as Council's electrical maintenance contractor, and are on-call 24/7 to provide assistance with resolving any electrical issues at any time. Regular meetings are held between 3 Waters, Water Unit, and Nairn Electrical staff to discuss the operation and maintenance requirements of the Council's water supplies. WaterForce are used to provide reactive servicing of pumps in the District, including well pumps. Established processes are documented to ensure works are completed satisfactorily, and managing the hygiene of the water supply. 3 Waters and Water Unit staff are in regular contact with WaterForce, as issues arise. Contact details are provided in Appendix 7A.

1.4. Community Engagement

This section details methods used to engage with the community who receive water from one of Council's public supplies, over and above the methods identified for specific stakeholder groups in Section 1.2.4. These communications may be directly between staff and the public, via the Council's Customer Services team, or with assistance from the Council's Communications and Engagement Team. A list of communication methods which may be used to engage with the community are stated in Table 1.7, with various methods used for different event types.

Table 1.7: Communication Methods Used By Event Type

Operational Matters	Planning	During and Prior to Construction Works	Emergencies
Community Notices: These are sent out on specific issues, on a case by case basis. This may be delivered as a letter drop or included as a pamphlet within the rates letter. This could be to provide advice regarding flushing being undertaken, an unplanned shutdown, or water restrictions as examples. **Website and Social Media:** The Council's website and social media pages are used to provide key information to residents and inform residents of operational issues (in additional to other engagement options above). **Newspaper Advertisements:** These are used to engage with sectors of society who may not receive information via the website or social media. **Service Request System:** Customer complaints are tracked through Council's service request system. There are target response times which vary depending on the nature of the issue. The number of issues and responses are tracked and reported on as part of Council's performance measures. 3 Waters, Water Unit, or Customer Services staff will respond to the complaint, and record the response and actions taken within the service request system. This system operates at all times, such that operational staff are always available, should an urgent issue arise.	**District Plan, Long-Term Plan and Annual Plans:** Each year Council prepares either an Annual Plan or a Long Term Plan to gain feedback from the community on significant projects, and rates for the coming year or years. Residents are able to make either written or oral submissions which are considered by Council before adopting the budgets for the coming year/s. Any submission received is considered, responded to, and in some cases budges adjusted. **Special Consultative Procedures (SCP):** Council generally undertakes a SCP to gain community input where a significant change to a level of service is being considered, or when several options are being considered. For example they have been conducted in the past when considering joining schemes, or when assessing water treatment options for an upgrade project. Over the last 10 years, consultation processes have been undertaken on nearly all supplies, as upgrades have been completed to achieve compliance with drinking-water standards. These processes will generally include a combination of the distribution of an information pamphlet, a public meeting or drop in session, submissions from the public, consideration by Community Board/s and Council, before proceeding with a project. **Consumer Satisfaction Survey:** Every three years WDC releases a Customer Satisfaction Survey for residents to provide feedback on Council services and facilities. Questions related to water include: taste, odour, pressure or flow, continuity of supply and Council's response to any of the above. The conclusion from the most recent survey found our public water services are managed at an appropriate service level. WDC has a target of less than 5 complaints per 1000 connections (TRIM 200313034937 & 201027143087).	**U&R Updates:** Updates are provided to the wider council departments and elected members, to provide information on the progress of a project. **Project Information Notices:** These are sent out to residents where construction works are taking place at or near their property. They will include details of the project, and who to contact with any questions or concerns. **Website and Social Media:** The Council's website and social media pages are used to keep residents up to date with a given project, or update on any issues that may arise during construction (traffic impacts etc.).	**Text / Email Alert System:** There is a text / email alert system which can communicate with all residents using their details registered on a given scheme in a very short amount of time. This historically has been used for issuing and lifting boil water notices, and could be used in the event of a water shortage or other significant operational issue in the future. **Critical Customers**: Critical customers (as noted in Table 1.6 and any dialysis patients may be directly contacted directly in an emergency or event, depending on the level. This may be done by 3 Waters staff, or assistance may be requested. **Website and Social Media:** The Council's website and social media channels are utilised during emergency events, where information is required to be sent to a large ground in a short space of time. **Other:** Other communication methods that may be utilised during an emergency including letter drops or VMS boards, as appropriate. Appendix 7A contains a list of emergency contacts.

2. Assessment of the Drinking-Water Supply System

2.1. Water supply system description and analysis

2.1.1. Flow diagram of the water supply system

A flow diagram of the Garrymere water supply has been produced in schematic format to provide an overview of the system, see Appendix 2A. The diagram is a summary of all the water supply elements from catchment to consumer. Included on the schematic are the process control links, and status of the four types of potential barriers to contamination.

2.1.2. Description and analysis of each element of the drinking-water supply system

Catchment Characteristics

Zoning and Activities

The Garrymere system is named after the road it resides on in a small rural area named Okuku in North Canterbury. The main activities within the catchment include residential housing, lifestyle properties and farming. Garrymere is zoned as a rural area in the Waimakariri District Plan, see Council's District Plan. Section 14 of the District Plan outlines the characteristics of a Waimakariri Rural Zone. Farming and lifestyle block activities are the most prominent activity on the land from the past, and will continue to be in the current and future time frames. There is potential for future land development in the area.

The Garrymere well is located 500 m north from the Ashley River and 715 m east from the Garry River, on the river terrace 30 m from the headworks. The area of the community drinking-water protection zone is 425 ha.

Groundwater

According to Brown (2001), being slightly north of the Ashley River Garrymere is within the Ashley Downs groundwater group. This area has more tectonic uplift than the area south of the Ashley River. Wells within this area penetrate the aquifer-aquiclude sequence of the Christchurch artesian system. The Ashley River is a main recharge source for shallow gravel aquifers.

The aquifers fed by the Ashley River are most at risk during summer as this is when the River experiences low flow. There is potential aquifer stress for wells further north than Garrymere due to the distance from river recharge (Brown, 2001). The Kowai River is the upper boundary for the Ashley Downs which has a smaller recharge potential due to its smaller catchment size. As Garrymere is close to the Ashley River it is less at risk of experiencing aquifer stress compared to wells that are further north and closer to the Kowai River.

Although there is reasonable understanding of the catchment, the recharge area for the water source requires further analysis to better understand how WDC can manage risks to the supply, and to meet future requirements via the Water Services Bill relating to Source Water Risk Management Plans. This is proposed as an improvement item for all WDC Water Safety Plans.

IMPROVEMENT RAI1: Develop source water risk management plan for primary sources for each supply

Geological

According to Barrell & Begg (2013) the Garrymere supply is located near where the Ashley Fault is likely to be, as shown in Appendix 2B. This was confirmed by the Canterbury Maps data layer which indicates there is definite and likely ground disturbance nearby if the Ashley Fault were to rupture, see Figure 2.1. The fault lines indicated have a minimum return period of 5000 years, and a maximum return period of 15,000 years, so while impacts may be significant, the likelihood is very low based on the return period.

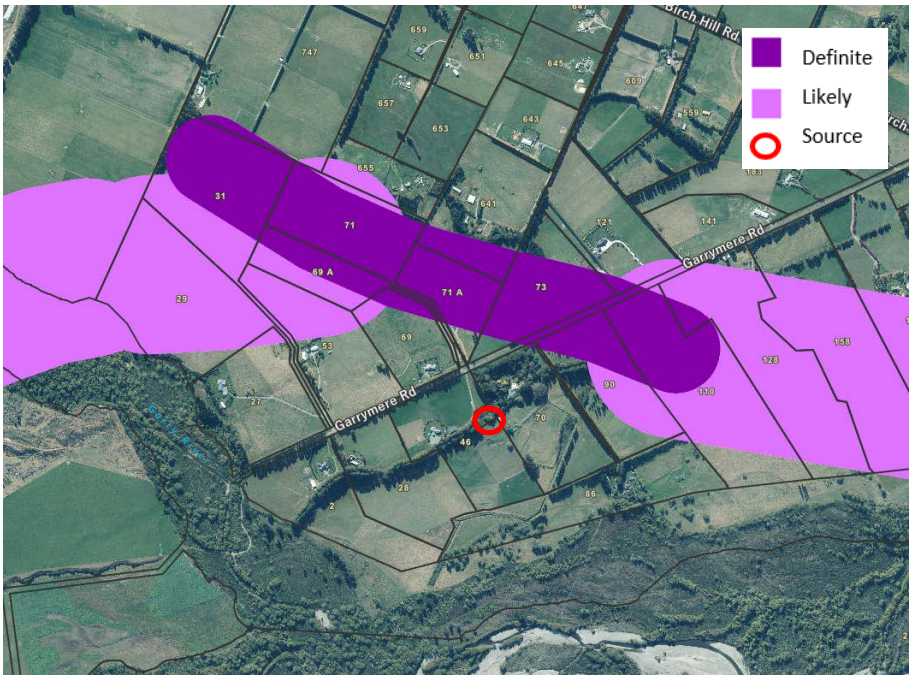

Figure 2.1: Ashley Fault location (Canterbury Maps, 2019)

Community Drinking-Water Protection Zone (CDWPZ)

The Garrymere CDWPZ available on the Canterbury Maps database has been considered for this WSP catchment analysis. Non-point source activities located within the CDWPZ have been identified from consents, aerial photographs confirmed by site investigations and by collating and verifying anecdotal information.

The following information has been found within the CDWPZ for the Garrymere well:

- ECan discharge consents for septic tank effluent to land/ground.
- ECan water consent to take and use water.
- ECan land consent to remove vegetation, undertake erosion/flood control works, plant vegetation and channel realignments.
- ECan land consent to extract gravel from the Ashley River.
- Open stormwater channels and pond (see Figure 2.2).

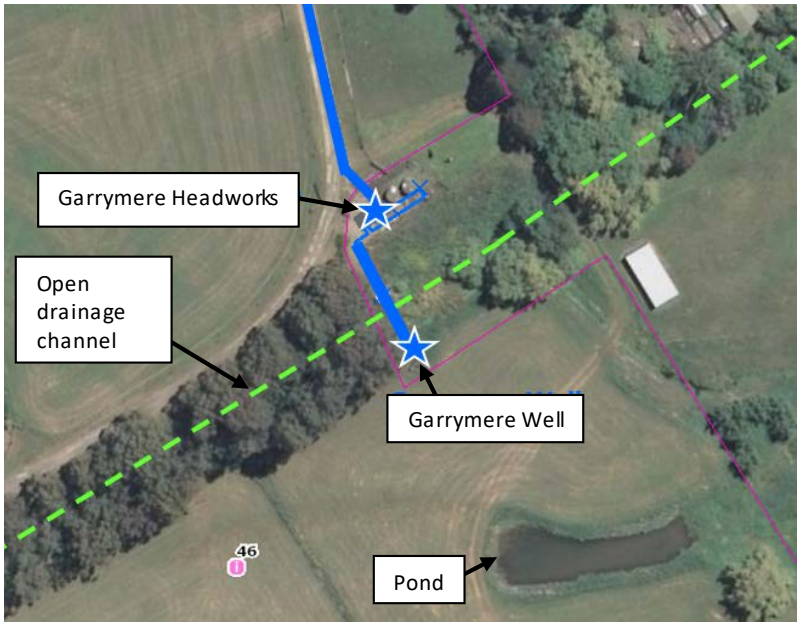

Figure 2.2: Open stormwater channels and pond near the well

The locations of the active resource consents and private wells/bores are indicated in Appendix 2C. Some private bores/wells were not indicated on the active ECan resource consents, but were present in the ECan in-active resource consent shapefiles on Canterbury Maps.

The following are not within the CDWPZ however were considered as part of the risk analysis:

- Unmapped septic tanks (e.g. Septic tanks with permitted activity status)
- Bores within the same aquifer as the source wells that may lead to 'short circuiting'.
- HAIL sites:
  - Livestock dip or spray race operations
  - Waste disposal to land
  - Storage tanks or drums for fuel, chemicals or liquid waste

Refer to Appendix 2C for a location of the well & protection zone. A summary of potential types of contamination as a result of activities in the community drinking-water protection zone/recharge area are shown in Table 2.1.

Table 2.1: Contamination sources in catchment and associated contaminants (MoH, 2019a)

Contaminant Source	Types of Contaminant	Potentially Relevant to Scheme
Agriculture and horticulture	• Sediments • Nutrients • Pesticides and other toxic chemicals and metals. • Faecal microbiological contaminants	Yes
Urbanisation, infrastructure and development	• Faecal microbiological contaminants from septic tanks • Sediments • Toxic chemicals and metals	No
Recreation	• Oils and fuel	No

Contaminant Source	Types of Contaminant	Potentially Relevant to Scheme
	• Toxic chemicals	
Industry	• Nutrients • Toxic chemicals and metals • Oils	No

Algal Bloom

ECan and WDC work together to monitor the risk of algal bloom in the Ashley River.

Monitoring of the Ashley River was specifically undertaken during the summers of 2006/07. Algal mats containing elevated levels of anatoxins were found in the Ashley River as far upstream as Ashley Gorge. The algal mats were tested, not the flowing water surrounding the algal mats. That is, the sample procedure involved collecting a sample of the algal mat, which was then broken down in the laboratory and the anatoxin levels measured. The levels were higher in the lower reaches of the Ashley River, with the Homoanatoxin-a level being up to 750 times higher than the MAV specified in the DWSNZ.

Following the detection of the algal mats in the Ashley by ECan, WDC staff initiated a sampling procedure for all supplies drawing water from the Ashley River, which included the Garrymere water supply. The sampling procedure involved taking samples from the flowing water in the Ashley River at the point closest to the abstraction point. Samples were also taken from one of the Garrymere post treatment reservoirs. The samples were all below the detection limit of 0.6 mg/L.

It was concluded that the likelihood of anatoxins entering the water supply is very low for the following reasons:

1. The levels of anatoxins in the flowing water were found to be below detection levels, despite the presence of algal mats in the river.
2. The abstraction point draws groundwater adjacent to the Ashley River, and not directly from the flowing water, which will prevent any algal mats from flowing into the well source.

Recent sampling taken from the raw water for microcystin and anatoxins at Garrymere had results that were below detectable levels, see Figure 2.3. Therefore, routine sampling for anatoxins is not deemed to be necessary.

Sample Details

Laboratory ID:	V61671-2	**Sample Type:**	Water	**Date Sampled:**	19/03/2020 12:25
Description:	Garrymere Raw			**Date Received:**	20/03/2020 07:20
Customer ID:	DW20152				

Analysis	Result	Units	Method
Microcystin LR	<0.030	µg/L	In-house by LCMS
Microcystin RR	<0.015	µg/L	In-house by LCMS
Microcystin YR	<0.030	µg/L	In-house by LCMS
Nodularin	<0.015	µg/L	In-house by LCMS
Other Microcystins	Absent	-	In-house by LCMS
Anatoxin-a	<0.20	µg/L	In-house by LCMS
Cylindrospermopsin	<0.20	µg/L	In-house by LCMS
Deoxycylindrospermopsin	<0.20	µg/L	In-house by LCMS
Homo-Anatoxin-a	<0.20	µg/L	In-house by LCMS

Figure 2.3: 2020 microcystin test results (TRIM reference 200403042725)

The Canterbury District Health Board (CDHB) notify the Council's Environmental Services Team and the Water Asset Manager Inbox (water.asset@wmk.govt.nz) if there is information regarding potential algal blooms in the Ashley River. Monitoring communications from ECan is a Level 1 response to cyanobacteria contamination, and the higher levels of the Incident Response Plan will be followed if required, see Component 7 (Management of incidents and emergencies) for more information.

Nitrate

There is growing awareness regarding the presence of nitrate in groundwater within the Canterbury region. Nitrate levels are checked as part of the annual chemical test for the scheme. In the most recent chemical test on the scheme (2020, TRIM reference 201117154955) nitrate levels were measured at 0.19 mg/L. While they are currently significantly less than the Maximum Acceptable Value (MAV) of 11.3 mg/L, they are generally expected to increase over time. Figure 2.4 shows the nitrate concentrations from raw bore water full chemical tests carried out since 2016.

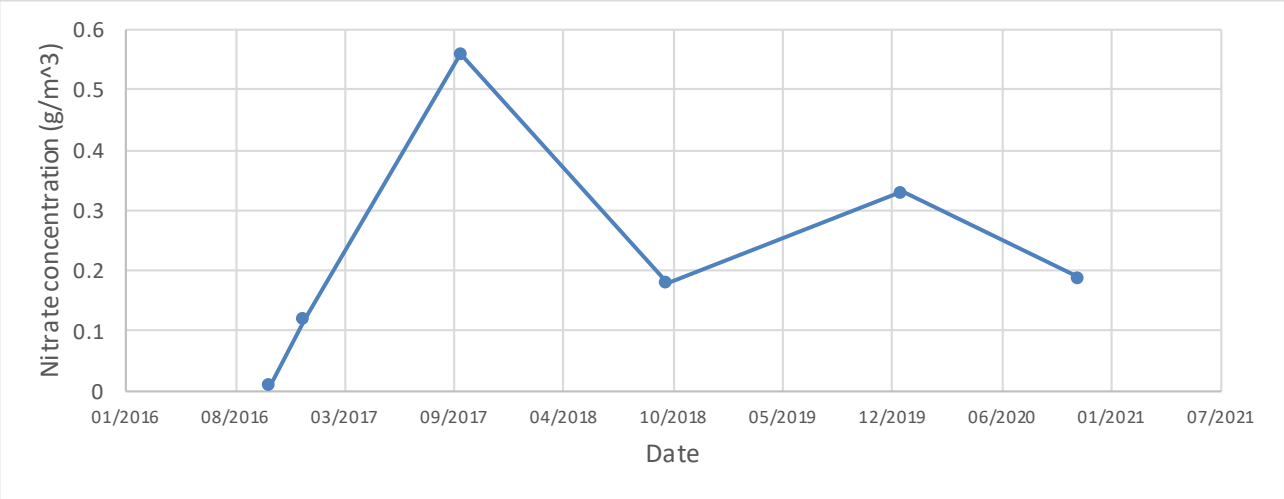

Figure 2.4: Nitrate concentration trend at Garrymere

Nitrogen concentrations are monitored regularly by Council. The ways that Council is monitoring and managing this generally includes the following:

- The issue of nitrates in groundwater has been raised at the Canterbury Drinking-Water Reference Group (CDWRG) which is a group made up of the territorial authorities in Canterbury, the Canterbury Regional Council and Canterbury District Health Board where matters relating to public drinking-water supplies are discussed to ensure all parties work together for the protection of public health.
- The results of modelling works undertaken by Environment Canterbury to predict future nitrate levels have been presented to Council staff. Council staff will continue to work directly with Environment Canterbury to understand the outputs of this work, and to provide any additional input to Environment Canterbury to assist with refinement of modelling in the future.
- Council staff are working closely with the Waimakariri Water Zone Committee (joint committee of Waimakariri District Council and Environment Canterbury), which provides recommendations to Environment Canterbury on the proposed Waimakariri sub-regional chapter in the Land and Water Regional Plan, in particular regarding setting of nutrient limits within the zone. Potential impacts on drinking-water are considered by the Committee when considering and understanding these nutrient limits. This has led to proposed Plan Change 7, which sets out how practices will be managed across the zone. It is noted that this applies only to supplies between the Ashley and Waimakariri Rivers, so does not include Garrymere.
- All Council's primary wells are now annually tested for all key chemical parameters (including nitrate) to gain further confidence that unexpected changes are not occurring.

Radiological

The Drinking-water Standards for New Zealand require that given radiological determinands are monitored. The minimum sampling frequency for Garrymere is 10 years, with it being a bore water supply. The source water was last tested for Radiological determinands in 2018, with the results below:

Table 2.2: Radiological Determinands (TRIM 181212146649).

Parameter	Maximum Acceptable Value (Bq/L)	Result (Bq/L)	Conclusion
Radon-222	100	10.5	Result approx. 10% of MAV
Total alpha concentration	0.10	< 0.031	Result below detection limit
Total beta concentration	0.50	< 0.15	Result below detection limit

Based on the above results, the risk of radiological contamination of the source water is considered to be low. This risk can be considered in more detail as part of the Source Water Risk Management Plan Improvement project (Improvement RAI1), to improve this understanding further.

Climatic Features

The Garrymere well is located 27 km away from the coast and approximately 130 m above mean sea level (according to LiDAR). Hence, it is unlikely coastal changes due to climate change will present a risk to this supply.

The Council has undertaken flood modelling up to a one in five hundred year event based on a rainfall event, as well as an Ashley River breakout. A combination of the results for both scenarios was plotted in the Council's GIS system, and is shown in Figure 2.5. This demonstrates that the well is not within the flood plains of these extreme scenarios.

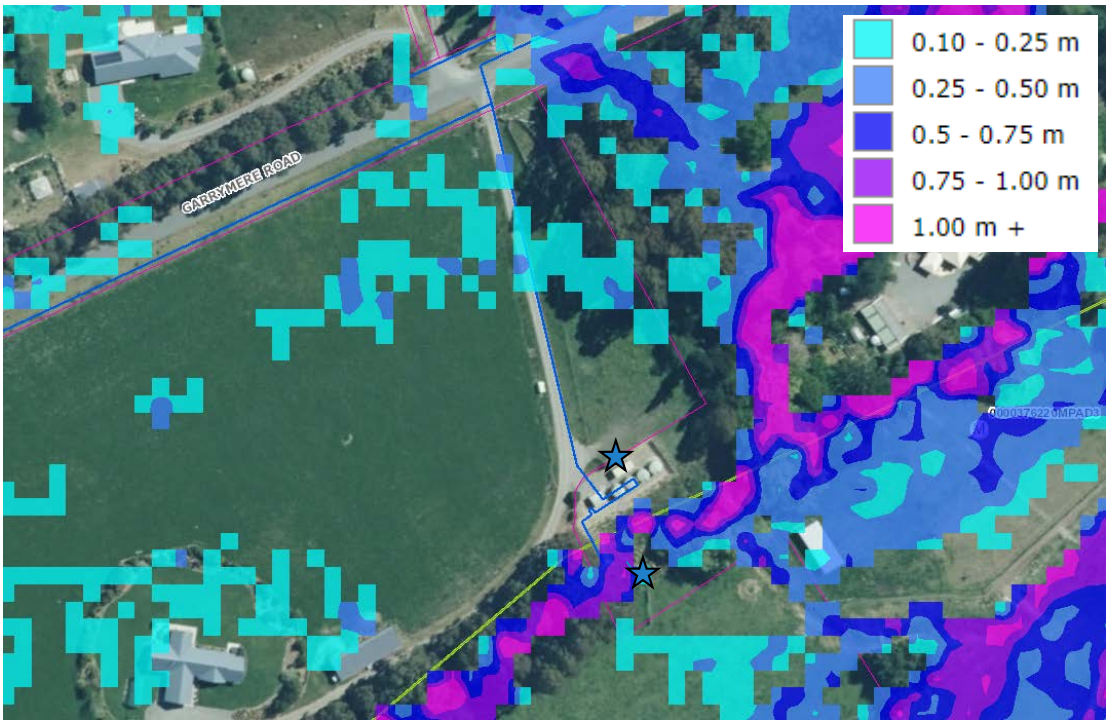

Figure 2.5: Flood Modelling for Garrymere Well (coloured squares indicate flood hazard zones)

Nearby Wells

An investigation was undertaken regarding wells in the area, within 400 m radius of the Garrymere well and 3 km upstream based on groundwater contours published by Environment Canterbury. This included both in service and decommissioned wells, to better understand their potential to influence on the Garrymere well. All non WDC wells (active and inactive) from the ECan Database are illustrated on Figure 2.6, and are at depths from 7.6 m to 65.8 m (respective to their recorded elevation).

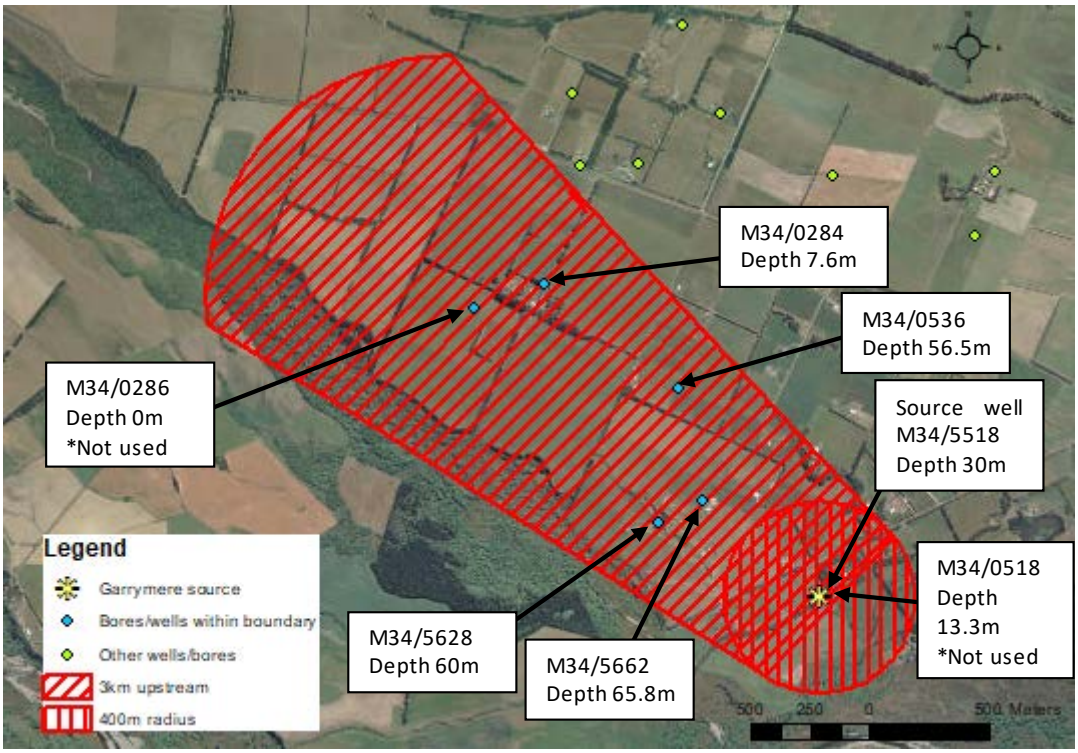

Figure 2.6: All wells 400m radius of Supply Well and 3 km upstream of M34/5518

Most wells are significantly deeper and screened at deeper depths than the Garrymere Well (M34/5518). The following comments can be made about two wells where further consideration was given:

- Well M34/5628 is at a screened at a depth (middle screen depth 28 m – 30 m) which suggests that there are potential links to the same aquifer. The water from this well is used for watering the property owner's garden. There is no backflow prevention device on this well, however is it considered to have a low contamination risk to the community supply based on the use of the well, and the separation distance between the well and the Council supply bore.
- Well M34/0518 was abandoned at the time of drilling as it did not achieve a suitable yield, and as such M34/5518 was drilled instead which is the source well for the scheme. No evidence can be found on site of M34/0518. While not noted on the bore card, normal practice would have been for the well to have been capped as part of abandoning the drilling.

ECan monitoring wells in the wider area were investigated. There were none available to provide additional water quality data, other than one for surface water which was monitored between 2014-2016. This data has not directly informed this plan, as WDC have more recent and relevant data from the Garrymere well.

Source

The primary source for the Garrymere water supply is a single shallow groundwater well (G00369, M34/5518). It is a non-secure source so cartridge filtration, UV disinfection, chlorine disinfection and pH correction treatment has been implemented to meet the requirements of the DWSNZ under Section 10 (Small Water Supply Schemes). There is no backup source available currently.

63mm diameter polyethylene (PE) pipework links the well head to a raw water tank at the headworks site. During the headworks upgrades in 2020, a flushing point has been provided on the upstand to the raw water tank. This is to allow for operational processes such as flushing should they be required (e.g. during times of continuous high turbidity).

The well has an exclusion zone around it, to prevent livestock from entering the immediate area of the well head. This is locked, accessible only to Council staff.

Table 2.3 summarises key data relating to the Garrymere Well.

Table 2.3: Garrymere Well Summary Information

Component		Detail
Source	Well name	Garrymere Well
	Unique DW-Online identification code	G00369
	Type	Well
	Approximate percentage of supply	100%
	Water quality issues	Non-secure shallow source
Source infrastructure	Well pump make / model / age	Lowara 16GS22 single phase submersible pump installed 2020
	Pump capacity	3.9 L/s
	Pump installation details	13.5 m
	Location	70 Garrymere Road, Okuku 7474
	ECan well number	M34/5518
	ECan consent number	CRC971822
	ECan consent expiry	20 April 2032
	Well depth	30 m
	Well diameter	150 mm
	Well drilled date	17 April 1991
	Initial water level	2.07 m below MP
	Screen 1	
	Top of screen	2.5 m BGL
	Bottom of screen	5.5 m BGL
	Screen 2	
	Top of screen	8.5 m BGL
	Bottom of screen	9.0 m BGL
	Screen 3	
	Top of screen	16.3 m BGL
	Bottom of screen	16.8 m BGL
	Screen 4	
	Top of screen	25.0 m BGL
	Bottom of screen	26.0 m BGL
	Screen 5	
	Top of screen	27.9 m BGL
	Bottom of screen	28 m BGL
	Original pump test yield	6.0 L/s
	Original pump test drawdown	0.13 m
	Specific capacity	46.15 L/s/m
	Driller	Clemence Drilling Ltd

Note: Environment Canterbury bore log only shows two screens however previous Council documents show more screens as above.

Treatment

The Garrymere Headworks (TP00593) is the primary headworks for the Garrymere water supply scheme. There is no backup headworks for this supply. The headworks is located approximately 30 m to the northwest of the well head.

The following section discusses the treatment and processes in place at the Garrymere Headworks and should be read in conjunction with the flow diagram in Appendix 2A.

It is noted that this section forms part of outlining how the requirements of Section 10.2 of the DWSNZ are met, in order for the supply to gain protozoal compliance with the DWSNZ.

Treatment Processes Summary

As the Garrymere supply is from a non-secure well it requires a protozoal removal of 4 log credits, according to DWSNZ Section 10, Table 10.1 and an assessment carried out by WSP (previously WSP Opus) (TRIM reference 171026115522).

Compliance with this has been achieved through the use of cartridge filtration (which meets the requirements of Table 10.1 of the DWSNZ of being a rigid cartridge with downstream filter pore size no greater than 5 micron prior to the UV reactor) followed by öNORM certified and validated UV disinfection unit (see Appendix 2D for certification documents). The filtration configuration has been designed to incorporate potential future requirements of Section 5.12 of the DWSNZ in the event that Section 10 is amended.

The CUNO cartridge filters have been extensively tested by the NZ supplier and comply with DWSNZ, see Appendix 2D. The CUNO filters are an approved product for municipal water treatment under both Section 10 and Section 5.12 of the DWSNZ. Certification has been provided in accordance for 5.12.1 of the DWSNZ showing the filters capable of providing 2 Log removal of protozoa. The treatment pumps run close to continuously to maintain stable reservoir levels with minimum stops, and when the start-up, they ramp up gradually on variable speed drives to minimise risk of 'blowing out' of a filter. Further, as cartridges are replaced, operational processes include running the system to waste for 5 minutes before bringing online. Continous monitoring of differential pressure across filters, and downstream turbidity ensure the compliance of the system can be proven.

Table 2.4 summarises the key treatment processes for the scheme.

Table 2.4: Treatment types and target values for the scheme.

Treatment Process	Type	Capacity	Protozoal Log Credit Achieved	Design Values *
Chlorine (sodium hypochlorite)	CHEM-AD VPP-E peristaltic pump with 150mL/hr capacity kit	200 L	< 0.25 for crypto (DWSNZ)	0.5 mg/L
pH correction (soda ash)	Grundfos DDA 7.5-16	400 L	NA	7
UV Disinfection	Wedeco spektron 30E disinfection unit (2020)	Maximum flow rate: 13.6 L/s @ UVT of 84.7% (T_{10})	3 (DWSNZ section 5.16.2)	UV dose rate greater than target dose for given flow and UVT UVT >85% Turbidity < 1 NTU 95% of the time
Cartridge filtration (two filters in series)	CUNO high flow 1HF40H housings (5 micron followed by 1 micron filters)**	Maximum flow rate: 22 L/s	Certified to provide 2-log.	Pressure < 240 kPa during normal operation, and no more than 340 kPa for no more than 3 minutes. Turbidity < 1 NTU 95% of the time
Total			Combined system of UV disinfection plus cartridge filtration is credited 4 log (DWSNZ Section 10 Table 10.1)	

*Note: Operators should be cautious when using these values. CCP values displayed at the headworks site shall take precedence. The target values shown are the values set at the time that this WSP was written.
** While Section 10 of the DWSNZ allows no greater than 5 micron as the downstream filter, this plant operates a 5 micron followed by a 1 micron at all times.

The above confirms that the requirements of Table 10.1 in the DWSNZ in terms of the minimum treatment requirements, through the use of the cartridge filtration followed by UV disinfection. The chlorine treatment is not required under Section 10, and provides an additional barrier to bacterial contamination to both source and reticulation contamination over and above the minimum requirements.

Monitoring of Treatment Systems for Protozoal Compliance

The full operational procedures for all elements of the scheme are outlined in Component 4 (Operational Procedures). The full list of monitoring systems for protozoal compliance are outlined in Component 5 (Verification Monitoring Programme).

Treatment Plant Process Description

The Garrymere plant's unique Drinking Water Online (DWO) identification code is TP00593.

Water is drawn from the Garrymere Well via a well pump and conveyed via small diameter pipework to a 30 m^3 raw water storage tank at the headworks compound. Water is then drawn from the raw water tank

and conveyed, via the treatment pumps, through two cartridge filtration units (5 micron, then 1 micron in series), a UV Unit, and subsequently dosed with chlorine and soda ash (pH correction) before discharging to three 30 m^3 storage tanks (which are connected in series).

Two 2.2 kW reticulation pumps, operating in duty assist configuration, draw water from the treated water tanks and convey it into the reticulation network. The key way in which the site is programmed to run to deliver water from the well out to the distribution system is outlined below:

- The well pump is called to run by a level sensor in the raw water tank.
- The treatment pump speed adjusts to try to maintain a constant level in the treated water tanks. They are on variable speed drives so that they can vary their flow, minimising the number of starts and stops in the system. In summer months the system runs entirely constantly, and in winter months (during low demand times) there are a small number of times the plant is required to shut down when the treated water pumps are at their minimum speed, and the treated water tanks hit their max water level.
- Prior to the treatment pumps being allowed to run, they will wait for a signal from the UV unit that it is warmed up and ready to treat water. As they are called to re-start, they will ramp up gradually to prevent any surges against the filters.
- As water is flowing, the system is monitoring headloss across each filter to ensure this is within allowable limits, turbidity downstream of the filters to ensure this is within allowable limits for the UV system, and UV dose achieved to ensure this is within its allowable limit. If any of these parameters are not able to be achieved, the plant will shut down and send an alert. There are also some early warning alerts programmed in.
- The chlorination system gets a signal that water is flowing and being treated, and doses chlorine to achieve its target set-point. The analyser downstream of this (but prior to the treated water tanks) checks the chlorine level, and informs the dose pump to adjust its dose rate to ensure its target is maintained.
- pH dosing is undertaken according to flow rate.
- The level sensor in the treated water tanks is informing the treated water pumps what speed to run at to maintain a constant level.
- The reticulation pumps are set to maintain a target pressure leaving the water headworks.
- There is a pressure sensor and chlorine analyser signal monitoring the pressure and chlorine residual leaving the treatment plant, both of which will alarm if either parameter is outside its target range.

Equipment

A list of all key treatment equipment relevant to the Garrymere Headworks are displayed in Table 2.5.

Table 2.5: List of equipment avaliable at the Headworks.

Equipment	Quantity	Notes	Function
Submersible Pump	1	Lowara 16GS22 single phase submersible c/w stainless steel shroud with 2.2 kW motor. Installed in 2020.	Pumps water from well into raw water tank.
Garrymere Raw Water Storage Tank	1	30 m^3 polyethylene tank	Provides a buffer to treatment and allows treatment systems to run continuously, to limit UV start/stop and match the flow leaving the headworks.
Garrymere Treated Water Storage Tanks	3	30 m^3 polyethylene tanks	Store treated water and provide at least 30 minutes of contact time for chlorine treatment.

Equipment	Quantity	Notes	Function
			Designed to work in series, but can be run independently if required. Able to be flushed if required.
Treatment Pumps	2	Duty assist variable speed pump set (Grundfos HYDRO MPC-E 2 CRIE15-3 4kW motor). Installed 2020.	Pump water from raw storage tank through the treatment system.
Reticulation Pumps	2	1 Grundfos CR8-60 with a 2.2 kW single phase motor, installed in 1992. 1 Grundfos CR10-6 with 2.2 kW motor installed in 2011.	In a duty assist configuration with the duty position rotated monthly. Both pumps are fitted with non-return valves on the pump discharge manifold. Pumps water from the Garrymere Headworks Treated Water Storage Tanks to the distribution.
Pressure Vessel	1	300 L	There is a 300 L pressure vessel immediately downstream of the reticulation pumps to accommodate low flow conditions outside of the range of the surface pumps.
Chlorine Dosing Pump	1	Grundfos DDA 7.5-16	To dose water with chlorine prior to treated water tanks. One 20 L sodium hypochlorite container is required for approximately one week as a minimum to top up the 200L tank. This demand increases during peak demand periods. 15% delivered neat, diluted on site to 7%. Chlorine analysers are located before and after the treatment tanks to measure for high & low residual chlorine levels.
Chlorine Analyser	2	Evoqua MFC with Deplox 5 sample cell card and PID control for chlorine and pH with flow proportional dosing and set point trim.	
Bulk Chlorine Tank	1	200 L bulk storage tank of sodium hypochlorite	
pH corrector Dosing Pump	1	Grundfos DDA 7.5-16	Flow paced duty pump configuration. Two 25 kg bags of soda ash are added to the separate 500 L mixing tank and the tank is filled with water. The solution is left to mix for approximately 24 hours with the aid of an automatic mixer. The operator returns to site after the mixing period and operates the transfer pump to move the solution into the 400 L bulk storage tank; 100 L are left in the mixing tank as there may be some residues that will not suit the dosing pump. The bulk soda ash tank provides storage for approximately one week during peak demand periods. Approximately one bag of soda ash is required weekly.
pH Analyser	1	Evoqua MFC with Deplox 5 sample cell card and PID control for chlorine and pH (the same as the one stated for chlorine)	
Bulk pH Corrector Tank	1	400 L bulk storage tank of soda ash	
Cartridge filtration	2	CUNO high flow 1HF40H housing with 5 and 1 micron filters (40'' long) in series	Each filter has a designated maximum operational life of three months, and will be changed regardless of the pressure differential across each filter unit once three months has elapsed. Pressure transducers upstream and downstream of each filter housing (wired back to RTU) to ensure pressure differential requirements across each filter observed.
UV disinfection	1	Wedeco Spektron 30e	10 bar rated unit that achieves compliant dosing by measuring the flow and modifies its dose to the required level.
Turbidity monitor	1	Hach 5300 Turbidity Meter	Turbidity is monitored after the cartridge filtration and before the UV disinfection.

Equipment	Quantity	Notes	Function
Generator	1	Portable 33 kVA	Portable generator available from the Water Unit in power outage event. If there is a power outage, an alarm will be generated to the duty operator.

Storage and reticulation network

The Garrymere distribution zone DWO unique identification code is GAR001GA.

The Garrymere Headworks has three treated water tanks at the Garrymere Headworks to provide sufficient storage. The treatment pump set is set to start when reservoir levels fall to 75% full and operates at variable speed based on reservoir level to induce long run times and minimise UV unit starts and stops. When the treated water tanks reach 90% full, the treatment pump set shuts down. Maintaining these levels means there is constantly an emergency supply in the order of 67.5 m^3 available. If the tank volume falls to 60% full, an alarm is sent to operators. Each treated water tank has overflow pipework with vermin and insect proof vents, which are inspected by the Water Unit as part of their requirements under the SLA.

According to SCADA data from 2018 to May 2021, the high storage alarm triggered 10 times and the low storage alarm triggered twice.

The three treated water tanks suppling the Garrymere reticulation network have a storage capacity sufficient to provide approximately 7.5 hours of emergency storage at an average daily peak flow of 3.3 L/s (2019/20 peak demand), as seen in Table 2.6.

Table 2.6: Reservoir Capacity Summary

Location	Reservoir	Capacity (m^3)	Combined Storage (hours)
70 Garrymere Road, Okuku	Garrymere Reservoir (three 30 m^3 tanks)	90	7.5

The pressure at the Garrymere Headworks is set at 500 kPa, to deliver approximately 200 kPa pressure to the connection furthest from the headworks. The set point of the reticulation pumps is monitored as part of the SCADA system following the upgrades at the headworks.

The Garrymere water supply has 42 connections and serves a population of 105 people. The supply contains a combination of 25 semi-restricted connections and 17 fully restricted connections. Semi-restricted schemes are designed to provide an on-demand water supply, but at a limited flowrate (13 L/minute per property). Fully restricted schemes provide a water supply restricted to 1.4 L/minute for a 2 unit connection. All fully restricted connections are required to provide onsite potable water storage on each dwelling lot equivalent to the minimum of 48 hours supply or 4 m^3, whatever is greater. Customers may require a pump to provide pressure from the tank to their individual water systems. Backflow prevention to the network is provided by an air gap at the top of the tanks that complies with G12/AS1 of the Building Code with an additional non-return valve within the toby box at the boundary. Upgrades have recently been completed to ensure each property has a modern toby box that can be inspected by Council staff as part of the restrictor checks programme, and also that it has a backflow preventer (this is part of the restrictor upgrades programme across all supplies with restricted connections).

The reticulation network and supply area is shown in Appendix 2Ea. The distribution sampling point at 158 Garrymere Road has a copper flamed tap to prevent any contamination during the sampling process.

Pipeline

The pipes within the Garrymere reticulation are a combination of 50 mm and 100 mm diameter PVC mains, and 63 mm OD PE mains. The majority of the pipework is considered to be modern materials, with a large amount of remaining life. Refer to Table 2.7 for the details of the pipelines materials and sizes.

Table 2.7: Water Supply pipe length (m) by diameter and pipe materials (TRIM reference 161116117714)

Pipe material	Pipe Diameter (mm)			
	< 50 (m)	50 (m)	100 (m)	Total (m)
Asbestos cement	0	0	0	0
PE	0	611	0	611
PVC	0	4,150	35	4,185
Steel	0	0	0	0
Other	0	0	0	0
Total	**0**	**4,761**	**35**	**4,796**

The asset condition for the Garrymere water supply reticulation is assessed based on theoretical remaining useful life, derived from component age and adopted useful life. Figure 2.7 below illustrates the asset condition for the water supply. This information was sourced from the 2021 Activity Management Plan for the supply.

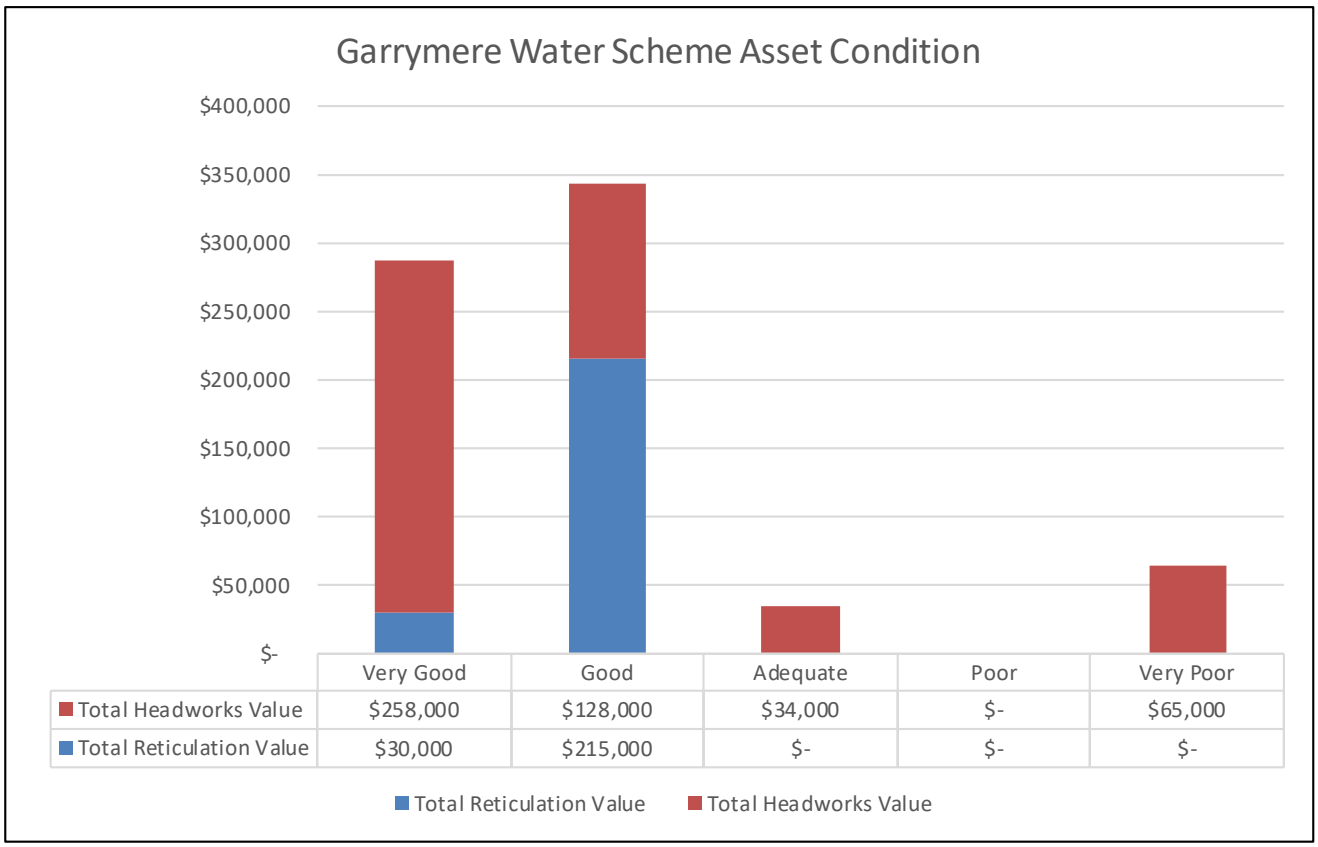

Figure 2.7: Assessed asset condition of the water supply assets 2021 (TRIM 200120006317)

As demonstrated above in Figure 2.7, the vast majority of assets have a large amount of remaining useful life. The water scheme's pipeline condition is illustrated in Figure 2.8 and the specific details relating to this graph are shown in Figure 2.9.

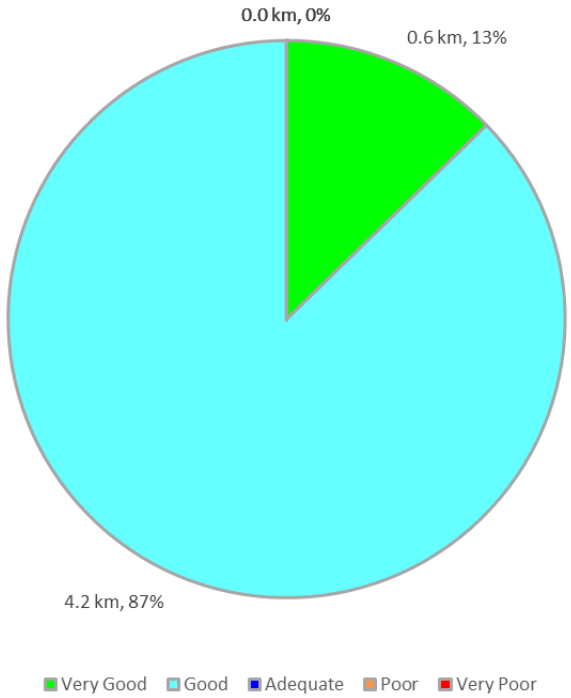

Figure 2.8: Water scheme pipeline condition 2020

Garrymere Water Scheme										
Condition Grade	**Definition**		**Pipeline Quantity**		**Total Reticulation Value**		**Total Headworks Value**		**Total Value**	
1	Very Good	*More than 80% of life remaining*	0.6 km	*13%*	$ 25,000	*12%*	$ 15,000	*6%*	$ 40,000	*9%*
2	Good	*Between 50% and 80% of life remaining*	4.2 km	*87%*	$ 187,000	*88%*	$ 132,000	*54%*	$ 319,000	*70%*
3	Adequate	*Between 20% and 50% of life remaining*	0.0 km	*0%*	$ -	*0%*	$ 34,000	*14%*	$ 34,000	*7%*
4	Poor	*Between 10% and 20% of life remaining*	0.0 km	*0%*	$ -	*0%*	$ -	*0%*	$ -	*0%*
5	Very Poor	*Less than 10% of life remaining*	0.0 km	*0%*	$ -	*0%*	$ 63,000	*26%*	$ 63,000	*14%*
Total			**4.8 km**		**$ 212,000**		**$ 244,000**		**$ 456,000**	

Figure 2.9: Condition grading of the water scheme

These show the water supply has entirely "Good" and "Very Good" pipeline with a life expectancy estimated to be between 50% to greater than 80%. There are no pipes classified as either "Very Poor", "Poor" or "Adequate".

Appendix 2Eb shows the locations of the different pipeline condition gradings throughout the distribution.

Criticality Based Renewals

Criticality assessments are undertaken on all pipes, and the planned renewal date calculated using a combination of theoretical life and criticality. Essentially, highly critical pipes are replaced before the theoretical end of life, and lower criticality pipes may be left in service beyond the theoretical end of life if they are continuing to perform well (based on operational data). This ensures that the highly critical pipes are replaced proactively, before they fail, rather than only replacing them as a result of failure or bursts.

Leakage

An annual leakage report is provided to Council by the Water Asset Manager for review of the systems performance. Leakage is additionally reported in the Activity Management Plans as part of performance measure reporting and as part of the Water New Zealand National Performance Review each year.

Leakage is measured using the Infrastructure Leakage Index (ILI) from the Water Loss Guidelines Manual (2010). The ILI method assigns a leakage band to each scheme based on a range of factors. In particular it takes into account the length of pipework, operating pressure, as well as the number of connections.

The ILI is determined to be the ratio of actual leakage relative to a calculated 'Unavoidable Annual Real Losses' (UARL). Essentially accepting that there is a level of leakage that cannot be realistically avoided for a given amount of pipework, connections and pressure and therefore calculating how much actual leakage is occurring relative to this unavoidable amount.

The bands of leakage adopted by the Council are shown in Table 2.8 below:

Table 2.8: Performance measures for ILI

Band	ILI Range	Guideline Description of Real Loss Management Performance Categories for Developed Countries
A	< 2.0	Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identify cost-effective leakage management
B	2.0 – 4.0	Possibilities for further improvement; consider pressure management, better active leakage control, better maintenance
C	4.0 – 8.0	Poor leakage management, tolerable only if plentiful cheap resources; even then, analyse level and nature of leakage, intensify reduction efforts
D	> 8.0	Very inefficient use of resources, indicative of poor maintenance and system condition in general, leakage reduction programs imperative and high priority

A summary of Garrymere leakage reports from the past four years are shown in Table 2.9. The minimum night flow method is used across all supplies as an initial screening, followed by some targeted work on a scheme by scheme basis if required:

Table 2.9: Garrymere Leakage Results

Assessment	Method	Minimum Night Flows (L/s)	ILI Score	Leakage Band
2017/18 (190130010451)	High Level Night Flow Analysis	0.19	2.4	B
2018/19 (190916129250)	High Level Night Flow Analysis	0.62	8.4	D
2019/20 (200814104721)	High Level Night Flow Analysis	0.80	9.4	D
2020/21 (210827138705)	Flow Balance (following installation of meters at property boundaries).	0.60	4.5	C

As demonstrated above, the scheme performs poorly in terms of the ILI performance measure. With the scheme's ILI score currently 4.5, the leakage is in the level where there is poor leakage management, although close to the B score (which is assigned to the ILI range of 2 – 4). This is an improvement from the previous two years where the ILI score was D. This improvement in score has been achieved following the installation of flowmeters at all properties, allowing a flow balance to be conducted which is considered a more accurate means of estimating leakage versus the minimum night flow method which has been used previously.

The significant difference in scores between assessment periods demonstrates the high sensitivity of the results to the methodology used, and also highlights the over-estimation of leakage that can occur when using the minimum night flow method, particularly on restricted schemes.

While the bulk flow analysis on Garrymere has improved understanding of leakage levels on the Garrymere scheme, it has highlighted the need to improve the assessment method across restricted schemes in general.

IMPROVEMENT PPI2: Develop improved methodology for assessing leakage on restricted schemes

Supply and Demand Characteristics

The supply currently has a total of 42 restricted or semi-restricted (13 L/min) connections and an estimated population is 105. The growth projections over the next 50 years is predicted to increase 64% for connections on this supply. It was assumed that this development would occur within the existing scheme boundary via properties converting from 13 L/min connections to fully restricted connections, therefore while the number of connections is forecast to increase, the flow characteristic are not (as the total number of units allocated is assumed to remain the same). A summary of the current and future demand can be seen in Table 2.10.

Table 2.10: Demand for the Scheme as per WDC flow analysis data (TRIM reference 121108078783) and AMP (TRIM reference 200120006317).

	Current (2021)	50 Year (2071)
Total Connections	42	78
Average Demand (m^3/day)	148	141
Peak Demand (m^3/day)	289	251

The resource consent for Garrymere Well (CRC971822) permits an extraction rate of 4.5 L/s, with a volume not exceeding 389 m^3 per day. This consent expires in 2032. Table 2.11 shows the capacity of the submersible pump currently in the well. There are no restrictions in the resource consent about the extraction rate during times the Ashley River flow is low.

Table 2.11: Capacity provided by well

Well	Capacity (L/s)	Comments
Garrymere	3.9	Capacity as per well pump commissioning sheet (refer TRIM 201105149216)

Supply Management Systems

All Council owned drinking-water supplies are the responsibility of the 3 Waters Unit, with key responsibilities assigned to the 3 Waters Manager, Water Asset Manager and Water Operations Team Leader. The 3 Waters Unit engage the Water Unit to undertake the operations and maintenance of all sites. The Water Unit carry out the majority of the work themselves and any work that they do not have the resource or expertise to complete is subcontracted out to appropriate specialists in the relevant fields. Examples of specialist work that is performed by subcontractors to the Water Unit are electrical work, generator maintenance and pump servicing. The management system for the Council drinking-water supplies is displayed in Figure 2.10.

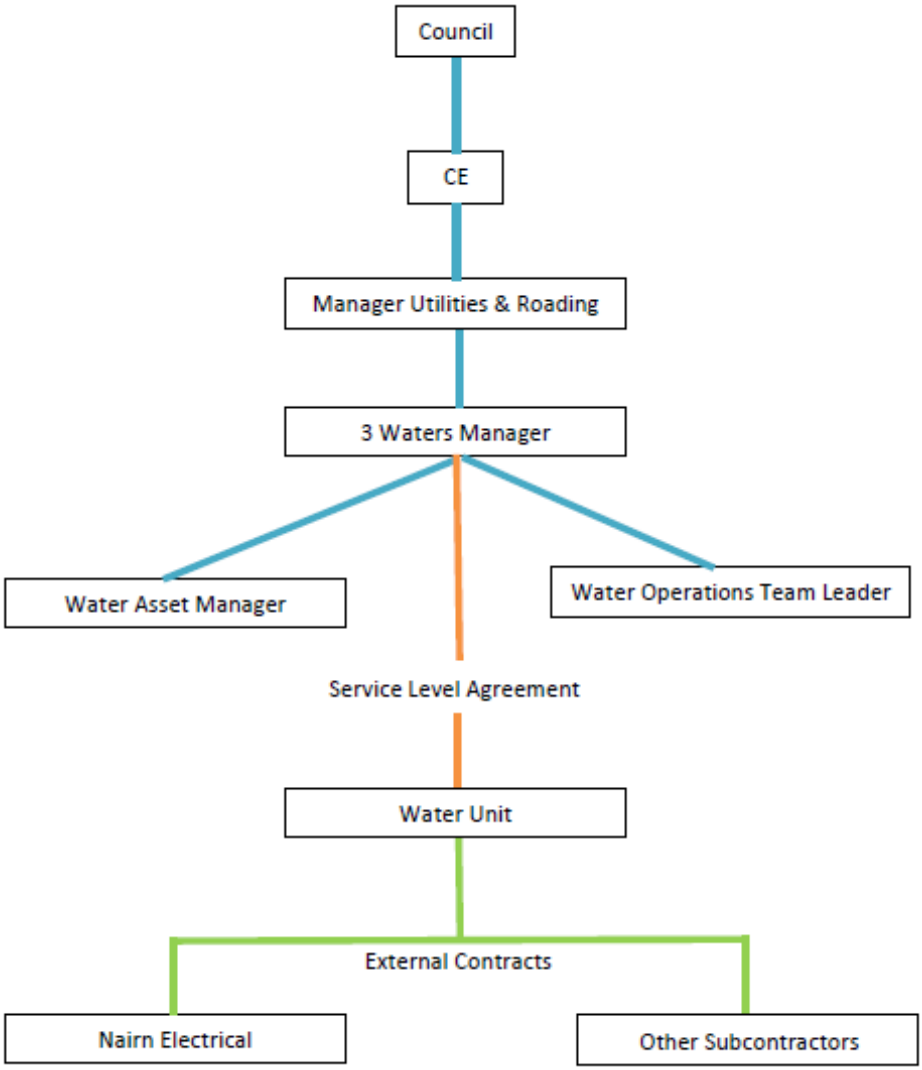

Figure 2.10: Supply management structure

2.2. Assessment of Water Quality Data

The Waimakariri District Council has four different ways to monitor the water quality of the Garrymere headworks:

- Weekly operator checks using handheld devices, and comparison to online meters;
- Sampling in accordance with DWSNZ schedule (see Appendix 5A);
- Annual full chemical analysis by an independent laboratory;
- SCADA continuous monitoring.

The different types of data collection ensure a robust and reliable set of data to understand the scheme performance, as results are able to be compared, trended, responded to, and inform future strategic or operational decision making processes.

2.2.1. Water Quality Data Summary

A summary of yearly samples from 2016 to mid-2020 is shown in Table 2.12. These results are from the samples collected and analysed at the Water Unit laboratory as per the DWSNZ schedule.

Table 2.12: E.coli and Total Coliform results 2016 - mid 2020 (TRIM 191010141657)

	MAV	Unit	Headworks Site ID: TP00593			Distribution Site ID: GAR001GA		
			No. samples	Transgressions	% of positive samples	No. samples	Transgressions	% of positive samples
E.coli	<1	MPN/100 ml	248	0	0%	73	0	0%
Total Coliforms		MPN/100 ml	248	0	0%	73	2	3%

E.coli

There have been no recordings of E.coli in the headworks or reticulation over the past five years, according to samples taken. In the event there were counts of E.coli in the headworks or reticulation, the microbiological incident response plan would be followed, see Component 7.

Total Coliform

There have been two instances where total coliforms were recorded in the distribution samples. This is only 3% of all distribution samples taken, which is minimal.

A summary of other water quality parameters measured from August 2017 to end of June 2021 taken during operator checks is displayed in Table 2.13. A comparison with GV and/or MAV values is provided.

Table 2.13: Water Quality summary from samples taken August 2017 - end June 2021 from DWO database

	GV	MAV	Unit	Source Site ID: G00369			Headworks Site ID: TP00593			Distribution Site ID: GAR001GA		
				Median	5th percentile	95th percentile	Median	5th percentile	95th percentile	Median	5th percentile	95th percentile
pH	7.0-8.5			6.85	6.40	7.28	7.18	6.81	7.57	7.15	6.63	7.6
Turbidity	2.5		NTU	0.53	0.28	7.57	0.47	0.13	1.71	0.42	0.12	4.70
FAC	0.2 - 1.0	5	mg/L	-	-	-	0.66	0.43	0.90	0.61	0.32	0.92
UVT	>85*		%	-	-	-	96.60	92.10	98.85	-	-	-

** for UVT this value is not strictly a GV but rather a design assumption when sizing the UV system*

pH

Results show at each sample point the results within the 5th percentile are below the GV values. pH correction is undertaken at the headworks, which improves the pH as demonstrated by the headworks and distribution results median and 95th percentile results. Given low pH can accumulatively cause increased deterioration, it is the median value that should be given the most weighting in considering this data, which is acceptable.

Turbidity

Turbidity results at the headworks and distribution are shown to be within the guideline range. Some raw water is above the GV, however the treatment methods at the headworks are helping with lowering these values. This is demonstrated by the equivalent headworks and distribution samples being less than what was recorded at the source. There was a significant rain event at the end of May / start of June 2021, with a close to 1 in 100 year flood level in surrounding rivers. This led to an incident in which the treated water turbidity was above target levels (refer Component 7 (Managing incidents and emergencies) for further detail). This event is not considered representative of normal operations, given the extreme nature of the flood. Further, despite turbidity being outside of design parameters, intensive sampling showed the treatment system was still capable of successfully treating the water, as there is some conservatism built into the limits within the DWSNZ.

Free available chlorine
All results show compliance with MAV, and are within the recommended range. Results in the 5th percentile within the distribution comply with the GV range.

UVT
UVT is measured as part of operator inspections and not sampled back at the Water Unit Laboratory as the other displayed results are. Results available for UVT were from 2018 – end June 2021. The analysis shows the UVT is consistently within the 90% range, which means the UV disinfection is effective. Variability within the data was minimal.

Other water quality data such as from SCADA and other operator checks is stored within online Council databases, and can be accessed for detailed analysis.

2.2.2. Full chemical analysis

Chemical testing has historically been carried out every 5 years, as per the requirements of the DWSNZ. From 2019 onwards chemical analysis has been carried out annually, to give a better understanding of any changes that may occur over time. The latest test results for the source is displayed in Appendix 2F.

WDC advertise the potable water testing requirements that are tested on each water scheme on the website, see https://www.waimakariri.govt.nz/services/water-services/water-supply/drinking-water-testing. This provides residents with readily accessible information about what chemical parameters are being monitored by their drinking-water provider.

Potential Priority 2 determinands are monitored as part of annual chemical testing and additional testing is undertaken, if required. Garrymere has no assigned Priority 2 determinands, so no additional chemical tests are currently carried out on the scheme.

In the most recent full chemical test, the saturation index (SI) did not meet its GV of -1.5-0.5. The result was -1.70. The SI is calculated using results from pH, alkalinity, conductivity and calcium hardness. It is known the pH in this area is low, so soda ash is used during the treatment process to increase the pH. The plumbosolvent risks of a low SI value are discussed below.

All other potable water parameters with an assigned GV were within their recommended limits. These include ammonia nitrogen, chloride, total coliforms, E.coli, fluoride, nitrate-N, pH, sulphate, total non-purgeable organic carbon and turbidity.

2.2.3. Comparison with Benchmarks

As the DWSNZ do not provide any guidance for benchmarking some of the parameters that have been analysed (leakage, pipe failure rates, total coliform levels), guidance has been sought from international and national data and examples to give context to the results from the Garrymere scheme. Table 2.15 summarises the Garrymere results against other benchmarked or typical values.

Table 2.14: Comparison of Garrymere Data with National and International Benchmarks and Data

	Source	Requirements / Typical Data	Garrymere Comparison
Coliforms	**American Water Works Association (AWWA) Manual of Water Supply Practices M68**	**Table 1-6: Summary of USEPA distribution system regulatory requirements and monitoring:** No more than 5% of samples positive for total coliform based on monthly samples at sites	The level of monitoring in Garrymere is similar to that specified by AWWA, and long term percentage of positive samples of 3% is less than the AWWA limit.

	Source	Requirements / Typical Data	Garrymere Comparison
	Water Quality in Distribution Systems	representative of the distribution system	
		Table 1-7 Summary of Health Canada distribution system guidelines and monitoring: For systems that serve up to 5,000 people, monitor at plant and in distribution systems 4 times per month, no consecutive samples from the same site and not more than 10% of samples should show the presence of total coliform bacteria.	The frequency of sampling in Garrymere at 3 times per quarter (monthly) is less than required by the Canadian Guidelines. The frequency of occurrence of positive total coliforms results of 3% is less than the Canadian limit.
Leakage	**DANVA 2019 Water in Figures**	**This report does not have guideline values, but includes actual reported data:** ILI ranges from 0.2 to 2.2 (page 19) Percentage leakage ranges from 2% to 27.5% (page 18) Leakage ranged from <1 m^3/km/day to 16 m^3/km/day	Garrymere's assessed ILI of 4.5 is outside of the typical range of DANVA supplies, however the percentage leakage of 19% is within the range of the DANVA supplies. Garrymere has an assessed leakage rate of 5.7 m^3/km/day, which is within the range of 1 – 16 in the DANVA supplies.
	Water NZ WaterLoss Guidelines	Refer Table 2.9 for ILI bands	Garrymere's assessed ILI of 4.5 achieves a 'C' band score, which means the scheme is assessed as having poor leakage management. This is a reduction on previous measurements however.
	Water NZ National Performance Review 2018-19	**This report presents data on participating local authorities in NZ (refer Figure 55 of the report):** 5 local authorities had a median ILI of A 18 local authorities had a median ILI of B 5 local authorities had a median ILI of C 4 local authorities had a median ILI of D Total = 32	Garrymere's assessed ILI of C puts it within the bottom 9 out of 32 when compared to the median reported value in NZ.
Pipe Failures and Age	**DANVA 2019 Water in Figures**	**This report does not have guideline values, but includes actual reported data:** The number of pipe bursts per 10 km of data ranged from 0.2 to 5.3 by scheme, with a median value of approximately 0.8.	Garrymere has not had any pipe leaks or bursts occur since service request data has been analysed from 2015/16. This gives it a pipe failure rate of 0 per km per year, which is less than results from DANVA, and gives it a BFI of 0, which

	Source	Requirements / Typical Data	Garrymere Comparison
	Water NZ WaterLoss Guidelines	**Burst Frequency Index:** This document provides a formula to calculate a 'Burst Frequency Index' (BFI). This is the number of bursts per 100km per year / 13. Well managed infrastructure has a BFI close to 1.	indicates well managed infrastructure as per the Water NZ WaterLoss Guidelines.
Pipe Age	**DANVA 2019 Water in Figures**	**This report does not have guideline values, but includes actual reported data:** The average age of pipe assets ranged from 20 to 75 years. A typical age was 30 – 40 years.	Garrymere's average pipe age of 26 years is within the younger age range compared to the DANVA data.
	Water NZ National Performance Review 2018-19	**This report presents data on participating local authorities in NZ:** Median pipe age for NZ water mains = 35 years. Range = 20 to 60 years by supplier.	Garrymere's average pipe age of 26 years is less than the median pipe age compared to the other local authorities that participated in the National Performance Review.

In general, the data above indicates that the key indicators of the performance of the Garrymere scheme are in line or performing better than most national and international examples of typical or target values.

The only measure outside of the guidelines or benchmark values referenced above is the leakage, although as it discussed under 'Leakage' in Section 2.1.2. There is some uncertainty in leakage estimates on restricted schemes. While improvements have been made on gaining better data for Garrymere (resulting in a reduction in the assessed score), further analysis is required as there has been just one round of flowmeter reading so far. There is a district wide improvement project to work on improved strategies for assessing leakage on restricted schemes, which includes Garrymere.

Correlations between Benchmarked Values and Water Quality Outcomes

In understanding the reliance that can be placed on the targets or typical values assessed above, the number of water quality incidents reported within these jurisdictions has also been assessed, where data was able to be sourced. The logic is that if a number of water authorities have a certain rate of leakage, pipe age, pipe failure, coliform and/or E. coli levels, and if there is a quantified number of water quality or contamination incidents, this can help inform the likelihood of such an event occurring on the Garrymere scheme, provided the Garrymere scheme has benchmark values within the same range as those schemes being compared to.

The results will not be precise enough to directly correlate a certain leakage level for example with a certain expected frequency of contamination events, but it is intended to demonstrate that for schemes generally operating within a certain range of parameters, a certain range of frequency of water quality events can be expected. This will therefore not assign a specific value of likelihood within the risk assessment, but it will help determine whether a certain assumed likelihood for an event occurring is within a realistic range, based on historical data.

The rate of water quality incidents from the schemes referenced for benchmarking are summarised below. This analysis has been completed only for the New Zealand context, as this is the most relevant.

New Zealand

Work has been completed to categorise the water quality events that were appended to the report of the Havelock North Drinking Water Inquiry: Stage 1 (May 2017) (the "HNI Stage 1 report"). This list of events was contained within Appendix 7: Table of Waterborne Outbreaks in New Zealand.

The data included within Appendix 7 of the HNI Stage 1 report was sourced from two key reports, with data from 1984 to 2013. In addition to these events, the Havelock North event itself was included in the analysis.

The events were not exclusively from public supplies, with some from ski-fields, schools, campgrounds and other similar facilities.

The data available has been categorised and summarised to better understand the causes of the events, where the contamination entered, and what types of treatment systems were normally in place, see Table 2.16.

Table 2.15: Categorisation of New Zealand Water Contamination Events from 1984 – 2013, plus the Havelock North event.

	Treatment System Normally in Place					Total	
Cause of Event	**Chlorination**	**Filter**	**Nil**	**Unknown**	**UV**	**Count**	**Percentage**
Contaminated Source	3	1	9	3	1	17	45%
Contaminated Source and Treatment Failure	3			1	1	5	13%
No Protozoal Treatment	1					1	3%
Reticulation				2		2	5%
Unknown	1		1	11		13	34%
Count	8	1	10	17	2	38	

The amount of sickness and death resulting from the events has also been summarised in Table 2.17.

Table 2.16: Median and Maximum Sickness and Death Levels from Water Contamination Events in New Zealand from 1984 to 2013, plus the Havelock North event.

	Sick	Deaths
Median	33	0
Max	5500	4

To get a broad understanding the number of supplies operating in New Zealand, the Annual Report on Drinking-water Quality 2017-18 was referred to (Ministry of Health, 2019). This noted that at that time, there were 493 registered drinking-water supplies that served populations of more than 100 people, representing 3,939,000 people.

The following key points can be made:

- There were 38 events in total over the 29 year time period (1984 to 2013).
- Of the 38 events that occurred, 23 were categorised as being on smaller private supplies (i.e. campgrounds, ski-fields etc.). The remaining 15 events were either on networked supplies or this was not clear from the data available.
- Of the 15 that were or may have been on a networked supply, they were distributed over approximately 493 supplies. This equates to the average likelihood of an event occurring within New Zealand on a networked supply and a population greater than 100 being a 1 in 2 year event across

all supplies (15 events in 29 years), or an average of a 1 in 986 year event per supply (1 in 2 year event across all supplies x 493 supplies).

- The median scale of event involved 33 people getting sick, with the Havelock North event representing the maximum scale event both in terms of sickness and death with 5,500 and 4 respectively.
- The most common causes of an event are a contaminated source (45%), or a contaminated source coinciding with a treatment failure (13%).
- The next category of cause was 'unknown' with only a small number of events attributed to either the reticulation system, or a lack of protozoal treatment.

While the above does not provide a direct correlation between measurable parameters of a water supply and a certain type of event occurring, it does assist with assigning typical likelihoods to events within the New Zealand context. It should also be noted that not every event that is minor in nature would have been referenced in the reports that were the data source for the above, as it would be reasonable to expect that there would be some sickness attributed to reasonably isolated events that did not register with health authorities or water suppliers as an event. However, it is also reasonable to assume that the types of events meeting the definition of a Major or Catastrophic event could not have gone unnoticed. Therefore, the above analysis is considered suitable to estimate the order of magnitude of frequency of Major or Catastrophic scale microbiological events for a typical water supply, but not suitable for informing the typical frequency of smaller scale localised events.

2.2.4. Protozoa

The Garrymere water supply has a non-secure source, so while sampling is not undertaken for protozoa, treatment is provided to protect against the risk that protozoa could be present. Post the completion of upgrades in June 2020, the treatment system (comprising filtration and UV Disinfection) at Garrymere headworks achieves 4 log reduction values for protozoa.

Protozoan compliance is claimed to be achieved under Section 10.2 of the DWSNZ, subject to approval of this document. This has been achieved by the following:

- Having an up to date Water Safety Plan that is being implemented (subject to approval of this document)
- Appropriate suitable protozoal treatment based on Table 10.1 from DWSNZ through the use of the new cartridge filtration units (final cartridge is a 5 micron pore size or less) and UV disinfection. It is noted that the filtration system has a 5 micron filter followed by a 1 micron (so exceeds the minimum requirements of Section 10), and has certification provided to say that is achieves 2-log protozoal removal. Refer to Appendix 2D for validation documents.
- Monitoring the performance of the treatment equipment as per "Monitoring of Treatment Systems for Protozoal Compliance" under Section 2.1.2 of the DWSNZ, and monitoring the water quality as described in Section 4.2. It is noted that the treatment equipment used is equivalent to that which would be used under Section 5.12 and 5.16 of the DWSNZ for cartridge filtration and UV disinfection respectively, and water quality monitoring is consistent with that required for bacterial and chemical compliance with the DWSNZ.
- Having remedial actions in place if and when MAVs are exceeded or treatment process controls are not being met. See Component 7 (Management of incidents and emergencies) for more information.

2.2.5. Plumbosolvency

Certain water supplies have a risk of being plumbosolvent. Plumbosolvent water is able to dissolve lead easily. Water that has low pH and alkalinity tends to be slightly corrosive and therefore plumbosolvent. However, testing for this characteristic is not an exact science.

The principal risk with plumbosolvent water is that metals from pipe fittings can be dissolved into solution and can consequently be ingested by people drinking the water. The health risks from drinking plumbosolvent water are relatively low as very small quantities are ingested and any health effects are chronic, rather than acute. Therefore many years of consumption of plumbosolvent water is required before the risk of adverse health effects are substantially increased.

Council complies with the requirements of the Drinking Water Standards for plumbosolvency by advertising twice per year advising customers to flush the first 500ml of water before taking water for drinking purposes. Adverts are District wide and do not distinguish between water supplies (TRIM Reference 200226025902).

2.2.6. Water Quality Incidents

WDC had a turbidity incident at the headworks as a result of the June 2021 storm, which required a Level 3 response as per WDC incident response plans (IRP). Consultation with the DWA resulted in a Boil Water Notice being issued as a precautionary measure, as the higher turbidity level may have resulted in treatment at the headworks being less effective. The Boil Water Notice was in place for nine days, and was lifted after turbidity levels returned to normal. Throughout the incident E.coli sampling was undertaken. All samples had 0 counts of E.coli. See TRIM 210827138990 for the Incident Response Report for this incident.

The opportunity was taken during this event to better understand the performance of the cartridge filtration and UV system when operating at turbidity greater than 2 NTU, which is the maximum allowed for within the DWSNZ. Samples taken from the source had high levels of E. coli, however samples taken downstream of the UV and filtration but upstream of the chlorination dosing point were absent of E. coli during this event, when turbidity was elevated. This is discussed further in the Incident Report, but provides reassurance that the treatment system still was capable of performing well, even during an extreme event impacting upon the water quality. The chlorine treatment downstream of this point provided a further barrier to contamination again.

2.3. Hazard, Hazardous Event Identification and Risk Assessment

2.3.1. Overview

WDC identifies hazards and evaluates risks within each water supply scheme through a risk assessment process. The process involves a team assessing hazards and risks relevant to the scheme and using qualitative descriptors to access the likelihood and consequence. The purpose of the assessment is to highlight and document risks, and define actions and responses to eliminate, reduce or manage risks with a view to improving resilience of the supply and ensuring safety of the water supply is maintained. The key steps undertaken during the assessment process are identified in Table 2.18.

Table 2.17: Risk assessment process for drinking-water safety.

Step	Process
1	Identify guidelines applicable to scheme as per Appendix 2G.
2	Present guideline in a Risk Assessment table format as per Appendix 2H.
3	Consider the type of hazard each risk poses into the five categories (protozoa, bacteria/viruses, chemical/aesthetic, radiological, and disruption to supply).
4	Define the maximum likelihood and consequence of each event using descriptors within Table 2.19 and Table 2.20, assuming no preventative measures in place. Assess the maximum risk level using the risk matrix in Table 2.22.
5	List all preventative measures in place to eliminate, reduce or minimise the risk.
6	Redefine the residual likelihood, consequence with preventative measures in place using Table 2.19 and Table 2.20. Reassess the modified risk level using the risk matrix Table 2.22
7	Consider the certainty of the analysis using the descriptors in Table 2.21.
8	Assess if the modified risk is acceptable using the acceptability matrix in Table 2.23.
9	Consider further improvements for unacceptable risks and transfer to improvement schedule.

The risk assessment process involves multiple staff members from WDC. The initial draft of the risk assessment is completed by the author of the WSP, then a workshop is held with the rest of the risk assessment team. In the workshop each risk is assessed to determine if all parties agree with the preventative measures, consequence, likelihood, and risk level assigned to each one. Attendees of the risk assessment workshop include: WSP authors, Utilities Projects Team Leader, Water Unit Technician Team Leader, Water Engineer, Water Operations Team Leader, Water Asset Manager and 3 Waters Manager. Multiple workshops are held to ensure all information is sourced and the risks are discussed thoroughly.

2.3.2. Risk Assessment Methodology

In order to undertake the risk assessment, definitions of the following were required:

- Likelihood
- Consequence
- Certainty
- Qualitative Risk Analysis Matrix
- Acceptability Definitions

Likelihood and Consequence Descriptors

Council has chosen to adjust the likelihood rating and consequence rating from the example provided in the WSP Handbook to better align with WHO risk assessment (WHO, 2009), with the aim to provide greater distinction between events of different scale, by considering the number of people affected, and the severity of the impacts in more detail.

The likelihood and consequence definitions are included in Table 2.19 and Table 2.20 broadly align with the definitions used by other councils in Canterbury with similar water supply characteristics, allowing for consistency in the assessment of risk in the region. Key modifications from the handbook guidance to better align with other approved Water Safety Plans, and achieve a more fine grained risk analysis process, thereby improving overall understanding of risk, is outlined below:

- The additional very rare likelihood has been included for events that occur less than or equal to every 20 years. As we have data dating back to this age range it was decided necessary to include in order to complete the risk assessment. This provides a distinction between events that may occur in the 5 – 20 year frequency versus some which may occur at a frequency of once every 50 years for example. Without this distinction, an event type may be 10 times less likely than another (i.e. every 50 years versus every 5 years), without any recognition or differentiation in the risk assessment.
- Distinction is made to consider population affected or potentially affected by a contamination event. This consideration of population affected is a measure of the severity of the event, as an event impacting many thousands of people is clearly more significant and should be prioritised over mitigating a risk that may impact only a small number of people. This assists with the prioritisation of risk, to ensure that for example a hazard type that may impact the entire population of a large water supply is prioritised higher (by generating a higher risk score) than a hazard type with equivalent likelihood that may only be able to impact on a sub-catchment of a small water supply.
- Distinction is made between a minor microbiological contamination event, and a major one, which is determined based on the potential amount of any pathogens that could enter the water supply. For example, minor microbiological contamination may include minor seepage through a sub millimetre crack in a reservoir roof, while major contamination would include events with the potential to include a larger concentration of pathogens to the system (i.e. dead animals in a reservoir would be an obvious example of a major contamination event, or an untreated aquifer or surface water with a direct connection to activities and contaminant sources on the surface). This is informed by the dose response relationship between concentration of pathogens, and probability and severity of infection.

The above distinctions assist in using risk assessment process as a prioritisation tool, to differentiate between different levels of risk allowing the highest risk hazard types to be clearly identified by the process and addressed with the highest level of prioritisation.

The following tables summarise the definitions assigned to likelihood, consequence, the risk matrix, and the acceptability of the final risk score.

Table 2.18: WDC descriptors of likelihood

Likelihood	Description
Almost certain	Occurs twice or more a week
Likely	Occurs twice or more per month
Possible	Occurs twice or more per year and no more than once per month
Unlikely	Occurs twice or more every five years and up to once per year
Rare	Occurs once every 5 to 20 years or occurred once within the lifetime of the supply
Very Rare	Occurs only in exceptional circumstances or less than every 20 years.

Table 2.19: WDC descriptors of consequence

Consequence	Description	
	Impact on Public Health	Impact on Operations
Catastrophic	• Major microbial contamination, possibly deaths expected, that affects >5,000 people OR	• Complete failure of systems • High level of monitoring and incident management required

Consequence	Description	
	Impact on Public Health	Impact on Operations
	• Chronic harm to people (long-term exceedance of chemical MAV) OR • Acute harm to people (short term extreme exceedance of MAV) OR • Widespread illness / declared outbreak	• Major disruption of service (over 24 hours and >50 customer complaints
Major	• Major microbial contamination, possibly deaths expected, that affects <5,000 people OR • Minor microbial contamination that affects >5,000 people OR • Chronic harm to vulnerable people (e.g. exceedance of nitrate MAV) OR • Sporadic illness	• Systems significantly compromised and abnormal operation • High level of monitoring and incident management required • Major disruption of service (8 to 24 hours and >20 customer complaints)
Moderate	• Minor microbial contamination that affects <5,000 people OR • Chronic harm to people (long-term low-level exceedance of chemical MAV) OR • Widespread exceedance of aesthetic GV	• Significant modification to normal operation but manageable • Increased monitoring • Disruption to service (4 to 8 hours and >5 customer complaints)
Minor	• Local exceedance of aesthetic GV	• Some manageable operational disruption • Short disruption of service (1 to 4 hours and ≤5 customer complaints)
Insignificant	• Isolated, single exceedance of aesthetic GV	• Little disruption to normal operations • Very short disruption of service (up to 1 hour and ≤5 customer complaints)

Certainty Descriptors

The qualitative descriptors for certainty were based on the Handbook for Preparing a Water Safety Plan (MoH, 2019b), with additional descriptions added for E.coli contamination.

Table 2.20: WDC qualitative descriptors for certainty

Certainty	Description
Certain	• There are at least five years of drinking-water quality monitoring data from the Treatment Plant and Distribution Zone available that is compliant with the requirements of the Drinking Water Standards for New Zealand (DWSNZ) 2005 (revised 2018) in terms of number of samples, days of the week used and days between samples. The data has been collated and analysed, and variability is predictable. • The hazardous event and preventive measures/processes involved are thoroughly understood.

Certainty	Description
	• There are operational measures/control points in place at the WTP that deal with the hazard (e.g. high turbidity divert settings, automatic shut-down of WTP on certain conditions).
Confident	• There are at least two years of drinking-water quality monitoring data from the Treatment Plant and Distribution Zone available that is compliant with the requirements of the Drinking Water Standards for New Zealand (DWSNZ) 2005 (revised 2018) in terms of number of samples, days of the week used and days between samples. The data has been collated and analysed, and variability is predictable. • There is a good understanding of the hazardous event and preventive measures/processes involved. • There are operational measures / control points in place at the WTP that deal with the hazard (e.g. high turbidity divert settings, automatic shut-down of WTP on certain conditions).
Reliable	• There is at least one year of drinking-water quality monitoring data from the Treatment Plant and Distribution Zone available that is compliant with the requirements of the Drinking Water Standards for New Zealand (DWSNZ) 2005 (revised 2018) in terms of number of samples, days of the week used and days between samples. The data has been collated and analysed, and variability is not predictable. • There is a good understanding of the hazardous event and preventive measures/processes involved. • There are operational measures/control points in place at the WTP that deal with the hazard (e.g. high turbidity divert settings, automatic shut-down of WTP on certain conditions).
Estimate	• There are limited monitoring data available. • There is a reasonable understanding of the hazardous event and preventive measures/process involved. • There are manual operational measures/control points in place at the WTP that deal with the hazard (e.g. high turbidity divert settings, automatic shut-down of WTP on certain conditions).
Uncertain	• There is sporadic or no monitoring data available. • The hazardous events or preventive measures/processes are not well understood. • There are no operational measures/control points in place at the WTP that deal with the hazard.

Risk Matrix

The qualitative risk analysis matrix is based on the example provided in the Handbook for Preparing a Water Safety Plan (MoH, 2019b), see Table 2.22. An additional row was added to include the Very Rare category. This additional category also will assist with differentiating in the risk prioritisation process, to differentiate in prioritisation in mitigating an event which may occur every 15 years versus every 100 years (for example).

Table 2.21: WDC qualitative risk analysis matrix for drinking-water safety assessment

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

Risk Acceptability

The acceptability matrix was mostly based the Handbook for preparing a WSP (MoH, 2019b), see Table 2.23. The acceptability for certain, confident and reliable medium risks was updated as there are some medium level risks (e.g. protozoa in distribution) where no practical additional actions can reduce the risk further, once the likelihood is reduced as much as is practicable.

Table 2.22: WDC acceptability matrix for drinking-water safety assessment

Risk level	Uncertainty	Acceptability	Management Actions
Low	Certain Confident Reliable Estimate Uncertain	Acceptable	Manage within existing processes, adopting continuous improvement. Further improvements still should be considered on a case by case basis to lower risk level further if warranted.
Medium	Certain Confident Reliable	Acceptable	Manage within existing processes, adopting continuous improvement. Consider implementing medium-term risk reduction measures.
	Estimate Uncertain	Unacceptable	Implement short-term measures, and investigate measures to reduce level of uncertainty as soon as possible
High	Certain Confident Reliable	Unacceptable	Implement short-term measures immediately.

Risk level	Uncertainty	Acceptability	Management Actions
	Estimate Uncertain	Unacceptable	Implement short-term measures immediately, and investigate measures to reduce level of uncertainty as soon as possible.
Extreme	Certain Confident Reliable	Unacceptable	Implement short-term measures immediately, put emergency plans on stand-by and give longer-term risk reduction measures top priority.
	Estimate Uncertain	Unacceptable	Implement short-term measures immediately, put emergency plans on stand-by and immediately investigate measures to reduce level of uncertainty.

Approach Where There is a Possible Range in the Consequence of An Event

While the above tables provide suitable guidance to undertake a risk assessment process, there are still decisions to be made when undertaking a risk assessment process, where the potential scale of the consequence of an event type has a range of possibilities. This is discussed below to guide interpretation during the risk assessment process, to ensure a consistent process is followed.

The minimum consequence of a microbiological event was deemed to be either major or catastrophic in all cases as part of the risk assessment process. In reality, the consequence of a microbiological event could be anywhere from minor to catastrophic. This however would depend on the concentration of microbiological contamination that enters the system, how far this is distributed through the system (based on where it enters such as at the source or at the extremity of the distribution zone) and the duration of the time over which the contaminant enters the system (i.e. very short duration transient event, or long term event).

The range of possible consequences for a given event type is evidenced in the paper 'Water contamination events in UK drinking-water supply systems' (Journal of Water and Health, 2008). In this paper 467 microbiological contamination events are referenced between 1990 and 2005, as well as a similar number of chemical events, yet it is concluded that 'few have resulted in significant adverse health effects'. This demonstrates that an event of a certain nature can have a range of consequences, depending on the scale and specific details of the event.

Similarly, the Australian Drinking Water Guidelines (2011) states, "in some cases variations of the same type of event can appear at both ends of the spectrum".

The above examples are not to say that microbiological or chemical contamination events cannot lead to serious outcomes, as there are a large number of examples worldwide where they have. Rather, the scale of the event being considered must be determined and considered when assigning a likelihood. Generally, the more significant scale of event being considered, the lower the frequency will be (or alternatively, the lower consequence version of the event being considered, the greater the likelihood would generally be).

Taking into account the above, there are three potential options for the nature of the hazardous events to consider when assigning consequence and likelihood scores. These are:

1. Assess each event under the lowest conceivable consequence that may result from that event occurring. This would underestimate all events, and would not present a realistic description of the risks on a scheme. This approach was therefore not followed.

2. Assess each event under the most likely consequence to eventuate from the hazard occurring (i.e. consider what the impact to the population would be in the most common foreseeable case of that event occurring). This would lead to generally the consequence being more severe than the first option, however it may mean that the worst case scenarios are not considered as they may be considered unlikely to eventuate to a certain scale of consequence.

3. Assess each event at the upper limit of the realistically conceivable consequence that could eventuate from the hazard occurring. As the more severe versions of the event type are being considered, this means that the frequency of these events may be less than the likelihood of events under one of the first two options. For example the likelihood of an event occurring with moderate consequence may be higher than the assessed likelihood of the same event occurring to a scale and/or duration sufficient to cause either a major or catastrophic consequence.

Of the three possible approaches, the third option above has been followed for the purpose of undertaking the risk assessment, which is consistent with the approach of assuming all microbiological events are either major or catastrophic, as per the Handbook for Preparing a Water Safety Plan (2019).

2.3.3. Risk Analysis Results

A risk assessment has been undertaken for the Garrymere supply using the methodology above. The full risk analysis assessment table is contained within Appendix 2H. The results are summarised below:

- One unacceptable risk was determined, which had a medium residual risk. This risk is a result of having only one primary source for the Garrymere scheme, and a secondary source is needed to reduce this risk.
- There were seven low residual risks that require additional improvements to further improve the reliability of drinking-water quality.
- There were two medium residual risks that were deemed acceptable risks, as there are either no additional preventative measure that could be implemented or the reliability of data relating to the risk is acceptable.

Refer to Component 3 (Preventative Measures for Water Quality Management) for further analysis on the Risk Assessment results.

2.4. References

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3. Preventive Measures for Drinking-Water Quality Management

3.1. Introduction

Preventative measures are actions, activities and processes used to prevent hazardous events from occurring, or reduce hazards to an acceptable risk level, by reducing either the likelihood, consequence, or both. They are active measures that exist throughout the water supply chain. Having multiple barriers to protect consumers from contamination is a priority for WDC as outlined in the drinking water commitment statement, to avoid reliance on a single preventative measure. The four types of barrier, as defined in the Handbook for Preparing a Water Safety Plan (MoH), are:

- Preventing hazards entering raw water
- Removing particles and hazardous chemicals from the water
- Killing or inactivating pathogens in the water
- Maintaining the quality of the water in the distribution system

3.2. Assessment of Existing Preventive Measures and Multiple Barriers

An assessment of the scheme's barriers to contamination has been undertaken as part of the risk assessment, and preventative measures have been categorised into the four barrier types as shown in Table 3.1. By presenting the preventative measures within these four categories, the relative ratio of the number of preventative measures against each barrier type is clear.

Table 3.1 presents the name of each preventative measure. Full details of each preventative measure are included within Appendix 3A. These details include a description of the preventative measure, categorisation of the task required, definitions of "what, where, how, when, who" for each task, where records are kept, what the critical limit is, and what corrective actions are required.

It is noted that some preventative measures may have benefits across multiple barrier types. The preventative measures are referenced by their assigned number throughout the risk assessment. All measures have been defined as either Type A or Type B. Type A preventative measures reduce the likelihood of the hazardous event, whereas Type B preventative measures modifies the consequence of the hazardous event.

Table 3.1: Existing Barriers to Contamination

Barrier Type	Preventative Measure	
Preventing hazards entering the raw water	A1	Historical Local Knowledge of Catchment
	A2	ECan Discharge Consents
	A3	Partnership with Regional Council
	A5	External Contractor Review
	A6	Specification Documents & Hygienic Practices
	A7	Well Drilling Standards
	A8	Inspections as per SLA
	A9	Asset Age Assessment and Renewals Programme
	A11	Well Head Exclusion Zone
	A12	Locked Well Head Enclosure
	A13	Elevated Well Head
	A14	Well Head Backflow Prevention
	A25	Maintenance
	A27	Trained and Qualified Water Unit Supply Operators
	A30	Designed by Qualified Person
	A46	Flood Mapping
	A15	SCADA Alarm

Barrier Type	Preventative Measure	
Removing particles and hazardous chemicals from the water	A25	Maintenance
	A27	Trained and Qualified Water Unit Supply Operators
	A30	Designed by Qualified Person
	B1	Natural Filtration
	B6	Well Flushing
	B8	New Well Commissioning Plan
	B15	Cartridge Filtration
Killing or inactivating pathogens in the water	A15	SCADA Alarm
	A25	Maintenance
	A27	Trained and Qualified Water Unit Supply Operators
	A30	Designed by Qualified Person
	A42	Chemical Supply Contractor
	A44	Labelled Chemical Tanks
	A45	Chlorine Stockpiles
	B3	Standby Chlorination
	B4	New Water Main Chlorine Testing
	B6	Chlorination of New Wells and New Pumps
	B7	New Well Commissioning Plan
	B11	Chlorine Disinfection
	B12	UV Treatment
Maintaining the quality of the water in the distribution system	A5	External Contractor Review
	A6	Specification Documents & Hygienic Practices
	A8	Inspections as per SLA
	A9	Asset Age Assessment and Renewals Programme
	A15	SCADA Alarm
	A17	Portable Generator
	A18	Trained and Qualified Water Unit Reticulation Staff
	A19	Water Unit Stand Over
	A20	Constant Positive Pressure System
	A21	Inspection/Approval of Subdivision and Council Capital Works
	A22	Leakage Detection
	A23	Backflow Prevention Programme
	A24	Business Continuity Plans
	A25	Maintenance
	A26	GIS Mapping Programme
	A27	Trained and Qualified Water Unit Supply Operators
	A28	BeforeUDig
	A29	Proactive/Reactive Flushing Programme
	A30	Designed by Qualified Person
	A31	Sampling Procedures
	A32	Locked Storage Tank / Reservoir
	A33	Reservoir Cleaning
	A34	Hydraulic Modelling
	A35	Tank Configuration
	A36	Chlorine Analyser
	A37	Storage Tank / Reservoir Drainage Backflow Prevention
	A38	Standard Operating Procedures
	A39	Service Request System
	A40	Headworks Bypass
	A41	Locked Headworks Building
	A43	Handheld Equipment Calibrated
	B2	Redundancy
	B9	Storage
	B11	Chlorine disinfection
	B13	pH adjustment

While most preventative measures relate to managing the risk of contamination (which are captured in the table above), there are some preventative measures that relate to maintaining a reliable supply, which did

not fit into the above table, but are referenced in the relevant Appendices. As an example, the replenishment of the water reservoirs by water tanker has been included as part of the risk assessment in response to a loss of source to reduce the consequence of this event.

3.3. Identification of Additional Preventive Measures

A summary of unacceptable risks from Appendix 2H is shown in Table 3.2. The interim mitigation actions and prioritisation for progressing improvements are outlined in Table 6.1 in Component 6 (Improvement Plan).

Table 3.2: Unacceptable Residual Risks

Risk Reference	Unacceptable Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference Number
R6	Source water receives discharge from, or is influenced by insufficient water. Too little water can be drawn from intake to meet demand due to catastrophic intake failure and/or screens damaged or clogged.	Currently only one source supplies Garrymere (M42/5518). If an event causes insufficient water to be abstracted from this well due to clogged screen, intake failure or loss of aquifer supply, then this would result in a disruption to supply. In the short term this can be mitigated by utilising the on-site storage of the supply, while minor events are resolved. In the medium term, water tankers could be used to replenish the tanks, however this would require multiple tankers to be driving close to continuously to keep up with demand. This would not be sustainable financially for an extended period of time. Therefore this risk is unacceptable, and a duplicate source is considered the long term solution to reduce this risk.	Disruption to supply	Medium	Duplicate Primary Source	RAI5

WDC have identified additional improvements through completing the risk assessment which are part of the preventative risk management response to protect the water from contamination, see Table 3.3 and Table 3.4. Although the improvements correspond to acceptable risks, WDC do not believe it is only unacceptable risks that need improvement, and a proactive approach should be used where possible.

Table 3.3: Additional improvements related to acceptable residual risks

Risk Reference	Potential Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference
R10	Too little water can be drawn from intake to meet demand due to damage to the pump or bore/well head by	If there is damage to the well or the transmission line (pipeline from the well to headworks), then this could result to a disruption in supply.	Disruption to supply			

Risk Reference	Potential Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference
	animals, and/or vandalism sabotage. Not enough source water available to meet demand due to inability to transmit water from source to pre-treatment storage.	While the residual risk is low, a duplicate source would reduce the risk further.		Low	Duplicate Primary Source	RAI5
R30	Changes in pressure, or water hammer, suck contaminants into the water due to pump failure due to mechanical failure or overload, pump failure due to no power, and/or pump failures due to flooding or other damage.	Negative pressure within the transmission line could cause contaminants to be sucked in. While the residual risk is low, a duplicate source would mean an alternative source could be used if this were to occur, and minimise disruption to the treatment process.	Protozoa and bacteria/ virus			
R31	Changes in pressure from the bore suck contaminants into the water due to failure of bore pump		Protozoa and bacteria/ virus			
R46	Resuspension of sediment or biofilm within the mains by pressure fluctuation, and resuspension of contaminants in sediments in the distribution system due to sediment or biofilm allowed to develop, significant fluctuations in reticulation pressure, sediment or biofilm allowed to develop and/or water velocity too high.	Although there is no formal flushing point at the extremity of the scheme, it is possible to flush the distribution line through the last toby box, if/when required. This is not ideal, so a more formal sampling/flushing point would improve the ability to flush any sediment/biofilm build up.	Chemical/ aesthetic	Low	New sampling /distribution flushing point by furthest property	RAI4
R47	Introduction of contaminating material into the distribution system due to affected area not correctly isolated, flow direction in affected area unknown, standard hygiene practices not adopted, inadequate staff training, inadequate flushing and distribution practices, unsuitable temporary bypass, and/or contamination during sampling. Development of sediment or biofilm due to poor repair practices allowing colonisation and/or	Currently, the distribution sampling point is not at the extremity of the distribution. This means that standard reticulation samples do not represent the quality at the furthest point in the scheme. There is a low residual risk of contaminating material in the extremity of the distribution system, that are not picked up at the sample point, as checks that have been made at the furthest toby have shown FAC to be maintained. To reduce this risk further, another flammable tap, with a flush point, would be	Protozoa, bacteria/ virus and chemical/ aesthetic			

Risk Reference	Potential Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference
	inadequate cleaning programme.	installed at the end of the distribution. It is inevitable some biofilm will develop in the distribution so this flush point will allow the entire system to be flushed, when required.				
R49	Development of sediment or biofilm due to poor chemical water quality leaving the treatment plant, poor microbiological water quality leaving plant, and/or water flows too low resulting in decay of chlorine	As the current distribution sample tap is close to the headworks, it is difficult to sample for biofilm/sediment at theend of the network (other than sample at toby). A new sample tap would ensure the samples represent the water at highest likelihood of having any issues, as well as allow greater flushing, to reduce the likelihood of an issue occurring.	Protozoa, bacteria/ virus and chemical/ aesthetic			
R51	Introduction of contaminating material into the distribution system. No, inadequate, faulty, or incorrectly installed backflow prevention device.	There is a low residual risk of inadequate backflow prevention within the supply resulting in contamination of the distribution system, due to maintaining chlorine residual, reducing the consequence of such an event, and most hazard types on this scheme being microbiological. There are also non-testable backflow devices at each water toby, to reduce this likelihood. However an audit of backflow prevention provided by existing tanks will reinforce that residual risk.	Protozoa Bacteria/ virus chemical/ aesthetic	Low	Audit of backflow prevention for restricted connections	RAI3

As identified in Component 2, some medium risks are considered acceptable, and some unacceptable. Table 3.4 below describes the medium but acceptable risks.

Table 3.4: Medium Acceptable Residual Risks

Risk Reference	Potential Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference
R1	Source water receives discharge from, or in influenced by contaminated sites, waste discharge to land, storage of hazardous substances, septic tanks, surface impoundments, faecal matter from livestock	WDC have multiple barriers to contamination which address potential microbiological risks associated with the contamination events. With it being considered likely that this source is influenced by some of the activities described under	Protozoa, bacteria/ virus, chemical/ aesthetic and radiological	Medium	None for microbiological risk. Multiple treatment barriers in place to protect water from microbiological contamination, and the risk is	RAI1

Risk Reference	Potential Risks	Description	Hazard	Level of Residual Risk	Improvement Description	Improvement Plan Reference
	or feral animals, irrigation, and/or fertiliser. Contamination of the aquifer due to stock, septic tanks, chemicals in close proximity, and/or aquifer is not secure	'potential risks', even though there are treatment systems in place to address these by minimising the consequence, the minimum resultant risk score that could be achieved is 'medium'.			considered to be acceptable. For chemical risk, a source water risk management plan will assist with gaining a better understanding of this risk, which is understood less than microbiological risks.	
R53	Incorrect water quality data used for supply management due to inappropriate/incorrect sampling, inadequate/incorrect test equipment or un-calibrated, inadequate reagents, inappropriate method or incorrect calibration, inadequate monitoring records, failure of staff to follow analytical methods, and/or use of non MoH approved laboratory	WDC has processes/tools for water supply data, however are considering a centralised system such as water outlook. This will: • Reduce human error when transferring data for reviewing/reporting. • Streamline the reporting process • Formalise requirements for what needs to be done when and by who to reduce likelihood of errors. • Formalise and automate alerting systems to ensure events are tracked, responded to, and resolved.	Protozoa, bacteria/ virus and chemical/ aesthetic	Medium	Infrastructure Data software is proposed to be purchased to assist with streamlining and centralising the processes referred to, to reduce the likelihood of errors. This will also allow greater visibility of data, allow improved decision making.	RAI2

4. Operational Procedures

4.1. Standard Operational Procedures

Standard operating procedures for the way in which water supplies are managed are outlined in the following key documents. An overview is given below, with further detail provided in the following sub-sections:

- **3 Waters Unit and Water Unit Service Level Agreement (SLA).** This documents all operational tasks that the 3 Waters Unit contracts to the Water Unit in order to operate and maintain its public water supplies. It includes what is required to be done, when it is required to be done, how it is to be done, and by who.
- **Waimakariri District Council Hygiene Code of Practice for Work on Public Water Supplies.** This outlines procedures required to be followed to maintain required level of hygiene at all times for works on public water supplies.
- **Operation and Maintenance Manual.** This is a document specific to each site, outlining any additional detail for specific items of equipment, where a greater level of detail is required over and above that contained within the SLA, or to help inform the development of the SLA.
- **Operational Process Mapping.** These are processes documented in Promapp outlining step by step how key operational tasks are performed.
- **Training and Competencies Register.** This outlines systems for ensuring staff that complete key tasks are sufficiently trained and competent to complete them.

4.1.1. Service Level Agreement

The WDC in-house contractor, the Water Unit, are the primary operators for WDC water supplies. The 3 Waters Unit and Water Unit have a Service Level Agreement (SLA) for Water Services, which is reviewed annually. The SLA covers the operations and maintenance of all WDC owned water supplies, wastewater disposal and drainage systems. The SLA sets out the requirements of the Water Unit, 3 Waters Unit and other relevant parties with regard to the provision of 3 Waters services that are the responsibility of WDC.

The objective of the agreement is to comply with relevant legal requirements, align with the Council's policies and operating procedures, achieve the Council's target levels of service, and to align with the Council's principles Tā mātou mauri (see Table 1.1). It defines the scope of maintenance required for all 3 Waters assets including drinking-water, which includes level of service timeframes and description of the required task.

The five areas of works incorporated within the SLA for drinking-water is shown in Table 4.1.

Table 4.1: Operational procedures as part of the Water Unit SLA.

Scope of Work	Description
Planned Works	Programmed operations and maintenance works of the water supply intakes/wells, headworks, pumping stations, and reticulation networks.
Reactive Works	Unforeseen works required to respond to identified issues impacting public or operator health, safety, service delivery or environmental standards, usually reported through service requests, SCADA alarms or consent monitoring.
Instructed Works	Works required to address issues identified during the planned works (including all programmed operations and maintenance) that do not require immediate attention (i.e. that do not trigger immediate reactive works, but may instead first go into a triage system). These are also known as "out of scope" works.
Capital Works	One-off projects that are separately contracted to the Water Unit. They include minor improvements to infrastructure, construction of new infrastructure, or renewal of existing infrastructure. Projects and their contracts are negotiated on a case by case basis.
Emergency Works	Works required to prevent harm to the public or staff, address health or safety issues, prevent damage to the environment, and prevent damage to property. These are works required to prevent or minimise the life or property loss due to an event of significant scale that affects or has potential to affect a large number of residents and property. They may require a coordinated and prioritised response across multiple agencies.

The following table highlights key areas of the SLA in terms of what tasks are required to be completed by the Water Unit, at what frequency, for the Garrymere supply. The specific details of each task is documented within the Basis of Payment Section of the SLA.

Table 4.2: Key Sections from SLA Outlining Operational Checks Required (Source SLA Appendix A).

Task No.	Task Name	Frequency	Responsible Party	Record Keeping
W5.1	Water Treatment Plant Inspection	Weekly	Water Unit Technician	Input to form on tablet
W5.1b	Chemical Monitoring	Weekly	Water Unit Technician	Not recorded
W6.1	Building Inspection	Monthly	Water Unit Technician	Not recorded
W7.3	Grounds Maintenance	As required to maintain standard	External Contractor	Not recorded
W9.1	Full Chemical Analysis	Annually	Laboratory Technician	External laboratory direct upload to DWO
W9.2	Water Sampling	As per DWO schedule (refer Component 5 (Verification monitoring programme) for Monitoring Plan).	Laboratory Technician	Electronic Lab book, uploaded to DWO
W11.3	Well Inspection	Monthly	Water Unit Technician	Input to form on tablet
W12.1	Chemical Supply	As required to maintain levels	Water Unit Technician	Not recorded
W12.4	Reference Sensor Check	Monthly	Water Unit Technician	Input to form on tablet
W12.5	UV Bulb Replacement	As required (based on run hours)	Water Unit Technician	Input to form on tablet
W13.1	Reservoir Inspection (External and Top)	Quarterly	Water Unit Technician	Input to form on tablet
W13.2	Reservoir Inspection (Exterior only)	Weekly	Water Unit Technician	Input to form on tablet
W13.4	Reservoir Cleaning	5-yearly	Water Unit Technician	Reservoir Management Plan

While there is good documentation of what needs to be done, at what frequency, by who, and within what limits within the SLA document, a project is required to improve the record keeping systems associated with these tasks, and automate escalation processes for deficiencies identified. 3 Waters staff are working through a project to obtain Water Consent and Compliance Monitoring Software to assist with this. This is considered an improvement project, intended to be implemented within 2021.

IMPROVEMENT RAI2: Purchase and implement Water Consent and Compliance Monitoring Software to improve record keeping at facility sites (Refer Improvement Programme 181129140491 for status)

4.1.2. Waimakariri District Council Hygiene Code of Practice for Work on Public Water Supplies

In July 2020, WDC adopted the "Waimakariri District Council Hygiene Code of Practice for Work on Public Water Supplies". This is a document setting out requirements for work on any public water supply system within the District. This covers work by operational and maintenance staff, capital works projects, or new infrastructure constructed by developers and vested to Council.

This document has been prepared based on documentation available from Watercare, Christchurch City Council and Water New Zealand. This ensures that practices with the Waimakariri District are consistent with national good practice.

This is stored within TRIM (record number 200331041625), and is available on Council's website.

4.1.3. Operation and Maintenance Manual

Each WDC water supply site holds a hard copy of a site specific operation and maintenance manual on-site for operators to refer to. Sites without an operations and maintenance manual are having these developed as part of their improvement programme. This manual is electronically available in Council's digital records database TRIM. The following document/s are relevant to the Garrymere Supply:

- Garrymere Water Treatment Plant Operational and Maintenance O&M Manual - TRIM 200706083269

In addition to the O&M manual, Council is working through a project to create process and instrumentation (P&ID) diagrams for each of its facility sites across the 3 waters. This will ensure each site has an easy to follow diagram with consistent format to ensure the flow process through a plant is well understood. This will remove reliance on experienced operators having good understanding of plants, and reduce risk of incorrect operational decisions as a result.

IMPROVEMENT PPI3: Create P&ID for each facility site (Refer Improvement Programme 181129140491 for status)

4.1.4. Operational Process Mapping

WDC is in the process of capturing and documenting processes used to carry out the standard operating procedures using the Promapp system. This ensures consistency in the way that key tasks are completed. Further information is provided within Table 8.2 regarding ownership and documentation of Promapp processes.

Key relevant Water Unit operating procedures for administration, management, reticulation management, treatment plant processes, work health and safety processes, and training have been transitioned across to the Promapp system, see Appendix 4A.

While there are a large number of processes already captured, as part of continuous improvement, additional processes are added into Promapp over as time and resources allow.

IMPROVEMENT PP4: Complete Water Unit process mapping exercise, particularly for technician / treatment processes (Refer Improvement Programme 181129140491 for status)

Promapp processes are available online, making them available from both in the office, or in the field.

4.1.5. Training and Competencies Register

The SLA outlines the minimum qualification and training requirements for Treatment Operators and Reticulation Maintenance Service Persons.

All technicians that operate a water supply hold a National Certificate in Water Treatment (Site Operator), or are working towards this, while reticulation workers are all required to hold a National Certificate in Water Reticulation (Planned and Reactive Maintenance Technician) (Level 3), or one of the previous equivalent qualifications, as set out on the SLA (refer Table 13 in SLA for minimum requirements). Refer to Table 1.3 in Component 1 for the list of key operations staff and their relevant training.

Technicians rotate between schemes to carry out the required maintenance and testing, as per the SLA. The rotation ensures all operators are competent at all treatment sites, and in turn this provides

redundancy in competent operators. The Technician Team Leader, oversees the system rotation and the operators.

Water Unit competencies are tracked in Promapp. Refer to Appendix 4B for a list of Water Unit reticulation competencies that are available in Promapp. Technician competencies are in the process of being input to Promapp by Water Unit administration staff. The purpose of the competency record is to keep track of when staff members need to be refreshed in a particular skill. The record has a specified validity period, after which another refresher is required of that particular skill set.

IMPROVEMENT PPI5: Complete Water Unit competencies documentation, particularly for technician / treatment processes (Refer Improvement Programme 181129140491 for status)

A competency assessed task can be tracked by field staff completing a job-site Take 5 health and safety assessment. This enables validation that a staff member has performed an activity within the "recency" or "currency" limits set for the specific task.

4.2. Operational Monitoring and Inspection

This section covers the planned series of measurements and observations that are defined to ensure preventative measures are functional and continuously effective. These operational activities do not always have a quantifiable limit as the set drinking water standards for compliance do, but are in place to ensure that preventative measures are working correctly as per the relevant descriptions.

The water safety preventative measures and operational limits table is shown in Appendix 3A.

4.2.1. Monitoring Tasks

Routine monitoring visits are carried out at the water supply headworks site in accordance with the SLA. Results and observations from the visits are recorded on tablets and the Water Supply Log when required. All information is maintained in the Tech1 asset management system, or the Council's record database (referred to as TRIM).

SCADA results are managed by the Council's Control Systems Engineer and is stored in Council's database. Alarms are generated from the SCADA system that go to the duty operator to respond to and resolve or escalate as necessary.

Since September 2018, the Water Unit have transitioned from undertaking water supply logs on tablets and phones instead of the paper format. The Collector Survey 123 application allows all Water Unit staff to see the map of the District and the location of all water facilities sites. Sites that are due to be inspected show as red, and ones that have been inspected show as green. This improves transparency, and allows the operators to know which site has been visited in that week and which sites still require visiting.

The Water Operations team can check for compliance with the SLA and DWSNZ by using the overview spreadsheet that has been developed by the 3 Waters Water Engineer (*Water Unit Service Request SLA Audits and Scoring.xlsx*). It pulls information from the Council's various databases to measure multiple parameters for compliance.

The Asset Management Information System (AMIS) has been rolled out at WDC from November 2020, starting with the 3 Waters services. It means the Council have improved capability to track and monitor service requests, coordinate Water Unit works, have an integrated system, relay information from the field to an asset management system, and obtain improved asset information. It has been designed utilising Tech1 software currently used as the Council's core asset management and financial management system.

4.2.2. Operational Log

A log of all non-routine mechanical & electrical work carried out by operators and external contractors are recorded in the Operational Log held on site. The log is intended to provide a complete record of faults and changes to how the supply is operated. There are monthly meetings with supplies operators and periodic site visits to ensure that the activities recorded on the Operational Log are communicated to the Water Operations Team Leader.

As noted earlier, 3 Waters staff are working through a project to obtain Water Consent and Compliance Monitoring Software to assist with this. This is considered an improvement project, intended to be implemented within 2021. This will include functionality to digitise the Operational Log, and have it available to all operators and other maintenance staff not only on site (as per the current system) but also remotely.

IMPROVEMENT RAI2: Purchase and implement Water Consent and Compliance Monitoring Software to improve record keeping at facility sites (Refer Improvement Programme 181129140491 for status)

4.3. Critical Control Points

A Critical Control Point (CCP) is a specific preventative measure where control is applied to reduce the concentration of a hazard in the drinking-water to an acceptable level, or prevent the potential hazard entering the drinking-water. It is required to have continuous monitoring of its performance, in case there is an issue with the control procedure. This means action can be taken prior to any harm to consumers. CCPs clearly outline threshold values for performance criteria and corrective measures for the target range, action and critical limits. It is an essential function to protect public health. The Garrymere water supply has multiple CCP at the headworks which is monitored by a supervisory control and data acquisition (SCADA) system.

The relevant Critical Control Point Plans which have been developed are attached in Appendix 4C**.** A hardcopy of the Garrymere CCP is available at the headworks site. The actions required to respond to a CCP are part of the competency processes, covered through the Water Unit's systems (for example, to operate a site and respond to a CCP, the technician must be shown to be competent in using the key water treatment equipment at that site). The documentation surrounding these competency processes is currently under development, with the completion of this a key Improvement Project, split into the documentation of the processes, and the documentation that technicians are competent in following the relevant processes for a given site.

IMPROVEMENT PPI4: Complete Water Unit process mapping exercise, particularly for technician / treatment processes (Refer Improvement Programme 181129140491 for status)

IMPROVEMENT PPI5: Complete Water Unit competencies documentation, particular for technician / treatment processes. (Refer Improvement Programme 181129140491 for status)

4.4. Corrective Actions

Corrective actions are required for when the performance criteria of preventative measures are outside of the target range. Preventative measures that are essential for compliance with the DWSNZ have a CCP which contains specific detail on corrective actions for the range of threshold values (refer to Appendix 4C for CCPs and their associated corrective actions). For all other preventative measures, their operational measurements and associated corrective actions are documented within Appendix 3A.

The corrective action responsibility, responses and documentation record keeping system varies with different preventative measures. The record keeping system for each respective corrective action is also documented within Appendix 3A.

Where the performance criteria operating outside of its target range is deemed to be an 'Incident' (as defined within Component 7), the incident and associated corrective actions (if required) are recorded within the Water Quality Incident and Investigation Register (TRIM 181129140491). The Water Engineer maintains this spreadsheet, with higher level input for higher level incidents (Level 3 or greater). Level 1 and 2 incidents are separated into three categories: ECan Incidents, General Incidents and CCP Triggers Incidents. Level 3 and greater incidents are recorded and undergo a review on a separate tab within the spreadsheet, called Review of Incidents. At the discretion of the Water Asset Manager, a Level 1 or 2 incident may undergo a review.

5. Verification Monitoring Programme

The effectiveness of the Water Safety Plan is determined by verification monitoring, which assesses the drinking-water quality at one point that the overall performance of the drinking-water supply system is capable of providing water of acceptable quality at the point of supply. The assessment makes use of water quality testing and consumer complaints and a number of other parameters that are monitored as a quality control check in the drinking-water safety planning quality assurance approach.

Verification monitoring provides another check on the effectiveness of the preventive measures, although the information it provides is retrospective.

5.1. Drinking-Water Quality Monitoring

The SLA outlines water supply sampling and testing requirements to be met by the Water Unit Laboratory and Operators, including reporting during any transgressions that may occur. Section 2.10 of the SLA references the Waimakariri District Council Water Supply Testing Schedule which sets out the minimum monitoring requirements for each supply, including:

- Listing each sampling site for E. coli and Priority 2 determinand monitoring;
- The population of each scheme used to input to the determination of minimum sampling requirements;
- The criteria from the DWSNZ used to determine minimum sampling requirements;
- The minimum frequency that must be achieved, and the planned frequency of sampling. This includes a schedule for each day of the compliance year, outlining which samples must be taken, and what parameters assessed.
- A list of other samples required (i.e. annual full chemical test suites to be completed).
- A self-checking tool to ensure that planned samples meet or exceed minimum DWSNZ requirements.

An export of the 2021 monitoring programme for all WDC water supplies to achieve DWSNZ compliance is shown in Appendix 5A. More information regarding the SLA is provided in Component 4 (Operational Procedures). The overall responsibility of the SLA is the Water Operations Team Leader, while the creation of the sampling schedule that inputs to this is the responsibility of the Water Asset Manager.

5.1.1. Laboratory Accreditation

The WDC Water Unit Laboratory is accredited (No. 827) to perform E.coli and Total Coliform analysis by Colilert Quanti-Tray (51 Well) method by International Accreditation New Zealand (IANZ). Refer https://www.drinkingwater.org.nz/mohlabs/labandtests.asp?orgcode=784.

As part of maintaining accreditation, IANZ conduct an annual external audit of equipment, records and processes. IANZ has adopted NZS ISO/IEC 17025:2018 as the general criteria for testing and calibrating laboratory accreditation. This international standard specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO9001.

In addition to the above, the Water Unit laboratory is a participant in the Global Proficiency Programme (No. 11062). Every two months a spiked sample is sent, analysed for E. coli and total coliforms via enumeration @MPN/100ml +/-.

5.1.2. Sampling Reporting Procedures

As noted above, the Water Unit Laboratory is IANZ accredited and undertakes all sample taking and analysis for E. coli and total coliform analysis. When samples are undertaken, data is entered directly into the 'Electronic Lab Book' spreadsheet.

This lab book then is programmed to alert on any exceedances or deviations from the DWSNZ limits, or samples that were not taken as programmed. This includes alerting on total coliforms, turbidity and chlorine residual, when these are outside of operational targets, rather than necessarily being breaches of MAVs.

The relevant Incidence Response Plans are referred to for any such breach or alert.

The lab book also exports data in a format each month to be uploaded to DWO. The Water Engineer is responsible for these monthly uploads to DWO.

For samples that the Water Unit Laboratory are not certified to process the samples, these samples are collected by Water Unit staff, but sent to external laboratories for analysis and reporting. The majority of these (Full Chemical analysis, Manganese and Iron analysis for Woodend and Pegasus) arrangements have been made with the relevant laboratory (Eurofins) to directly upload these samples to DWO. For others where there is not this capability by the laboratory used, these samples are manually uploaded by the Water Engineer.

5.1.3. Sampling Processes

The Water Unit Laboratory follows a number of processes for the sampling and processing of drinking-water samples. The majority of these processes have been converted to the Promapp process, however some are still in the old QS document format, to be brought across to the latest process mapping software, as time and resources allow. All relevant processes are outlined in Table 5.1.

Table 5.1: Summary of Drinking-water Sampling Related Process Documentation

Promapp Processes	QS Documents (to be uploaded to Promapp)	Improvements and Processes Required
• Plan & Schedule Testing of Drinking-Water • Collecting Drinking-Water Samples + Transport • Conduct In-House Bacteriological Tests • Collect Free Available Chlorine (FAC) Sample • Respond to positive result from E.coli in Drinking-Water	• Laboratory Samples incoming procedures QS - O920 - AA • Microbiological Testing of water samples as per QS-O920-AC	• Identify which determinands "collecting drinking-water samples process" is relating to • Sample collection for Full Chemical testing • Sample collection for Manganese and Iron • Sample collection for Nitrate • Other laboratory to use for samples not normally collected by WU lab (such as for Cryptosporidium or cyanotoxins) including contact details for laboratories • Include testing method use to each determinand (E.coli and total coliforms = enumerated tests /quanti-tray etc.)

5.1.4. Sampling Locations and Minimum Requirements

The sampling locations for the supply and minimum frequency of sampling has been listed Table 5.2. The treatment plant and distribution sample points are kept in a locked and secure cabinet or bollard respectively. These frequencies are based on DWSNZ requirements. In addition to minimum requirements of plant and distribution zone samples, raw source E.coli / total coliform samples are taken monthly as well to maintain a good understanding of the source water quality, and a suite of chemical parameters assessed annually. When samples are programmed, there is some allowance made for additional samples over and above the minimum, as indicated by the numbers in brackets in the Minimum Samples per Quarter column below:

Table 5.2: Minimum Sampling Requirements

Determinand	MAV / GV	Associated hazard	DWSNZ compliance criterion	Minimum Samples Per Quarter (actual programmed)	Maximum days between samples	Minimum days of the week to be used	Sampling locations	Response to exceedances (DWSNZ compliance requirements)
Monitoring at the Treatment Plant Treatment Plant ID Code: TP00593								
pH	7 - 8.5 (GV)	Chemical/aesthetic	Criterion 1	13 (16)	13	5	Sampling point after water leaves the treatment tanks	Section 8.4
Turbidity	<2.5 NTU (GV)	Bacterial/viral						Figure 5.1, Figure 5.2
E.coli	< 1 E.coli/100ml	Bacterial/viral						Figure 4.1, Section 4.2.9
Free available chlorine	5 mg/L	Bacterial/viral						Figure 4.1, Section 4.2.9
Total Coliforms	NA	Bacterial/viral						Figure 4.1
Monitoring in the Distribution Distribution ID Code: GAR001GA								
pH	7 - 8.5 (GV)	Chemical/aesthetic	Criterion 6A	3 (4)	45	2	Garrymere Road sample point at 158 Garrymere Road	Section 8.4
Turbidity	<2.5 NTU (GV)	Bacterial/viral						Figure 5.1
E.coli	< 1 E.coli/100ml	Bacterial/viral						Figure 4.2, Section 4.3.6
Free available chlorine	5 mg/L	Bacterial/viral						Figure 4.2, Section 4.3.6
Total Coliforms	NA	Bacterial/viral						Figure 4.2
Monitoring at the source Source ID Code: G00369								
Full chemical	As per individual chemical	Chemical/aesthetic	NA	0 (once per year)			Sample tap at entrance to raw water tank	Section 8.4
pH	7 - 8.5 (GV)	Chemical/aesthetic		0 (3)	45	2		
Turbidity	<2.5 NTU (GV)	Bacterial/viral						
E.coli	< 1 E.coli/100ml	Bacterial/viral						
Total coliforms	NA	Bacterial/viral						
Conductivity	NA	Chemical/aesthetic						
Radiological Determinands	Refer Table 2.4 of DWSNZ	Radiological	Section 9	Every 10 years	NA	NA	Sample tap at entrance to raw water tank	Section 9.5

5.1.5. Protozoal Compliance

Protozoal compliance is achieved via Section 10 of the Drinking-water Standards for New Zealand, as outlined under 'Treatment' in Section 2.1.2.

The way in which the system is monitored to achieve protozoal compliance is outlined in Table 5.3.

Table 5.3: Monitoring of Protozoal Treatment and Remedial Actions

Treatment Process	Measured Parameters	Limit / Target / Monitoring	Remedial Actions	Verification	Notes
UV Disinfection	UV Irradiance as measured by the UV intensity meter	Not less than: • The value required to achieve the value claimed log credit for more than 5% of monitoring period • 80% of the value required to achieve the value claimed log credit for the duration of any 3 minute period As measured by continuous monitoring, recorded in Council's SCADA system.	If parameter limit activated for 2 minutes, UV unit alarms, and plant shuts down. Operator attends site and resolves issue prior to target / limits being exceeded.	• UV unit validated against öNORM M5873 (Osterreichisches Normungsinstitut 2001) • Operator checks irradiance against reference sensor monthly	Consistent with 5.16.1 of DWSNZ to achieve 3.0 protozoa log credits.
	Turbidity	The turbidity does not exceed: • 1 NTU for more than 5% of the monitoring period • 2 NTU for the duration of any 3 minute period	If parameter limit activated for 2 minutes, turbidity meter alarms, and plant shuts down. Operator attends site and resolves issue prior to target / limits being exceeded.	Online turbidity meter verified against handheld meter weekly as part of routine operator visits.	
Cartridge filtration (two filters in series)	Pressure Differential Across An Individual Filter	No greater than: • 340kPa for no more than 3 minutes As measured by continuous monitoring, recorded in Council's SCADA system.	If parameter limit is activated, the plant will alarm the duty operator, and the plant will shut down until the issue is resolved.	All pressure transducers which are used for compliance verified quarterly against manual gauge	Consistent with requirements for CUNO High Flow Polypropylene 1 micron cartridge filter which is validated for 2.0 protozoa log credits

5.1.6. Sampling Equipment

The equipment used to conduct the water analysis for pH, turbidity, chlorine (where applicable) and UVT are listed below in Table 5.4. There are DWSNZ 2005 (Revised 2018) requirements to have the equipment standardised for measurement of pH and turbidity as per manufacturer's specifications. These tests are carried out using handheld meters by the Water Unit operators. The hand held equipment is validated / calibrated periodically, and used to verify the online meters at the station.

Table 5.4: Water Chemistry Handheld Test Equipment for validation

Test	Device	Process Documentation to Maintain Accuracy
pH	Hach HQ11d	Promapp - Use and Maintain Handheld Water Testing Equipment
Turbidity	Hach/Thermo Fisher Turbidity Meter	
Chlorine	Hach Pocket Colorimeter 2	
UVT	Real Tech portable UVT meter UVT - 045010	

5.1.7. Approved Signatory

Water Unit sampling staff are required to have a NZQA Level 3 Undertake Sampling and Site Analysis for Water Treatment qualification. Additionally the IANZ accreditation and the Global Proficiency programme provides a secondary check to ensure sampling staff are competent.

Table 5.5 lists the operators with Approved Signatory status in the field of drinking-water testing, also referred to as key trained personnel (KTP). They achieve this status by demonstrating the defined technical and professional standards while reading and determining the results of the samples taken to their team leader or manager. Final approval and sign off is granted by IANZ following the submission of their application and current CV. The WDC KTP are approved to sign reports endorsed in the name of IANZ.

Table 5.5: IANZ Approved Signatories

Approved Signatory
Darryn Williams
Susan Dalzell
Kirk Hindmarsh
Bevan Stack

5.1.8. Compliance Checks

Compliance checks with minimum requirements of monitored parameters are undertaken in the following ways:

- SCADA alarms where there is a treatment process used to maintain quality of drinking-water that operates outside a design range, or a water quality parameter (i.e. turbidity) continuously monitored that exceeds its target level;
- Automatic daily compliance check email to ensure programmed samples have been taken as planned;

- Automated email / text to 3 Waters and Water Unit staff it parameter is outside target range;
- DWO quarterly/annually compliance report completed on a quarterly basis, to confirm samples taken met requirements defined and loaded into DWO;
- Monthly UV and Cartridge filtration compliance reports are prepared by the Water Engineer, using an exception based script from the SCADA system, as well as checks from data collected during operational visits by Water Unit staff.

Currently the systems used for compliance checks require multiple databases to be checked and reported on. A new water management software would allow better tracking of alerts, data extraction for compliance checks and better closing out issues. A business case has been prepared for software to assist with this, and budget assigned. This has been added to the Improvement Programme.

5.2. Consumer Satisfaction

The WDC offers a range of options to report issues and/or feedback from the community. Customers can phone, email, submit a request online, submit a request through the phone app (Snap Send Solve) or discuss in person at one of the Council Service Centres. All feedback and complaints are entered into Technology 1, referred to as the Service Request database.

Each type of request gets assigned to a team within the Council. For water supply related requests, the Water Unit staff are required to respond and react to operational issues, with Water Unit staff on-call to respond 24 hours per day, 7 days per week. Any escalations are sent to the Water Operations Team Leader or alternatively the Water Asset Manager.

The response period for service requests varies depending on the type of query. Urgent issues are required to be attended to within 60 minutes, and resolved within 8 hours. Further details on response times and requirements are outlined in the SLA.

5.2.1. Responses to Service Requests

The response of a service request depends on the nature of the issue. Table 5.6 notes a general list of complaints and enquires from the public and the response to those enquires.

Table 5.6: Service Requests general responses.

Type	General Response	Responsibility
Complaints		
Water quality (colour taste and odour or suspended solids),	Measure water quality parameters in the field, flush the distribution, report results back to Water Operations team member, who may require further action or discuss the matter further with the resident.	Water Unit initial response, then refer to 3 Waters team
No supply and low flow/pressure	Investigating the reason for no supply if not already known by 3 Waters team and undertake to restore supply promptly where possible.	Water Unit
	Investigate the reason for no supply looking at SCADA and considering other complaints received for the supply.	3 Waters Team
Sickness	Measure water quality parameters in the field, flush the distribution, report results back to Water Operations team member, who may require further action or discuss the matter further with the resident	Water Unit initial response, then refer to 3 Waters team
Site reinstatement	Complete works at a site if not already programmed.	Water Unit
Surface box damage	Investigate and remedy the issue (i.e. replaces broken lids).	Water Unit
Water leaks	Investigate and repair the leak promptly.	Water Unit
Enquiry		
New connections	To contact the customer and discuss options/costs and the process for connecting to a public scheme.	3 Waters Team
General water enquiries	To contact the customer and discuss whatever their concerns may be. These are generally enquiries about levels of minerals in the water, source of supply, treatment types etc.	3 Waters Team
Requests for quick fills	Remove restrictors and allow full flow in order to fill tanks over 24 hours (this incurs a charge based on the time). Should the customer want a free quick fill then 3 Waters Team would assess each case individually as to the cause of the customer wanting the quick fill. Should it be a Council issue then it would be free of charge, should the customer simply want it for filling a swimming pool then they would need to pay.	Water Unit
Location query	Investigate and find the location of an asset (i.e. toby).	Water Unit
Water maintenance service request	These are requests created by council for maintenance. These types of requests are now undertaken via AMIS, with the exception of the customer services team who still input these requests via the service request system. The response is the action requested within the maintenance request.	Water Unit

5.2.2. Service Requests from past 5 years

Appendix 5B shows all water service requests for the past five years for the Garrymere water supply. Half of the service requests received were created by Council staff for maintenance, in lieu of Works Order system being available previously. With the development of the AMIS system, these maintenance tasks can be created via a Works Order now, rather than as a Service Request.

Of the other five service requests, three relate to no supply/ low pressure which triggered an investigation by the Water Unit. The other two requests were complaints regarding leaks on the supply: one triggered maintenance of a broken fitting, and the other required the operators to check the reason for tank overflow at the headworks which was since resolved.

5.2.3. Annual Reporting

Key Performance Indicators (KPIs) are available online on the Council's intranet. These are monitored by the Water Asset Manager / Water Operations Team Leader and discretions or issues investigated further. These are also monitored periodically by the Council's Management Team, and ultimately feed into the Council's Annual Report.

A key performance measure relating to water quality is an aggregate of the total number of complaints per year relating to one of the following:

(a) Drinking-water clarity
(b) Drinking-water taste
(c) Drinking-water odour
(d) Drinking-water pressure or flow
(e) Continuity of supply, and
(f) Council's response to any of these issues

The result is expressed per 1000 connections. The number per year is then reported against a self-assigned target by each local authority. Recent results are summarised below on Figure 5.1 shows the trends of complaints for all drinking-water supplies owned by the WDC which are regularly reviewed by the Water Asset Manager and periodically by the Management Team.

Figure 5.1: Total customer complains for all drinking-water supplies operated by Waimakariri District.

The data above shows that complaints typically range from 1 to 9 per 1,000 connections over the 2016 to 2020 period. This data can then be compared to other local authorities based on data from the Water NZ National Performance Review reports as seen in Figure 5.2.

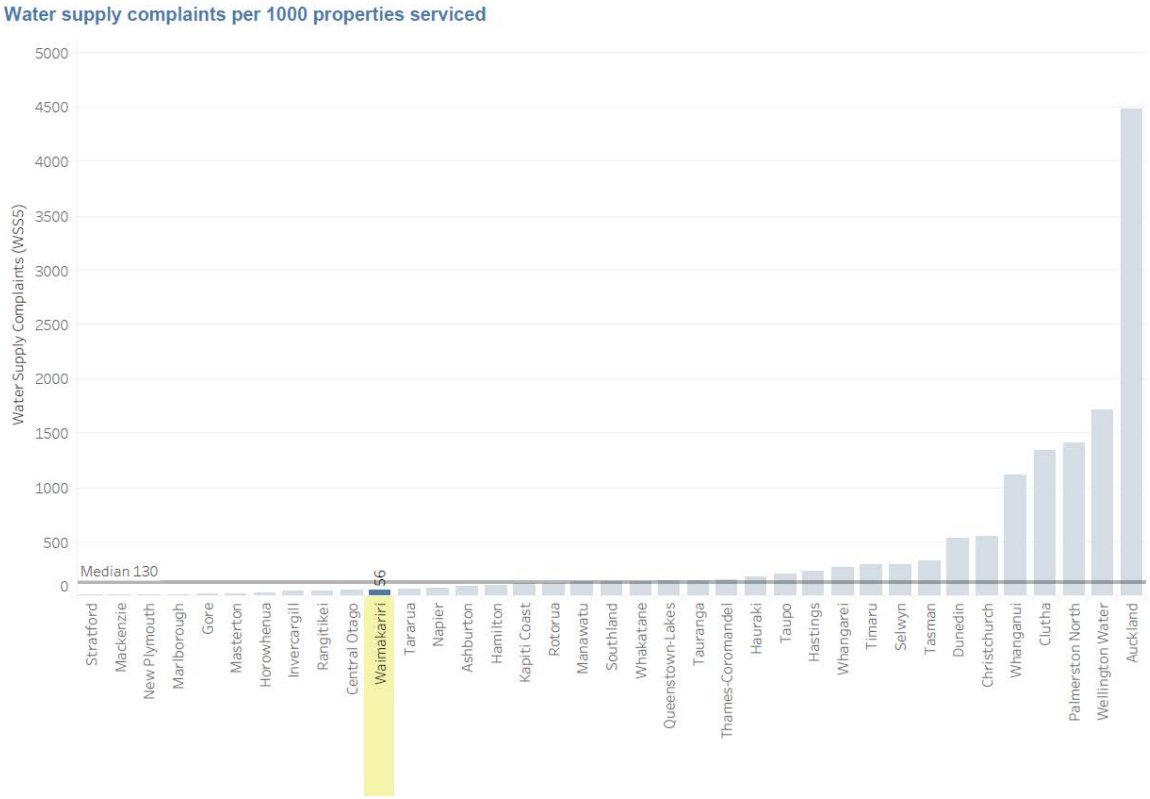


Figure 5.2: 2019/20 Water NZ National Performance Review Results for Customer Complaints

Comparison of the national results to the WDC results demonstrates that WDC performs better than average, relative to other councils, and the trend for this measure has generally improved over recent years, as a number of historic ongoing issues are being managed and resolved with time.

5.3. Short-Term Evaluation of Results

The current systems used for the short term evaluation of results is spread over multiple databases. WDC is looking to improve this system by switching to a software system to compile and consolidate all information into one database. This will allow all reports to be run more effectively through one system. This improvement has been added to Section 6 (Improvement Schedule).

5.3.1. Continuous monitoring

Continuous monitoring of water quality data is reviewed through the SCADA database where any values outside the range on the CCP sends alerts to the Supply Operators to respond to, resolve or escalate as necessary. The Control Systems Engineer submits a monthly report on the overall SCADA performance to the Water Operations Team.

Every month, the water engineer will extract the data relating to the filters and UV unit to undertake a check of the SCADA system to ensure compliance and submits a report to the Water Asset Manager.

5.3.2. Routine Water Quality Monitoring

The Water Unit Laboratory sends an automatic daily email to confirm the samples required for that day have been undertaken. This email is automatically generated from the electronic lab book. This email is sent to the Water Operations Team for review.

If transgressions relating to a MAV are found, these are immediately notified by the laboratory to the Asset Manager or Water Operations Team via phone call. Additionally, the automatic daily email also notifies any transgressions. The procedure for exceedance are generally scheme specific and therefore outlined within the CCP (refer Section 4.3), and Incident Response Plans (refer Component 7 (Management of Incidents and Emergencies)).

Through continuous SCADA monitoring, critical events can be monitored and alarms are set at exceedances/ significant changes. Any significant changes in the continuous monitoring will indicate a potential issue, and the alarms ensures operators are alerted immediately so that they can either resolve or escalate as necessary.

5.3.3. Service Request Monitoring

The service request database is monitored online and available to Water Unit and 3 Waters staff at all times. This is a priority for the Council and is also highly visible with a screen on the wall of the 3 Waters department, within view of the Department Manager's office. This provides an indication of the number of services requests including the status of the requests.

If the response time of a service request is not achieved, then reports are sent to the relevant team leader to review, as well as being visible on the live dashboard.

Water supply related service requests, which are escalated to the 3 Waters Team get actioned by the Water Engineer. If an urgent issue arises, the Water Engineer will notice a pattern and advise the Water Asset Manager and the Water Operations Team Leader for urgent action. Similarly, the Water Unit will action service requests, and any urgent issues arise which require escalation will be passed to the Water Engineer.

The Water Unit and 3 Waters (WU/3W) have a monthly operational meeting. For each meeting the Water Unit Manager creates a report which summarises less critical issues and service requests. The 3 Waters Team considers the issues and if improvements are required for the supply. KPIs for service requests are also discussed in WU/3W monthly meeting.

5.3.4. Full Chemical Testing

The full chemical water quality samples are collected by Water Unit sampling staff, with analysis undertaken externally by an independent laboratory. The results are compared against MAV and GV, and any transgressions are highlighted within the report. The water quality data is emailed to laboratory staff, Asset Managers and Asset Information Management (AIM) team. The Water Operations Team Leader and Water Asset Manager are responsible for reviewing this full chemical data. Furthermore, the Incident Response Plans are referred to in order to determine an appropriate response in the event of any transgression.

6. Improvement Plan

Inclusion of an improvement plan in a WSP is a statutory requirement. Under Section 69Z(2)(a)(v) of the Health Act 1956 WSPs requires a set out timetable to manage public health risks that were identified as being associated with the drinking-water supply.

6.1. Drinking-Water Quality Management Improvement Plan

Table 6.1 details the improvement schedule developed for this supply based on the 'unacceptable risks' identified in the risk assessment in Component 2 (assessment of the drinking-water supply system) and acceptable risks that could benefit from further improvement. Improvements generated from incident response reviews are displayed in Table 6.2. In addition to this, the Council is going through a process of improving documentation, systems and processes which is reflected in Table 6.3. A number of these items are District wide projects, which are relevant to the water supply. The status of these improvements are kept in TRIM 181129140491.

The Water Asset Manager has the overall responsibility of the Improvement Plan, however as is noted under 'Responsibility' in Table 6.1, some tasks are assigned to other parties, with oversight from the Water Asset Manager to ensure these are completed. Each task has been given a priority based on the following parameters:

- Priority 1 is for tasks already committed to and underway. These are tasks that are either considered an essential improvement addressing an immediate and significant deficiency, or where the cost is sufficiently low to allow them to proceed without requiring that a future budget be set.
- Priority 2 is for tasks committed to in a future budget. These are tasks that have been identified as being required, but not with an immediate need, or that may be dependent on an external factor before they can proceed.
- Priority 3 is for tasks where a need has been identified, but where there is currently no budgetary allowance to allow them to occur at this time (meaning that they will be presented to Council as part of an Annual Plan or Long Term Plan process). It is noted that if an item is identified that is deemed to meet some criteria of a Priority 1 improvement (addressing an immediate and significant deficiency) specific reports can be brought to Council outside of the Annual Plan / Long Term process to request budget with immediate effect, if warranted by the Water Safety Planning process.

Table 6.1: Improvement Schedule Generated from Risk Assessment Process

Improvement Plan Reference	Improvement	Mitigates Risk	Scheduled	Responsibility	Estimated Cost	Priority	Short term action to mitigate risk
RAI1	Develop source water risk management plan for primary sources for each supply	R1	2021/22	Water Asset Manager	$150,000 (District Wide)	1	Formal notification method set up with ECan so that we will be notified when a spill has been reported in the CDWPZ, so WDC can monitor as necessary. Real-time monitoring of source water

Improvement Plan Reference	Improvement	Mitigates Risk	Scheduled	Responsibility	Estimated Cost	Priority	Short term action to mitigate risk
							quality, with triggers to initiate Incident Response Plan if required.
RAI2	Update water quality data and compliance system	R53	2021	Water Asset Manager	Funded from department budget	1	Existing systems are in place but they are over multiple databases which triggers the need for a centralised system.
RAI3	Audit backflow prevention for restricted properties	R51	2020-2022 for on demand supplies and 2022-2023 for restricted supplies.	Water Asset Manager / Water Unit	$2,000 for Garrymere	1	Backflow prevention policy Backflow prevention education letter Chlorination Strategy (chlorination of restricted supplies)
RAI4	New sampling /distribution flushing point by furthest property	R46, R47, R49	2021	Water Operations Team	$5,000	1	Sampling and flushing can be undertaken at tobies.
RAI5	Duplicate Primary Source	R6, R10, R30, R31	2023	Water Asset Manager / PDU	$90,000	2	Water Tanker Operations (refer IRP004)

Table 6.2: Improvement schedule from incident response review

Improvement Plan Reference	Improvement	Scheduled	Responsibility	Estimated Cost	Priority	Short term action to mitigate risk
IRI1	Install expansion to turbidity meter to allow both pre-filter and post-filter turbidity to be monitored continuously.	2021	Water Asset Manager	$5,000	1	Continuous turbidity sampling of treated water leaving the treatment tanks

Improvement IRI1 will also assist with mitigating risk R27 (UV Dose too Low), to ensure the UV disinfection unit is receiving water of sufficient quality to be filtered ready for UV disinfection.

Table 6.3: Improvement to Procedures and Processes

Improvement Plan Reference	Improvement	Scheduled	Responsibility
PPI1	Add Water Safety Plan processes, and Incident Response Plans to training register, to ensure relevant staff are adequately trained in water safety processes.	March 2022	Water Asset Manager
PPI2	Develop improved methodology for assessing leakage on restricted schemes	June 2022	Water Engineer
PPI3	Create P&ID for each facility site	By March 2022	Water Asset Manager
PPI4	Complete Water Unit process mapping exercise, particularly for technician / treatment processes	Key treatment processes by September 2021, remainder by June 2022	Water Unit
PPI5	Complete Water Unit competencies documentation, particularly for technician / treatment processes	Key treatment processes by September 2021, remainder by June 2022	Water Unit

The above improvements are all allowed for within existing budgets, and the Improvement Plan has been approved by the Utilities and Roading Committee of Council as part of approval of this Water Safety Plan for submission (refer to Report 210831139727, with meeting minutes published on the Council's website).

7. Management of Incidents and Emergencies

Incidents and emergencies can pose a risk to water supplies due to their unexpected nature and unknown extent to which they may affect the supply. It is important WDC do everything reasonable and practical to plan and be prepared for an incident and emergency, so that any potential impact to residents can be adequately managed, and the consequence minimised. This component outlines the planning processes in place to deal with any reasonably foreseeable events.

It is important to note the distinction between a corrective action, and an emergency response. Corrective actions are undertaken in accordance with Component 4 (Operational Procedures), and are considered part of normal operating procedures. An incident and emergency response would only be triggered following the failure of corrective actions and/or preventative measures causing an emergency situation to arise.

7.1. Levels of Incident and Emergency

The level descriptions provided within the Handbook for Preparing a Water Safety Plan have been adopted, with some further clarification provided. These are shown in Table 7.1. These levels are used to identify the scale of incidents and emergencies, to ensure the response taken is appropriate, and consistent between events. The scales used escalate from the least significant at Level 1, to the most significant at Level 5.

Table 7.1 Incident and emergency level descriptions

Incident / emergency level	Description of Level
5	Widespread outbreak of waterborne disease. Declared civil defence natural disaster, impacting on the water supply. Water supply unable to be maintained for significant length of time (>50 properties for greater than 24 hours). Gross exceedances of one or more chemical MAVs (e.g. more than five times the MAV, including cyanotoxins)#
4	High level of E. coli (>10 per 100mL sample) or any pathogen detected in the reticulation. Failure of infrastructure resulting in the need for severe restrictions on usage (Level 4 water restrictions or greater) to maintain continuity of supply, or outage for > 20 connections for > 8 hours. Major exceedance of chemical MAV (i.e. more than 50% greater than MAV, but less than 5 times MAV)# Alert from Canterbury District Health Board that its intelligence strongly suggests cases of illness in the community are drinking-water related.
3	Detection of E. coli in the reticulation, but less than level to trigger Level 4 (i.e. ≤10 per 100mL sample). Failure of infrastructure which compromises the ability to supply water, indicating that short-term water restrictions may be required (i.e. Level 3 water restrictions) to maintain supply. Minor exceedances of one or more chemical MAVs (i.e. measured concentration between 101% and 150% of the MAV). Alert from Canterbury District Health Board that its intelligence suggests that cases of illness in the community are possibly drinking-water related.
2	Failure of infrastructure or source supply, where water quality or supply is unlikely to be compromised, or an alternative process is available to provide drinking-water. Exceedance of a DWSNZ aesthetic guideline, possibly resulting in customer complaints* or between 50% and 100% of the MAV
1	Exceedance of an operational limit, able to be managed through operational and maintenance procedures.

**excludes the aesthetic parameter of pH, where this may normally be < the guideline value on certain supplies*
 # chemical exceedances that are greater than 150% of the MAV but only intermittently, and where there are no acute risk to public health from short term exposure, may not trigger a Level 4 or 5 event. Some discretion is required once specific health advice is obtained for the chemical parameter in question, and the frequency and duration of expected exposure.

7.2. Incident Response Plans

The following incident response plans (IRPs) have been prepared to provide clear guidance on the triggers to initiate activation of an IRP, and the steps to take in responding. These ensure an appropriate, efficient and effective response to any event that may occur.

Table 7.2: Summary of IRPs

IRP ID	IRP Name	TRIM
IRP001	Microbiological Contamination of Treated Water	210303035530
IRP002	Non-Microbiological Contamination	210319046558
IRP003	Loss of Source/Treated Water Quality	210319046564
IRP004	Insufficient Supply of Water	210319046556
IRP005	Cyanotoxin Contamination – back up river sources	210319046560

Key documents relating to the IRPs are included in the Appendix 7A – 7D. These include contact details of key external and internal people to contact during an incident/emergency, the promapp process for issuing Boil Water and Do Not Drink notices, and the templates for Boil Water and Do Not Drink Water notices.

7.3. Organisational Level Emergencies

It is noted that there are some events that may have a scale of impact greater than just the water supply. While responses in relation to a given water supply are covered by Water Safety Plans, the over-arching organisational response to a wider emergency is led by the Civil Defence Emergency Management Unit. The WDC's Civil Defence Emergency Management Unit is responsible for the policies, plans and procedures for emergency responses within the Waimakariri District.

A list of national, regional and local documents have been compiled and is available on our website. These documents provide procedures and planning guides for major hazardous events. These documents briefly discuss water supply however do not cover step by step response specific to the water supply operation, as these detailed responses are covered by the Water Safety Plan process.

WDC have Business Continuity Plans (BCPs) that are activated during emergency events. This document contains information about how the organisation can keep its essential functions operational during a disruptive time and the approach WDC takes for Crisis Management. Staff have access to BCPs on the intranet and is circulated by management when required. The BCP is reviewed annually.

7.4. Emergency Response Training

7.4.1. Training in Preparedness to Respond to Event

The Council undertakes training exercises to test its response to an emergency, involving staff from across the organisation being required to simulate how they would respond to a given event. This involves the participation of 3 Waters staff, as appropriate to the event being simulated. Records of these training events are stored in TRIM under CDE-06-02.

7.4.2. Testing of Key Systems Used In Response

In addition to simulating responses to emergency events, key software and systems that may be used during an emergency event are also regularly tested to ensure that it will remain functional, and that staff are familiar with it. As an example of this, the e-text software used to generate text/email alerts to communicate quickly with any given water supply is tested by the Water Operations Team quarterly. Other systems such as backup supply bores, generators, critical alarms, and back-up treatment systems are checked periodically to ensure they are operational if and when required. Frequency of testing is generally set out in the SLA.

7.4.3. Training in Water Safety Plan Processes and Incident Response Plans

With the Water Safety Plan processes and Incident Response Plans recently having gone through an update in overall structure and content, it has been identified that training of all staff that may have actions assigned through these processes is undertaken, and records of this training captured. As this has not yet been completed, this has been identified as improvement PPI1 (refer to Component 6).

7.5. Review of Previous Incidents and Emergencies

7.5.1. Overview of Systems

A tracking system has been developed to ensure all minor incidents are tracked, and any incidents of Level 3 or greater are formally reviewed and improvements sought. A record of these events and subsequent investigations and responses are within TRIM folder WAT-06-06, with subfolders created for each Level 3 or greater event.

The register of events and tracking system is within spreadsheet TRIM 181129140491 which tracks events at all levels. The report template for incident reporting and review is within TRIM 210218028075. It is noted that historically the structure of investigation reports has reviewed, however the template report created is to be utilised for all reports from 2021 onwards.

The Water Incident Report template prompts a review into the adequacy of the following:

- The response to the event;
- Whether the root cause has been identified, and addressed to prevent recurrence;
- Whether the Incident Response Plan followed was followed, and was adequate, or requires changing;
- Whether the Water Safety Plan is required to be reviewed or updated;
- Whether there are long term consequences of the event;
- Whether there are implications from the findings that should be applied to other supplies.

All reports are completed in accordance with the above, and then forwarded to the Manager Utilities and Roading for acceptance of the investigation and the recommendations. Once this report is signed, it is then forwarded to the Drinking Water Assessor. The recommendations are then implemented, once accepted by the Manager Utilities and Roading.

7.5.2. Past Events for the Garrymere Supply

There has been one past Level 3 or greater incident on the Garrymere supply, which occurred in June 2021, following the May / June 2021 floods, as mentioned in Section 2.2.6. The completed report for Garrymere can be found in TRIM (record number 210827138990).

Key findings from the incident review were:

1. The root cause of the incident was the extreme and unprecedented rain event that impacted significantly on the raw water quality.
2. Some additional monitoring of turbidity data both prior to and post the filters will assess with understanding better the plant performance during any future events, as well as further particulate sampling. This is included as an improvement.
3. The project to establish a duplicate source will add an opportunity to have a well not screened as shallow as the current source, which may reduce the consequence of future rain events. This recommendation will be included as the duplicate source project is commenced.
4. While the event did impact upon the compliance of the plant, its impact upon the safety of the water was deemed to have been minimal, based on downstream sampling results, and multiple barriers still being maintained (i.e. UV system still achieved target dose, chlorine levels still able to be maintained, and no E. coli or coliforms detected downstream of either treatment process).
5. The suitability of the Incident Response Plan used during the event was assessed and deemed to be suitable for the event.

This incident review report was reported to the Council's Utilities and Roading Committee in September 2021, to ensure that senior leadership are aware of the incident, the investigation, and the findings.

IMPROVEMENT IRI1: Install expansion to turbidity meter to allow both pre-filter and post-filter turbidity to be monitored continuously.

8. Documentation and Reporting

8.1. Management of Documentation and Records

As a local government organisation, WDC is subject to the requirements of the Public Records Act 2005. This Act is given effect to via Council's Information Management Policy 2018 (QP-C296-A), and the WDC Information Management Procedures 2018 (QP-C296-B). All staff, external consultants and service providers creating and processing information on the behalf of Councils are required to adhere to the requirement of the Act, and Council policies and procedures.

The Council's record keeping system is managed by the Information Management Team Leader, who reports to the Chief Information Officer, within the Finance and Business Support Unit of Council. These staff hold overall responsibility for the operation and management of the document management system.

Training systems are in place, and included as part of the induction of all new employees, to ensure that individual staff use these record and information systems correctly (refer to Component 1: Commitment to Drinking-water Quality Management for training and induction processes). The establishment of these systems by the Information Management Team, and training provided to the wider organisation, enables individual staff to correctly utilise these systems such that accurate records are kept, and are readily available to support staff in their key functions and responsibilities.

While the Information Management Team is responsible for the record keeping framework and systems, the Water Asset Manager is responsible for ensuring that records in relation to water safety are created, accurate, up to date, and retrievable within this system.

8.1.1. Development of Documentation

The responsibility for the development of documentation such as policies, critical control point plans, standard operating procedures, or checklists is generally assigned to a specific staff member within an appropriate team. This will then be reviewed, and ultimately signed off at an agreed level, from a staff member or leadership group with the appropriate delegation.

Examples of categories of document types, and minimum sign-off levels is given below in Table 8.1. Included in this table is the party within the Council for ensuring that the Policy, procedure or document remains current. As a policy or process is updated, as a minimum the new policy or process will be circulated around relevant stakeholders such that they are aware of the latest document.

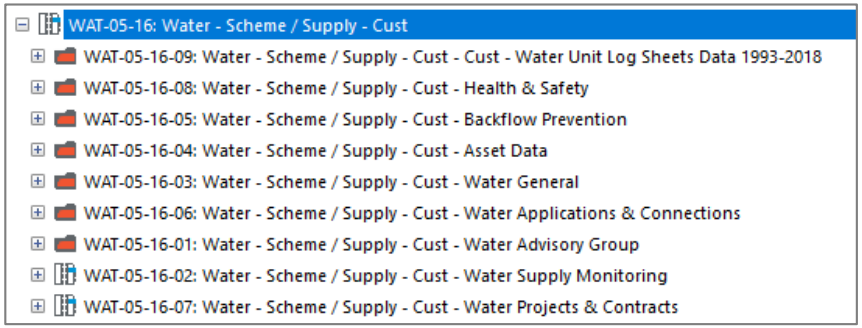
Table 8.1: System Descriptions and Responsibilities for Record Management Options at WDC

Document Category	Example Document	Approval Level	Party Responsible for Maintaining Currency
Policies	Backflow Prevention Policy	Council	Council Policy Team monitors policies, and informs policy owner of need to update.
Budget Creation	Annual Plan, Long Term Plan, Report to Council	Council	Chief Executive ultimately responsible for delivering each revised budget to Council for approval
Water Safety Plans	Individual Scheme Water Safety Plan	Utilities and Roading Committee	Water Asset Manager
Code of Practice	Hygiene Code of Practice for Work on Public Water Supplies	3 Waters Manager	Development Manager
High Level Processes and Plans	Critical Control Point Plans	Water Asset Manager	Water Asset Manager
Water Unit Standard Operating Procedures	Refer to Appendix 4A	Water Unit Manager	Water Unit Manager
3 Waters Forms	Application for the supply of water Application to connect to water infrastructure	Water Asset Manager	Water Asset Manager
Maintenance Agreements	3 Waters Water Unit Service Level Agreement (SLA)	Relevant Unit Managers	Relevant Unit Managers
Asset Information	TechOne Asset Register	Asset Information Management Team	Asset Information Team Leader

8.1.2. Document System Overview and Responsibilities

An overview of the record keeping and asset management systems used to store information in relation to water supplies and water safety is provided in Table 8.2 below. This outlines the various systems used for records of different types related to water supplies and water safety. Included are descriptions of the record system, a description of what it is and how it is used, and details on the various responsibilities for keeping, maintain, and updating records in these various systems.

Table 8.2 System Descriptions and Responsibilities for Record Management

Record Management System	Description	Applications*	Responsible Record Keeper
TRIM	All Council records are kept in the overarching record management system TRIM (Content Manager). Information such as contracts, water safety plans, water supply logs, council reports and asset information are stored within TRIM. This makes all historical records easily discoverable and searchable. This ensures that all future decision making is as informed as possible. TRIM keeps record of revision numbers for each document and shows who the revision was by. Each staff member at Council under goes TRIM training upon arrival so that the correct metadata and processesare applied when using the software. An example of the file structure in TRIM for the Cust water supply scheme is shown below. All water supplies havethe same record structure within TRIM.  	Contracts	Contract Manager (usually PDU Engineer)
		Backflow Prevention Test Records and Register (190319036125)	Water Unit Business Support Team Leader
		Backflow Prevention Property Database (191108156299)	Water Operations Team Leader
		Reports to Council / Community Boards etc.	Report author (usually Water Asset Manager)
		Asset Information (i.e. headworks as-built plans)	Water Asset Manager
		Water Applications (e.g. WAT-05-16-06)	Water Operations Team Leader
		Water Sampling / Monitoring Records (e.g. WAT-05-16-02)	Water Unit Laboratory Technician (internal results), Records Management Team (external results).
		Water Incident Records (WAT-06-06 / 181129140491).	Water Operations Team Leader

Record Management System	Description	Applications*	Responsible Record Keeper
		Other / miscellaneous	Document author
Cloud Based Hard Drive System	Council uses filing systems on the cloud based hard drive system, available via Windows explorer on each PC. Each department has a designated folder where they can save all information related to their roles. Access to specific folders is granted depending on a staff member's role at Council which reduces the likelihood of people saving files in the wrong locations etc. The IT department at WDC control who gets access to where and are available to provide assistance to all staff members using a job logging database.	Asset management and 3 waters operational working documents, pre-being finalised and uploaded to TRIM.	Water Asset Manager Water Operations Team Leader Water Engineer
		Contract management working files	PDU project manager
		Water Safety Plan working documents, pre-finalisation	PDU Water Safety Plan author.
		Electronic Lab Book	Technician Team Leader
Promapp	Promapp is process management software, which provides navigation of workflow for key processes. This has been adopted across Council to document steps required in key processes, and provide and relevant linkages. This includes implementation across water supply related activities. Each process mapped has a process owner, and relevant stakeholders who are made aware of any changes. The identification of the process owner ensures a chain of custody of any changes, and the identification of stakeholders ensures that those who utilise a given process are made aware if changes are made.	This is used to document any key processes relevant to a particular team's functions. As an example, the Water Unit have a number of reticulation maintenance processes mapped to ensure tasks are carried out consistently and correctly. Refer to Appendix 4A for examples of these processes.	A 'Promaster' is assigned within each team, as the champion to capture and input team processes.
TechnologyOne (Tech1)	Tech1 is a finance and asset management system used by Council to store all relevant asset data and associated financial information. This includes everything from asset age, material, criticality, value, depreciated value etc. As of late 2020, when the Asset Management Information System (AMIS) project was implemented, maintenance activities undertaken on all reticulation assets are fed directly from the field worker via their mobile tablet into the asset management system, which will allow improved reporting and decision making on assets. Technicians who undertake headworks and treatment plant routine inspections and maintenance tasks also utilise the Tech1 system to keep records regarding the facility operation and performance. Data is recorded on site via a tablet, uploaded to Tech1, and available via SQL reports. For more information on water supply logs and operations logs, refer Sections 4.2.1 (water supply log) and 4.2.2 (operational log). Access from the intranet: http://wmkbike/reports/browse/	Capture and update of asset information.	Asset Information Management (AIM) team.
		Financial information storage and reporting.	Finance team.
		AMIS Project Implementation	BATS team.
SCADA and Datran System	Collects raw data relating to water supply operations and compares it to assigned values. This includes power outages and mechanical faults. If the data is outside a set range, an alarm is triggered to the duty pager twice, and if both pages	Collection of all SCADA data	Control Systems Engineer

Record Management System	Description	Applications*	Responsible Record Keeper
	are not received a second alarm is sent to the standby pager. Power outage notices are sent directly to MainPower. The Water Asset Manager is immediately notified of any urgent faults and corrective actions, other non-urgent notifications are passed on at the fortnightly meeting.	Storage of data on IAAS based SQL server	IT Manager
Drinking Water Online (DWO)	All water supply sampling data is uploaded to the Drinking Water Online database. This includes E. coli and total coliform data and chemical analysis, including for P2 determinands where applicable.	Upload of all sampling data to DWO database	Water Engineer
GIS / Waimap	The Council has a GIS system that maps the location based information associated with assets stored within the Council's Asset Management System (Tech1), as well as linking to other GIS databases that are applicable (ECan). This is made available to all staff via the Waimap system, allowing easy and accurate identification of the location of assets within the district. The linkages to the Tech1 system allow this to display pipe asset information such as age, material, diameter etc., which is critical in allowing staff to undertake day to day maintenance activities.	Display of geospatial information relating to Council systems.	Geospatial Team Leader

**Application descriptions provided are not necessarily an exhaustive list, but typical examples of the way in which the various record keeping systems are used.*

The responsible record keepers above either maintain the relevant record keeping systems themselves, or are responsible for ensuring their staff regularly update these systems on their behalf.

8.2. Reporting

Reporting takes place for a range of purposes, and to a range of audiences. Reports may be internal or external. The following sections outline the nature of reporting that is undertaken, the frequency, report author, audience and distribution.

8.2.1. Internal reporting

Table 8.3 contains reports that are generated for internal circulation which contain information relating to water supply, or which have sections relevant to water supply as well as covering wider parts of the business.

Table 8.3: Internal Reports Summary

Report Description	Frequency / Timing	Author	Audience	Distribution
Water Conservation Implementation Report. This is an annual report on the implementation of the Council's Water Conservation Strategy, including information on leakage analysis and benchmarking, and other water conservation related initiatives.	Annually after the end of Council's financial and reporting year.	Water Asset Manager	Utilities and Roading Committee	Agenda and report content is publicly available on the Council's website
Annual Drinking Water Quality and Compliance Report	Annually, after the annual report from Drinking-Water Assessor received	Water Asset Manager	Utilities and Roading Committee	Agenda and report content is publicly available on the Council's website
SCADA Report on overall performance of SCADA system	Monthly	Control Systems Engineer	Water Operations Team Leader / Water Asset Manager / Water Unit	Email
Incident Response Report (as per Section 7).	Following Level 3 or greater incident, as defined in Section 7.	Water Operations Team / Water Asset Manager	Manager Utilities and Roading (minimum) with potential for escalation to Management Team or Utilities and Roading Committee. Drinking Water Assessor	Email
KPI Annual Report – to show conformance with the level of service and mandatory KPIs (protozoa and bacterial compliance) based on data and service requests. KPI data is feed into the Annual Report.	Annually	Water Asset Manager	Council/Department of Internal Affairs	Email
UV Disinfection Compliance Report to assess UV systems against DWSNZ.	Monthly, for each scheme with UV treatment.	Water Engineer	Water Asset Manager	Email
Water Unit Monthly Operational Progress Report	Monthly	Water Unit Manager	3 Waters and Water Unit staff at monthly meeting	Email distribution, in person discussion at meeting.
Council Decision / Council Information Reports - Where issues arise that require councillors to be briefed or make a decision such as project procurement and legal obligations and financial issues.	As required	Staff	Council	Agenda and report content is publicly available on the Council's website.

8.2.2. External reporting

The following reports in Table 8.4. are prepared primarily for external audiences. It is noted that some of the reports in Table 8.3 were for both internal and external audiences.

Table 8.4. External Reports Summary

Report Description	Frequency / Timing	Author	Audience	Distribution
Annual Report - This reports is a comprehensive account of Council's activities from the previous year and includes key financial and non-financial performance measures.	Annually after end of Council financial year	Chief Executive / Mayor	General Public	Website and hard copies at service centres
Long Term Plan – 10 year outlook for community outcomes, Council activities, long term focus for Council, allows for integrated decision making between community and council.	Three yearly	Chief Executive / Mayor	General Public	Website and hard copies at service centres
Annual Plan – Contains proposed annual budget and activities for relevant financial year from the Long Term Plan	Annually	Chief Executive / Mayor	General Public	Website and hard copies at service centres
Drinking Water Standards Compliance – An electronic report to measure water quality monitoring data against DWSNZ compliance requirements. Indicates if a scheme is not complying so action can be taken to improve the scheme	Quarterly	Water Engineer	DWA	Electronic report in DWO
Resource Consent Compliance – Data is submitted to ECAN to demonstrate compliance with resource consent	Annually	Water Engineer	ECan	Email
Activity Management Plans	Three yearly	PDU & 3 Waters	WDC Staff, Councillors and General Public	Website and hard copies at service centres
Water Supply Advisory Groups receive verbal reports of scheme operations, at meeting, documented in minutes which are circulated.	When meeting required	3 Waters Administration Assistant	Local community/General Public	Minutes and agendas are publically available on Council's website
Water Safety Plans and System Assessments	5 yearly, or when major upgrade occurs	WDC staff	General Public and CDHB	Submitted to CDHB via email, approved plans on website
Water New Zealand National Performance Review. This is an annual report published by Water New Zealand, which the Waimakariri District Council contributes data towards to allow national benchmarking of system performance.	Annual	Water New Zealand	General public, and other local authorities / water suppliers.	Water New Zealand website.

9. Investigations

This section sets out the procedure for activating, planning and carrying out investigations as part of WDC's preventative risk management approach and during instances of unsatisfactory performance of the drinking-water supply. This includes the identification of situations that may result in the need for an investigation, and the procedures for activating, planning and carrying out the investigation, depending on the purpose of the individual investigation.

Also included is documentation of the processes followed for ensure there is sufficient validation of equipment, processes and practice. This validation collects evidence to establish that preventative measures are capable of performing to the level expected.

9.1. Investigative Studies

Investigations enable continuous improvement, helping to increase understanding of hazards, hazardous events and risks, as well as the appropriateness of preventative measures in controlling these risks. These investigations may either be reactively activated following an event (reactive investigations) or a planned investigation, put in place proactively to gain a better understanding of an element of the water supply (proactive investigations). These two types of investigations are outlined below.

Reactive Investigations: These are undertaken following incidents such as those described in Component 7 (Incidents and Emergencies). This includes some reactive investigations following customer complaints. These incidents are described in further detail within Section 7.1.

Following the incident, an Incident Review will be completed, which documents the investigation to the reactive investigation. Past incident reports are saved in TRIM, within folder WAT-06-06. This report may assign corrective actions, and will include the person responsible, and timeframe to address any deficiencies identified.

Proactive Investigations: These are undertaken as part of normal good practice of either operating a water supply, or assessing the performance of a water supply to consider the need for any upgrades. These ensure that system performance is well understood and functioning as expected, and the consequences of any changes are sufficiently considered and assessed before being implemented.

The process for activating and implementing investigations is outlined in Table 9.1.

Table 9.1: Investigation Process Summary

Investigation	Process
Trigger to initiate investigation	An investigation will be undertaken for each event / incident of Level 3 or greater, as defined in the WDC Incident Response Plans.
Responsibility for the investigation	Reactive Investigations will generally be led by the Water Operations Team Leader, although this specific determination will be made as the incidence response process is initiated. Proactive Investigations will be initiated by the Water Asset Manager, who will assign roles at the initiation of the investigation.
Steps to be taken	Reactive Investigations will have steps defined as per Incidence Response Plan. Proactive Investigations will be have project specific steps, defined in the relevant project plan.
Actions to be taken after completion of the investigation	Reactive Investigations will have an Incident Report completed, utilising the template document (210218028075). This report will be forwarded to the Manager Utilities and Roading, and the Drinking Water Assessor.

Investigation	Process
	Proactive Investigations will generally result in recommendations, which will be investigation specific. The Water Asset Manager will receive the output from the investigation, and assign staff to complete the next steps.

Multiple proactive investigations are completed each year as part of the preventative risk management processes WDC uses. Table 9.2 and Table 9.3 show district wide investigations and scheme specific investigations, respectively.

Table 9.2: Proactive Investigations Summary – District Wide

What	Why	Where	Who – Physical Works	Who - Review	When	How
Hydraulic Modelling Investigations	To assess how the network is performing, identify deficiencies, and plan for growth.	Each WDC scheme	Network Planning Team	Water Asset Manager	Full analysis is undertaken every 3 years, to inform the Activity Management Plans, and LTP. Small scale investigations are undertaken as required, in response to new subdivision applications or queries.	The Network Planning Team input growth projections, existing asset data, assess existing performance, assess impact of growth, and recommend any upgrades to maintain levels of service. (TRIM reference 201102146327).
Leakage Investigations	To assess the condition of distribution pipes, and understand trends / changes, prioritise upgrades or further assessments.	Each WDC scheme	Network Planning Team Project Engineer for high level analysis, Water Engineer for scheme specific detailed studies.	Water Asset Manager	High level assessment and reporting annually, which triggers scheme specific studies.	Each scheme has their night flow rates analysed annually and an ILI value is assigned. These results are compared with national/international standards to clearly demonstrate the condition of the pipe network, relative to other supplies both within the district, and nationally/internationally. The Network Planning Team carries out the high level assessment, the Water Engineer identifies scheme specific studies from these results, and the Water Asset Manager reports this to Council's Utilities and Roading Committee. See Section 2.1.2.

Table 9.3: Proactive Investigations Summary – Scheme Specific - Garrymere

What	Why	Where	Who – Undertake Assessment	Who - Review	When	How
Garrymere Water Supply Upgrade Options Assessment - 2017	To identify the best option to upgrade the Garrymere water supply to achieve	Specific to Garrymere scheme	WSP Opus	Water Asset Manager	2017	Opus were engaged to investigate options to upgrade the Garrymere water supply headworks to achieve compliance with the DWSNZ. A

What	Why	Where	Who – Undertake Assessment	Who - Review	When	How
	compliance with the DWSNZ.					number of options were assessed, and ultimately this resulted in a 4-log treatment system of cartridge filtration and UV disinfection being installed. Refer TRIM 171026115522 for options report.

9.2. Validation of Equipment, Processes and Practices

Validation of equipment is undertaken to ensure critical assets are preforming at the level expected. Table 9.4 provides an overview of the equipment which operators are required to validate. The aim of validating equipment regularly is so that WDC can ensure that all data collected is accurate, to ensure responses to data are appropriate. Not all schemes have the same treatment equipment, and therefore some of the validation processes are scheme specific, depending on the applicable treatment equipment. In some cases Promapp processes have been developed specific to the referenced validation tasks, which are referenced where applicable.

Table 9.4: Validation of Equipment

Equipment Requiring Validation	How	Frequency	Person Responsible	Performance Value	Applicable schemes / sites
Turbidity Meter (site)	*'Use and Maintain Online Water Monitoring Equipment'*	Verification weekly Calibration of analyser monthly	Site operator	*'Use and Maintain Online Water Monitoring Equipment'*	• Waikuku Beach • Mandeville • Garrymere • Kaiapoi • Rangiora • Woodend-Pegasus • Oxford Urban – Rural No.2 • Oxford Rural No.1
Turbidity Meter (Handheld)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	Standardised daily, or each time unit is switched on.	Handheld unit owner (sampler or operator)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	• All
Chlorine Analyser (site)	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	Weekly verification. Quarterly calibration (minimum).	Site operator	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	Permanent Chlorination • Pegasus • Ohoka • Mandeville • Oxford Rural No.1 • Oxford Rural No.2 • Cust • West Eyreton • Summerhill • Poyntzs Road • Garrymere Emergency only • Rangiora • Oxford Urban • Woodend
Chlorine Analyser (Handheld)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	Verified weekly using manufacturer's verification device. 6 monthly by accredited external laboratory	Handheld unit owner (sampler or operator)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	

Equipment Requiring Validation	How	Frequency	Person Responsible	Performance Value	Applicable schemes / sites
					• Waikuku Beach • Kaiapoi •
UVT (site)	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	Verification weekly Calibration every 30 days	Site operator	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	• Waikuku Beach
UVT (handheld)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	Calibration quarterly	Site operator	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	• All
pH Meter (site)	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	Verification weekly. Calibration either in response to verification result, or monthly.	Site operator	*Refer Promapp 'Use and Maintain Online Water Monitoring Equipment'*	• Oxford Urban / Rural No.2 (Bay Road and Gammans) • Mandeville • Oxford Rural No.1 (McPhedrons) • Pegasus • Garrymere
pH meter (handheld)	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	Calibration weekly	Site operator	*Refer Promapp 'Use and Maintain Handheld Water Testing Equipment'*	• Oxford Urban / Rural No.2 (Bay Road and Gammans) • Mandeville • Oxford Rural No.1 (McPhedrons) • Pegasus • Garrymere
UV disinfection unit	Verification of reported dose is carried out by reference sensor check	Duty sensor – monthly Reference sensor - annually	Site operator	Refer CCP for target dose, and responses to breaches. Check recorded doses are within 10% of reference sensor.	• Waikuku Beach • Mandeville • Garrymere
Pressure Transducer	Transducer value to be verified against manual gauge.	Various as per SLA	Site operator	Adjust if there is a discrepancy	• All
Flowmeter on water takes	External verification	5 years	Water Engineer to engage external party	As per ECan requirements.	• All
Reservoir level sensor	Calibration	Annually	Site operator	As per SLA	• All (except Waikuku Beach)

Equipment Requiring Validation	How	Frequency	Person Responsible	Performance Value	Applicable schemes / sites
Secure Bore Water Status	Age dating / young fraction analysis by GNS	5 yearly	Water Asset Manager	Bore head security (DWSNZ, Section 4.5 Criterion 2).	• Rangiora • Kaiapoi • Woodend-Pegasus • Cust • Ohoka • Oxford Urban • Oxford Rural No.2 • Oxford Rural No.1 • West Eyreton – Summerhill - Poyntzs
Generator Run	Turn on generator	Monthly	Site operator	Generator should run without problems.	• Rangiora • Kaiapoi • Woodend-Pegasus • Cust • Oxford Urban • Oxford Rural No.2 • Waikuku Beach
External Asset Condition Check	External check of wells, treatment plants, pump stations and reservoir sites.	Various as per SLA	Site operator	Visual external check to ensure assets condition doesn't show major issues or damage which might present risk. As per SLA.	• All
New Treatment System Or Operational Asset	Pre-validation by manufacturer	Prior to purchase	Capital Works Engineer	As per guideline values in DWSNZ.	• As required
	Treatment system specific	At commissioning	Capital Works Engineer	Refer to relevant commissioning report.	• As required

In response to a failed verification or calibration result, the operator undertaking the checks will generally be able to rectify the result such that the equipment can achieve readings within its required level of accuracy at the time. If this is unable to be achieved, they may escalate this to the Technicians Team Leader for assistance, who would escalate this to the Water Operations Team Leader if they were still unable to achieve satisfactory results.

For more information on sampling, training and sampling checks, refer to Sections 4.2 and 5.3.

9.3. Validation of Alarms

A number of preventative measures are reliant on alarms being generated through the Council's SCADA system. To maintain confidence that this system is operating correctly to generate alarms if and when required, Water Unit Operators are required to undertake Critical Alarm checks. The requirements of these checks are outlined in the 3 Waters Water Unit SLA, which gives the types of alarms to check, the frequency, and some requirements about how the event is required to be simulated to generate the alarm.

10. Oversight, Review and Continual Improvement

This component provides an overview of Council's high level oversight and performance assessment against organisational goals and objectives, and lessons and opportunities for continual improvement. This includes processes for the long term evaluation of results, audits of drinking-water quality management, and review by senior leadership within the organisation.

10.1. Long Term Evaluation of Results

Long term evaluation of operational, investigative and verification monitoring results is an important process to ensure preventative measures are functioning correctly. The evaluation assists in identifying future improvements required for maintaining/improving water quality in the district, to ensure that continual improvement is achieved.

Every year there are multiple internal audits of Council's water quality data and associated processes. A number of these feed into reports, as described in Table 8.3. These reports are used to identify any emerging issues that may be occurring, such that any issues can be pre-empted and addressed. The responsibility for completion of each of these reports is documented within Table 8.3.

A key report that compiles and considers long term results is the Annual Drinking Water Quality and Compliance Report. This is prepared by the Water Engineer and Water Asset Manager, and is based on a template document to ensure that all required matters are considered (refer TRIM 210303035602). It includes analysis of performance over a number of measures over the previous 12 months, then compares results with historical data, and makes recommendations based on this analysis. As the report is submitted to the Council's Management Team and ultimately the Utilities and Roading Committee, these recommendations are escalated through the Council's senior management as necessary. The results considered as part of this report include:

- Compliance against bacterial, protozoal, chemical and radiological components of the DWSNZ.
- Assessment of trends of other water quality parameters, particularly total coliforms.
- A summary of any incidents during the year, with consideration of any previous events, or the emergence of any patterns.
- Water quality or continuity of supply related complaints.
- Water Safety Plan compliance, and consideration of the need for any changes to processes within the plans, based on the previous year's results. This includes the completion of an annual review of all Water Safety Plans, based on template TRIM 210309039827.

In addition to the annual review, all Water Safety Plans undergo comprehensive reviews either every 5 years or when there is a major change to a supply. The preparation of an updated Water Safety Plan triggers a full review of risks to the water supply, which incorporates a review and analysis of water quality data trending for the lifetime of the supply. This Water Safety Plan review process is discussed further under 10.2 Audit of Drinking-Water Quality Management.

The past results as summarised in these annual reports have helped to inform this Water Safety Plan. In particular the risk assessment takes into account this data when considering recurrence intervals of events which informs the likelihood scoring, as well as certainty levels which are a function of the available data to inform the score assigned.

10.2. Audit of Drinking-Water Quality Management

Auditing is the systematic evaluation of activities and processes to confirm that defined objectives are being met. This seeks to determine whether the Water Safety Plan has been implemented as planned, and, coupled with the long term evaluation of results, whether the Water Safety Plan is adequate. Audits are both internal and external.

10.2.1. Internal Audits

Internal audits are carried out at varying levels within the organisation. These included at a 3 Waters / Water Unit level, between 3 Waters or Water Unit staff and external contractors, and at an organisational level. These varying levels of audit are described below:

Water Unit Performance

Following the launch of Council's Asset Management Information System (AMIS) and the update and implementation of the 3 Waters Water Unit Service Level Agreement (SLA, TRIM folder WAT-06-05), the Water Unit and the 3 Waters Unit have improved transparency regarding operational and maintenance activities, and performance. The SLA sets out expectations and requirements for the Water Unit to fulfil, while the AMIS is a system for recording and capturing this information as work is undertaken.

Phase 1 of AMIS was launched in November 2020, which covers all reactive maintenance and response to events within the reticulation system. The SLA was finalised and signed in early 2021.

The SLA has a number of Key Performance Indicators (KPIs) within it, which the Council's Water Engineer audits monthly. The audit is completed, forwarded to the Water Operations Team Leader, and brought to the monthly 3 Waters / Water Unit Operational meeting. At this meeting, any matters arising from the audit process in terms of KPIs not being met are discussed, and actions assigned to resolve issues as necessary. An example of a monthly audit is TRIM document 210318045854, with key items assessed listed below:

- **Service Delivery:** This includes assessment of service request completion timeframes, reactive work order completion times, water supply outages, and time taken to attend site.
- **Work Delivery:** This includes assessment of the completion levels of planned inspections, operational visits, and water sampling tasks across the district relative to requirements as set out in the SLA.
- **Quality:** This includes the assessment of the quality of the work with the completed tasks. This includes verification and review of the quality of data input via service requests, work orders, planned works etc.
- **Reporting:** This assesses the completion levels for operational reports from the Water Unit, and Health and Safety reporting.

Hygiene Code of Practice Implementation

In 2020, Council adopted the Waimakariri District Council Hygiene Code of Practice for Work on Public Water Supplies. This includes a number of requirements to ensure that appropriate processes are followed on Council's systems. In order to ensure this is implemented, audits are undertaken when live mains are connected into. A Water Unit staff member will oversee the connection, complete an evaluation form, and this will be automatically forwarded to the 3 Waters Team, where the Water Engineer will review the results. If the results are not satisfactory, the Water Engineer will discuss the issues identified with the Water Unit staff member overseeing the works, and determine the appropriate level of response, following guidance given within the Hygiene Code of Practice document. Completed audit forms are saved in TRIM under WAT-02-03-01.

Organisational KPIs and Levels of Service

The Water Unit's performance against KPIs are linked to organisational KPIs and level of service performance measures. These performance measures are set 3-yearly via the Activity Management Plan and Long Term Plan process. These are then assessed at the following levels:

- **Senior Management Level:** Performance against KPIs is visible throughout the organisation via the Power BI reporting tool. Performance in terms of response times, resolution times, significant outages, water consumption, and compliance with the DWSNZ is visible internally via a traffic light system. This allows 3 Waters and Water Unit staff to monitor performance against these targets, as well as the Council's senior management team to have oversight.
- **Governance Level:** Each quarter, the Water Asset Manager completes reporting against levels of service, and these are reported to Council's Executive Management Team, before being reported to Council's Audit and Risk Committee, who review the results. Where there are any unsatisfactory results, an action to resolve is included to ensure events are followed up on and tracked.
- **External Level:** Each year the levels of service performance measures are reported via Council's Annual Report, which are audited by the Department of Internal Affairs to ensure what is being reported is accurate.

Water Safety Plan Audit

It is noted that other processes described under Component 8 (Documentation and Reporting) include audit functions, as well as reporting functions. For example as part of the process of preparing the Annual Drinking Water Quality and Compliance Report, a Water Safety Plan review is carried out. The review template is shown in Appendix 10A. Water Operations Team and Water Asset Manager will be responsible for communicating the key outcomes to relevant staff members. Any actions that are required following the review will be added to the Process Improvement Spreadsheet, which is included in a tab within spreadsheet TRIM 181129140491. The review will occur after the DWA annual compliance report is received and key outcomes will be included in the annual Water Quality and Compliance Report.

10.2.2. External Audits

External audits of Council's performance are carried out by the following parties:

- **Drinking Water Assessors (DWAs):** DWAs audits of Council's performance in delivering drinking-water in terms of the annual compliance report, Water Safety Plan review and approval process, Water Safety Plan implementation visits, and approval of secure bore applications. These audit processes may involve recommendations or non-conformances. These are reviewed, tracked and actioned in order to ensure compliance is maintained, or non-compliances are rectified. WDC records recommendations from the audits of each scheme in TRIM record 181130141173. The Water Asset Manager is responsible for ensuring that actions are assigned and completed. Outcomes from resolutions of each recommendation are recorded to demonstrate what changes that have been made.
- **Department of Internal Affairs (DIA):** As noted earlier, DIA is one of the parties (as well as internal parties) that audits Council's performance against level of service performance measures.

10.3. Review by Senior Leadership

The Water Engineer alongside the Water Asset Manager is responsible for preparing an annual Drinking Water Quality and Compliance Report (refer TRIM 210303035602 for template document) for the Utilities

and Roading Committee, which is reviewed by the Council's Management Team before submission to the Utilities and Roading Committee. Also of note is that reports presented to the Utilities and Roading Committee are published on a public agenda, with members of the public and media welcome to attend meetings. This ensures not only review and scrutiny from the senior leadership of the Council, but also the wider community.

This report covers all WDC supplies and summarises information such as:

- Internal and external audit reports
- WSP annual performance evaluation outcomes
- Long-term evaluation of water quality results and conclusions drawn from these
- Incident/investigation reports
- Service requests from water quality or level of service related complaints
- Impacts of changes to legalisation, expectations and requirements

This information enables the Utilities and Roading Committee to gain an in-depth understanding of the performance of Council's water supplies against the various measures above. If staff believe changes to budgets or processes that require elected member delegation to progress (i.e. assigning a new budget) as a result of the findings of the report, a recommendation will be made. This allows senior leadership to review the results for the Council's various schemes, and make informed decisions about any key changes required.

Another mechanism by which senior leadership of the Council review the performance and safety of water supplies is via the Water Safety Plan approval process. Prior to submission, each WDC WSP is:

- Prepared by 3 Waters Unit, PDU and Water Unit staff.
- Reviewed by the 3 Waters Manager, and Manager Utilities and Roading.
- Submitted to the Council's Management Team for approval;
- Submitted to the Council's Utilities and Roading Committee for final sign-off before submitting to the DWA.

The above process ensures that all levels of leadership within the Council are provided with the opportunity to review the outcomes of the WSP, understand the key risks and proposed improvements, before final submission. This process links back to the principles of Component 1 (Commitment to drinking-water quality management), in which there is a commitment made to drinking-water quality management by the organisation.

11. Appendices

APPENDIX 1A: Council Meeting Calendar 2021

Waimakariri District Council
Meetings Calendar of 11th Term of Council
November 2020 to December 2021

CE Review Committee Tuesday	
13 April 2021	10am
14 September 2021*	10am

LGNZ Conference
July 2020 (CE, Mayor + Councillors)

Long Term Plan Community Consultation
Friday 5 March to Monday 12 April 2021

Council Briefings 2021
1pm 2nd Tuesday in Chambers

	Agenda items advised to Governance@wmk
9 February 2021	*21 January*
9 March	*17 February*
13 April	*24 March*
11 May	*21 April*
8 June	*25 May*
13 July	*23 June*
10 August	*21 July*
14 September	*25 August*
12 October	*22 September*
9 November	*20 October*

2021 Statutory Holidays	
1 January 2021 (Fri)	New Years Day
8 February (Monday)	Waitangi Day
2 April (Friday)	Easter
5 April (Monday)	Easter
26 April (Monday)	ANZAC
7 June (Monday)	Queens Birthday
25 October (Monday)	Labour Day
12 November (Friday)	Canterbury Show Day
27 December (Monday)	Christmas Day
28 December (Tues)	Boxing Day

Community Service Awards
Wednesday 20 October 2021

Citizenship Ceremonies *Thursdays, 3.30pm in Chambers*
Subject to DIA

Council Tuesdays

Meeting Date	*Time*	*Agendas Close (Thurs 5pm)*
Tuesday 3 November 2020	1pm	22 October
Tuesday 1 December 2020	1pm	20 November
(Long Term Plan Budget Meetings)	(Agenda despatche 15 January)	
Tuesday 26 January 2021	9am – 6pm	7 December
Wednesday 27 January	9am – 6pm	7 December
Thursday 28 January	9am – 5pm	7 December
Tuesday 2 February	1pm	21 January
Tuesday 23 February *(Approve LTP for consultation + DP Notification)*	pm	11 February
Tue 2 March	1pm	18 February
TBC – **HUI -Thurs 18 or 25 March @ WDC**	5.30pm	
6 April	1pm	18 March
*Tuesday 4 May @ (Kaiapoi)**	1pm	22 April
Hearing LTP submissions		
Wed 5 May (Kaiapoi)	1pm – 6pm	22 April
Thurs 6 May (RSC	9am – 9pm	22 April
Fri 7 May (Oxford)	9am – 1pm	22 April
LTP Deliberations		
Tues 25 May	9am – 6pm	6 May
Wed 26 May	9am – 6pm	6 May
Thurs 27 May	9am – 5pm	6 May
Fri 28 May (reserve)	9am - noon	
1 June	1pm	20 May
15 June *Adopt LTP*	2.30pm	27 May
6 July	1pm	24 June
3 August	1pm	22 July
7 September @ Ruataniwha Kaiapoi Civic Centre*	1pm	26 August
5 October incl Adopt AR	1pm	23 September
12 October Extraordinary adopt AR (Reserve Date)	1pm	30 September
2 November	1pm	21 October
7 December 2021	1pm	25 November

Waimakariri District Council
Meetings Calendar of 11th Term of Council
November 2020 to December 2021

Joint Governance discussions with Neighbouring Councils (Mayor and Councillors) –
all dates yet to be confirmed, primarily 9.30am/10am – 11.30am/noon

Ecan	(pm) 29 March 2021 & 24 August (am) 2021
CCC	9.30am – 11.30am 30 March 2021 (confirmed) & (am) 28 September 2021
Hurunui	23 February 2021 & 7 September 2021
Selwyn	11 May 2021 & 9 November 2021

Hearings / Bylaws

Cemeteries Bylaws	3 & 4 March 2021
tbc	16 & 17 June
Tbc	Week 28 June
Tbc	Week 26 July
tbc	18 & 19 August
tbc	Week 27 September

No meetings to be scheduled Week 26 April (school holiday Councillor break week)

No meetings to be scheduled Week 12 July (other than WSCB & RACB) (school holiday Councillor break week)

School Holidays (guide)

17 December 2020 – 31 January 2021
17 April – 2 May 2021
10 July – 25 July
2 October – 17 October
18 December 2021 – 30 January 2022

Christmas Council Closure
Rangiora Service Centre
Closed noon Thursday 24 December 2020.
Reopen Wednesday 6 January 2021.
Closed noon Friday 24 December 2021 (tbc)

Waimakariri District Council
Meetings Calendar of 11th Term of Council
November 2020 to December 2021

Oxford-Ohoka Community Board
(Alternating Oxford, Mandeville, West Eyreton, Cust & Ohoka locations)

Meeting Date (1st Wednesday* after Council)	Time	Agendas Close (Thursday 4pm)
Public forms 7pm to 7.25pm		
4 November 2020 – Oxford	7.00pm	22 October
2 December 2020 – Ohoka	7.00pm	19 November
3 February 2021 -	7.00pm	21 January
3 March 2021 –	7.00pm	18 February
7 April 2021 -	7.00pm	25 March
5 May 2021	7.00pm*	22 April
2 June 2021–	7.00pm	20 May
7 July 2021–	7.00pm	24 June
4 August 2021 –	7.00pm	22 July
9 September – THURSDAY	7.00pm	26 August
6 October –	7.00pm	23 September
3 November 2021 -	7.00pm	21 October
9 December 2021 - THURS	7.00pm	25 November

Rangiora-Ashley Community Board
(Council Chambers}

Meeting Date (2nd Wednesday)	Time	Agendas Close (Thursday 4pm)
11 November 2020	7.00pm	29 October
9 December 2020	7.00pm	26 November
10 February 2021	7.00pm	28 January
10 March 2021	7.00pm	25 February
14 April 2021	7.00pm	1 April
12 May 2021	7.00pm	29 April
9 June 2021	7.00pm	27 May
14 July 2021	7.00pm	1 July
11 August 2021	7.00pm	29 July
8 September 2021	7.00pm	26 August
13 October 2021	7.00pm	30 September
10 November 2021	7.00pm	28 October
8 December 2021	7.00pm	25 November

Woodend-Sefton Community Board
(Alternating Woodend and Pegasus Community Centres)

Meeting Date (2nd Monday)	Time	Agendas Close (Thursday 4pm)
9 November 2020 - Woodend	6.00pm	31 Oct
7 December 2020 - Pegasus	6.00pm	28 Nov
9 February 2021 - Waikuku (Tuesday)	6.00pm	28 January
8 March – Woodend	6.00pm	25 February
12 April - Pegasus	6.00pm	1 April
10 May – Woodend	6.00pm	29 April
14 June – Pegasus	6.00pm	3 June
12 July – Woodend	6.00pm	1 July
9 August – Pegasus	6.00pm	29 July
13 September – Woodend	6.00pm	2 September
11 October – Pegasus	7.00pm	30 September
8 November – Woodend	6.00pm	28 October
13 December 2021 – Pegasus	6.00pm	2 December

Kaiapoi-Tuahiwi Community Board
Venues: Ruataniwha Kaiapoi Civic Centre (upstairs meeting room)

Meeting Date (3rd Monday)	Time	Agendas Close (Thurs 4pm)
16 Nov 2020	5.00.pm	5 November
14 Dec 2020	5.00pm	3 December
15 Feb 2021	5.00pm	4 February
15 March	5.00pm	4 March
19 April	5.00pm	8 April
17 May	5.00pm	6 May
21 June	5.00pm	10 June
19 July	5.00pm	8 July
16 August	5.00pm	5 August
20 September	5.00pm	9 September
18 October	5 00pm	7 October
15 November	5 00pm	4 November
20 December 2021	5.00pm	9 December

Community Board Chairs, Deputy Chairs & Mayor Discussions
(Prior to All Board Briefings)

Thursday 4 March 2021	3.30pm – 4.30pm
Wednesday 21 April	3.30pm – 4.30pm
Thursday 10 June	3.30pm – 4.30pm
Monday 6 September	3.30pm – 4.30pm
Wednesday 27 October	3.30pm – 4.30pm

All Boards – 5pm to 6.45pm
(agenda items to Com.Boards@wmk 4 weeks prior to meeting)

Thursday 4 March 2021
Wednesday 21 April
Thursday 10 June
Monday 6 September
Wednesday 27 October

Waimakariri District Council
Meetings Calendar of 11th Term of Council
November 2020 to December 2021

ENC Wednesdays 3pm

10 February 2021	Hurunui
31 March	Kaiapoi
26 May ** (LTP clash)	Hurunui
28 July **	Kaiapoi
29 September	Hurunui
24 November **	Kaiapoi

** sponsor event 5pm – 6.30pm Mayor & CE expected

Waimakariri Road Safety Coordinating Committee

2nd Wednesday of 2nd month at 10am
(Rakahuri Committee Rooms, Rangiora)

9 December 2020	10 February 2021
14 April 2021	9 June 2021
11 August 2021	13 October 2021
8 December 2021	

Multi Sports Facility Steering Group

Fourth Thursday of month at 10.30-noon

26 November 2020	
25 February 2021	25 March 2021
22 April 2021	20 May 2021
24 June 2021	22 July 2021
26 August 2021	

Waimakariri Water Zone Committee

First Monday at 3.30pm

	Agendas Close (Thursday at 4pm)
1 February 2021 @ 3.30pm	21 January
1 March @3.30pm	21 February
3 May @ 3.30pm	22 April
2 August @ 3.30pm	22 July
1 November @3.30pm	21 October

District Licensing Committee

(last Friday of the month at 9am)

Council Chambers

27 November 2020	agenda close 12 Nov
26 February 2021	agenda close 11 Feb
26 March 2021	agenda close 11 Mar
30 April 2021	agenda close 15 Apr
25 June 2021	agenda close 10 Jun
27 August 2021	agenda close 12 Aug
24 September 2021	agenda close 9 Sept
29 October 2021	agenda close 14 Oct
26 November 2021	agenda close 11 Nov

Waimakariri Passchendaele Advisory Group

Mondays

29 March 2021	28 June
27 September	29 November 2021

Greater Canterbury Partnership Cttee

2nd Friday 9am @ Ecan

12 February 2021	12 March
9 April	14 May
11 June	9 July
13 August	10 September
8 October	5 November
10 December 2021	

Represented by Mayor and Councillors Atkinson & Mealings

Full GCP partner governance mtgs – 9am to noon

Fri 5 March, Fri 19 March, Fri 18 June and Fri 15 Oct 2021

Youth Council

last Tuesday of month @ 7pm

26 November 2020	Nil in December
26 January 2021	23 February 2021
30 March	27 April
25 May	29 June
27 July	31 August
28 September	26 October
30 November	Nil in December 2021

Te Kōhaka o Tuhaitara Trust

First Wednesday of month at 5pm

4 November 2020	2 December 2020
3 February 2021	3 March 2021
7 April 2021	5 May 2021
2 June 2021	7 July 2021
4 August 2021	1 September 2021
6 October 2021	3 November 2021
1 December 2021	*(Cr A Blackie is Rep)*

Rūnanga Meetings

First Thursday at 10am
(Committee Rooms, Rangiora Service Centre)

4 February 2021
4 March
6 May 2021
1 July 2021
2 September 2021
4 November 2021

Annual Hui with Rūnanga at WDC
Thursday18 or 25 March 5.30pm

Waimakariri District Council
Meetings Calendar of 11th Term of Council
November 2020 to December 2021

Audit & Risk Committee

Meeting Date (Tuesday)	*Time*	*Agendas Close (Thurs 4pm)*
17 November 2020 **	9am	5 Nov
16 February 2021	9am	4 Feb
16 March **	9am	4 March
18 May	9am	6 May
20 July	9am	8 July
21 September	9am	9 Sept
16 November **	9am	4 Nov

** ENC & Te Kohaka Trust presentations of Financial Reporting (finish by 12.30pm)

Community & Recreation Committee

Meeting Date (Tuesday)	*Time*	*Agendas Close (Thurs 4pm)*
15 December 2020	4.00pm	3 Dec
23 February 2021	4.00pm	11 Feb
23 March	3.30pm	11 March
18 May	2.30pm	6 May
22 June	1.00pm	10 June
17 August	4.00pm	5 Aug
19 October	4.00pm	7 Oct
14 December 2021	4.00pm	2 Dec

Land & Water Committee Tuesdays 1pm

	Agenda closes
10 December 2020	26 Nov
16 February 2021	4 Feb
20 April	8 April
18 May	Mar
20 July	8 Jul
21 September	9 Sept
16 November 2021	4 Nov

Utilities & Roading Committee

Meeting Date (Tuesday)	*Time*	*Agendas Close (Thurs 4pm)*
17 November 2020	4:00pm	5 Nov
18 December 2020	9.00am (Fri)	10 Dec
16 February 2021	3.30pm	4 Feb
16 March	3.30pm	4 March
20 April (3waters reporting)	3.30pm	8 April
18 May	4.00pm	6 May
15 June	3.30pm	3 June
22 June (3waters reporting)	3.30pm	10 June
20 July	3.30pm	8 July
24 August (3waters reporting)	3.30pm	12 August
21 September	3.30pm	9 Sept
26 October (3waters reporting)	3.30pm	14 October
16 November	3.30pm	4 Nov
14 December 2021 (3waters reporting/update)	2.30pm	2 Dec

District Planning & Regulation Committee

Meeting Date (Tuesday)	*Time*	*Agendas Close (Thurs 4pm)*
15 December	1.00pm	3 Dec
23 February (B)	1.00pm	11 Feb
16 March	1.00pm	4 March
15 June	1.00pm	3 June
17 August	1.00pm	5 August
19 October	1.00pm	7 Oct
14 December 2021	1.00pm	2 Dec

Mahi Tahi Committee

Meeting Date (Tuesday)	*Time*	*Agendas Close (Thurs 4pm)*
15 December	9.30am	3 Dec
9 February - Briefing	9am	28 January
23 March (Decision)	9am	11 March
20 April	9am	8 April
22 June	9am	10 June
17 August	9am	5 August
19 October	9am	7 Oct
14 December 2021	9am	2 Dec

Rural Drainage Advisory Groups

all commence 7.30pm

Ohoka	11 Feb	27 May	9 Sept	Rangiora Town / Rangiora Service Centre
Oxford	18 Feb	3 June	16 Sept	Oxford Service Centre
Clarkville	25 Feb	10 June	23 Sept	Kaiapoi Service Centre
Central	11 March	24 June	7 Oct	Rangiora Town Hall / Rangiora Service Centre
Water Race	18 March	1 July	14 Oct	Oxford Service Centre
Coastal	25 March	8 July	21 Oct	Rangiora Town Hall / Rangiora Service Centre

All Groups Get-together Session: Thursday 6 May 2021 - Chambers

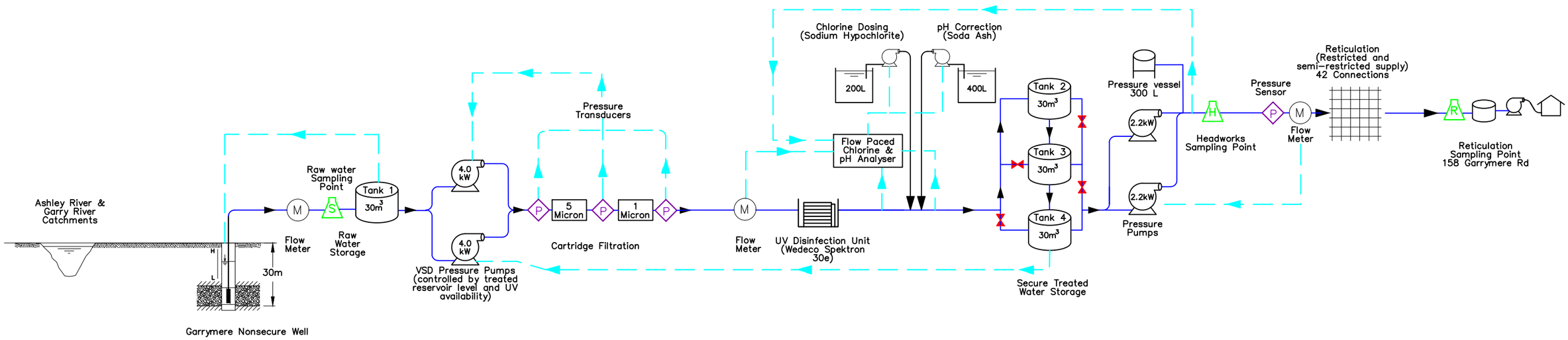
APPENDIX 1B: Water Unit Training

Type	Reference no.	Title	Tags
Course	HS006	Accident Investigation (including H&S risk management)	Health and Safety
Course	HS004	Anti-Skid Driver Safety Training	Health and Safety
Course	HS025	Asbestos Awareness Training	Health and Safety
Course	WU_TRG043	Asbestos Class B Removalist	Water Unit
Course	HS028	Asbestos Handling and Disposal	Health and Safety
Course	HS031	Asbestos Policy and Procedure Training	Health and Safety
Course	WU_TRG001	Backflow Prevention Course	Water Unit;Qualification
Course	WU_TRG003	Backflow Prevention Refresher Training Course	Water Unit;Qualification
Course	WU_TRG004	Backflow Survey Course	Water Unit;Qualification
Course	WU_TRG005	Cable Location	Water Unit
Face to Face	WU_TRG006	CCTV Operation	Water Unit
Course	WU_TRG007	Certificate of Signatory Approval (Drinking Water Testing)	Water Unit;Qualification
Course	WU_TRG008	Certified Handler (Hazardous Substances)	Water Unit
Course	WU_TRG009	Chainsaw Skills	Health and Safety;Water Unit
Course	HS029	Chemical Awareness and Spill Response Training	Health and Safety
Course	HR003	Coaching and Feedback	Human Resources
Course	WU_TRG014	Confined Space Awareness Training	Water Unit
Course	WU_TRG011	Confined Space Training - WU Bundle	Health and Safety;Water Unit
Course	HS030	Crisis Resilience and Emergency Response Procedure Awareness	Health and Safety
Course	LD002	Domestic Violence Training	Learning and Development
Document	WU_TRG015	Driver's License - Class 1	Water Unit
Course	WU_TRG016	Driver's License - Class 2	Water Unit
Course	WU_TRG019	Driver's License Endorsement R (Roller)	Water Unit
Course	WU_TRG020	Driver's License Endorsement T (Tracks)	Water Unit
Course	WU_TRG021	Driver's License Endorsement W (Wheels)	Water Unit
Course	HS013	Drug and Alcohol Training (Managers and Team Leaders)	Health and Safety
Course	HS009	Emergency Warden	Health and Safety
Course	HS US15757	Fall Arrest Systems	Health and Safety;Qualification
Course	HS023	Fire Extinguisher	Health and Safety
Course	HS008	First Aid	Health and Safety
Course	HS033	Forklift Training	Health and Safety
Course	WU_TRG022	Hazard Identification Training	Water Unit

Course	HS US18426	Hazards of a Confined Space	Health and Safety;Qualification
Face to Face	WU_TRG023	Health & Safety Induction - Water Unit (Site Level)	Health and Safety;Water Unit
Course	HS011	Health and Safety Induction	Health and Safety
Course	HS020	Health and Safety Representatives	Health and Safety
Course	PMP 001	Introduction to Promapp and Navigation Basics	Promapp Implementation
Document	WU_TRG002	IQP Backflow Preventers	Water Unit;Qualification
Online Resource	WU_TRG044	Knife Safety	Health and Safety;Water Unit
Course	WU_TRG024	Laboratory Training Record QS-01010-AD	Water Unit
Course	HR004	Licence to Recruit	Human Resources
Course	WU_TRG025	Load Slinging and Communication	Water Unit
Course	HS017	Manual Handling	Health and Safety
Course	WU_TRG027	NC in Infrastructure Works (Infrastructure Pipelaying Technician) - Level 3	Water Unit;Qualification
Course	WU_TRG028	NC in Wastewater Treatment - Level 4	Water Unit;Qualification
Course	WU_TRG029	NC in Wastewater Treatment (Site Operator) - Level 3	Water Unit;Qualification
Course	WU_TRG030	NC in Water Reticulation (Serviceperson) - Level 3 - Wastewater	Water Unit;Qualification
Course	WU_TRG031	NC in Water Reticulation (Serviceperson) - Level 3 - Water	Water Unit;Qualification
Course	WU_TRG034	NC in Water Reticulation (Supervisor) - Level 4 - Wastewater	Water Unit;Qualification
Course	WU_TRG035	NC in Water Reticulation (Supervisor) - Level 4 - Water	Water Unit;Qualification
Course	WU_TRG033	NC in Water Treatment - Level 4	Water Unit;Qualification
Course	WU_TRG032	NC in Water Treatment (Site Operator) - Level 3	Water Unit;Qualification
Course	HR001	New Employee Induction	Human Resources
Course	WU_TRG037	NZ Day Skipper Certificate	Health and Safety;Water Unit
Course	HS014	Occupational Overuse Syndrome Prevention and Management	Health and Safety
Course	HS005	Off-road (4WD) Driver Safety	Health and Safety
Course	HS US25510	Operate an Atmospheric Testing Device	Health and Safety;Qualification
Course	WU_TRG038	Operate Truck Mounted Lifting Equipment	
Course	WU_TRG039	PE Pipe Electrofusion Welding Course	Water Unit
Course	HR002	Performance Review Training	Human Resources
Course	HS US17588 & US17	Permit to Work: Issuer and Receiver	Health and Safety;Qualification
Course	HS US17599	Plan a Confined Space Entry	Health and Safety;Qualification
Course	PMP 002	Promapp Writer Training (Session 1)	Promapp Implementation
Course	PMP 003	Promapp Writer Training (Session 2)	Promapp Implementation
Course	PMP 004	Promapp Writer Training (Session 3)	Promapp Implementation

Course	PMP 005	Promapp Writer Training (Session 4)	Promapp Implementation
Course	HS016	Psychological First Aid	Health and Safety
Course	WU_TRG040	Respirator Fit Testing (& Basic Toolbox)	Water Unit
Course	HS026	Safe Trenching Practices	Health and Safety
Course	HS US17600	Safe Work at Heights	Health and Safety;Qualification
Document	HS032	Safe Working in the Field Manual Acknowledgement	Health and Safety
Course	HS022	Site Traffic Management Supervisor (STMS)	Health and Safety
Course	LD004	Situational Leadership	Learning and Development
Course	HS001	Situational Safety	Health and Safety
Course	LD006	Solutions-Focused Communication	Learning and Development
Course	HS021	Traffic Controller	Health and Safety
Course	LD001	Tuahiwi Marae Cultural Workshop	Learning and Development
Course	HS015	Two-Way Radio Training	Health and Safety
Course	HS US23229	Use a Safety Harness	Health and Safety;Qualification
Course	WU_TRG042	Water Sampling Course	Water Unit
Course	HS027	WDC Contract Health and Safety Management Training	Health and Safety

APPENDIX 2A: Flow Diagram



Multi-screened

From	2.5m	8.5m	16.3m	25m	27.9m
To	5.5m	9m	16.8m	26m	28.9m

Key

- Process Control
- Flow Direction
- Source Sampling Point
- Reticulation Sampling Point
- Mains Pressure Sensor
- Flow Meter
- Valve (Normally Closed)
- Headworks Sampling Point

REV	REVISION DETAILS	DRN	CHK	APP	DATE
C	FLOW METER MOVED. pH TANK CONNECTION TANKS ALTERED	MB	OM	OM	08/08/2013
D	IMPORTED FROM MICROSTATION, REVIEWED AND UPDATED FOR CONSENT 2018	MB	JD	CR	01/11/2018
E	UPDATED WITH PROPOSED SCHEME TREATMENT UPGRADES	MA	CR	CR	10/10/2019
F	UPDATED TREATMENT SURFACE PUMPS & PRESSURE VESSEL FOR WSP	CB	MA	CR	22/05/2020
G	BARRIERS REMOVED	CB	CR	KS	02/09/2021

SURVEYED	-	-	PROJECT No PD001311
DRAWN	MA	16/07/2019	CON No
DRAWING CHKD	CR	10/10/2019	SCALE (A3)
DESIGNED	MA	16/07/2019	NOT TO SCALE
DESIGNED CHKD	CR	10/10/2019	DATE ISSUED
APPROVED	CR	10/10/2019	16/07/2019

WAIMAKARIRI DISTRICT COUNCIL

PROJECT

GARRYMERE
WATER SAFETY PLAN

SHEET TITLE

FLOW DIAGRAM

FOR INFORMATION
NOT FOR CONSTRUCTION

DRAWING 2700

SHEET 01

REVISION F

APPENDIX 2B: Fault Line

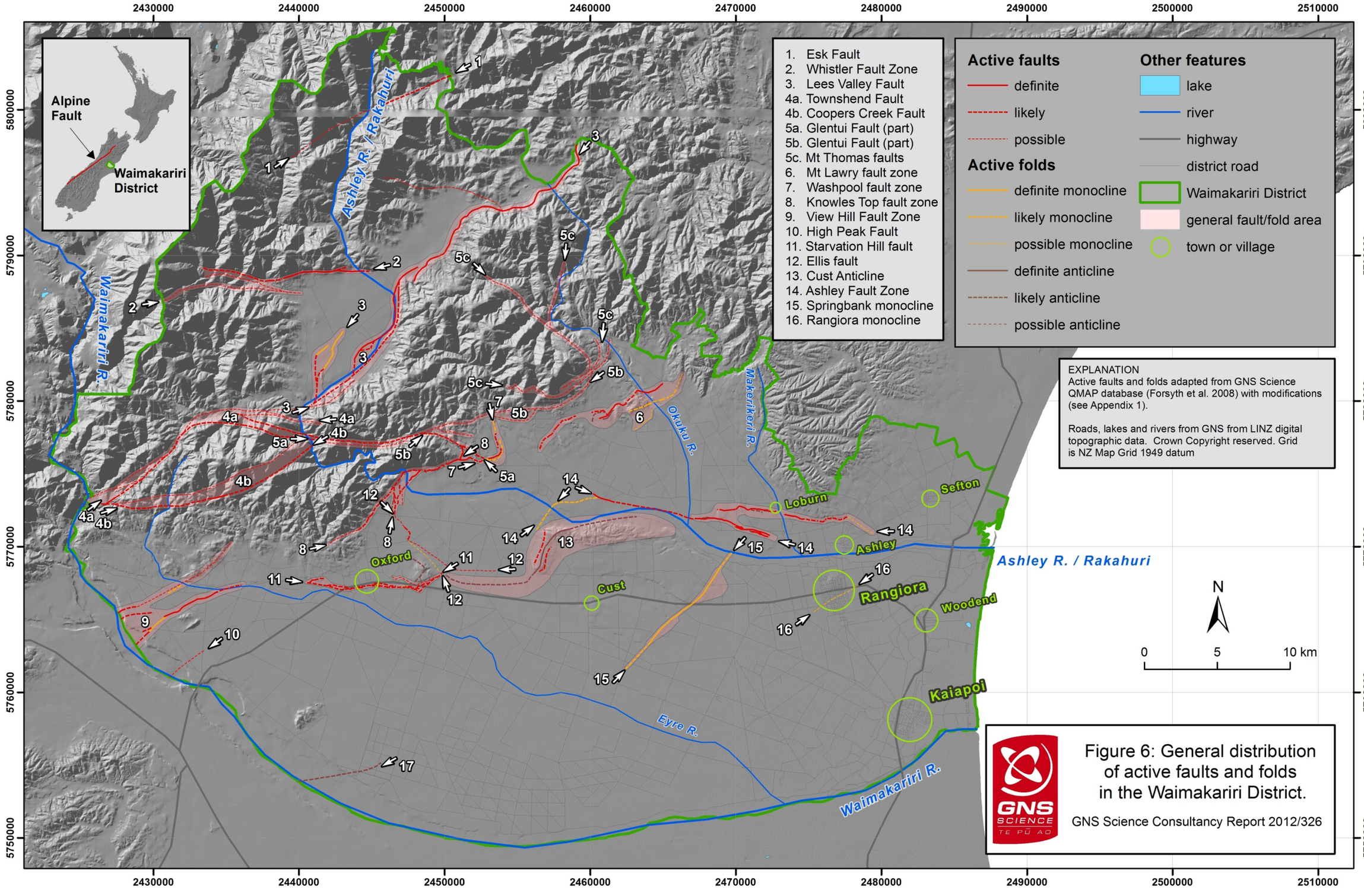
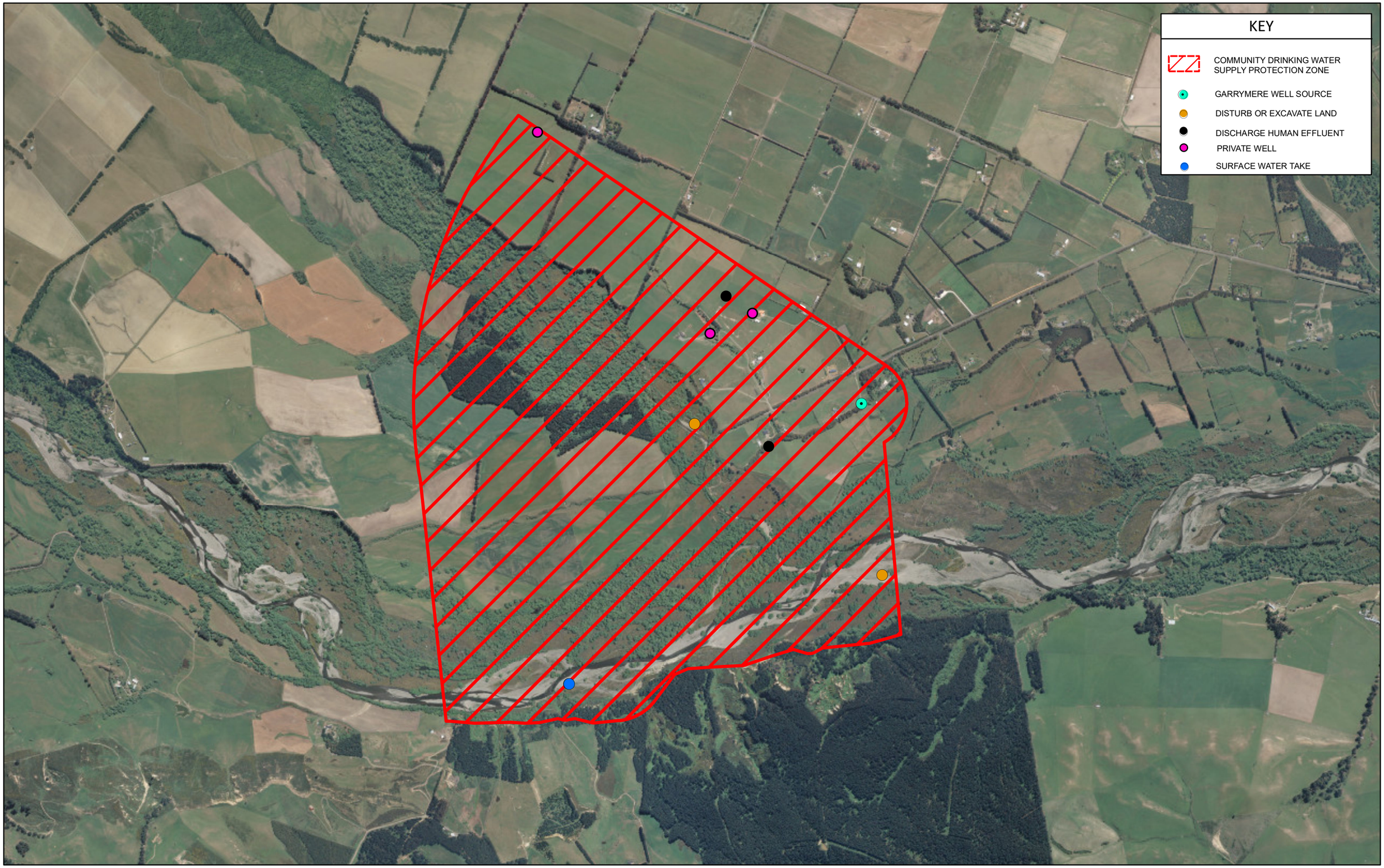


Figure 6: General distribution of active faults and folds in the Waimakariri District.

GNS Science Consultancy Report 2012/326

APPENDIX 2C: Community Drinking-Water Protection Zone



WAIMAKARIRI DISTRICT COUNCIL

ISSUE	AMENDMENT	DRAWN	CHKD	APPD	DATE
A	FIRST ISSUE	MSB	OM	OM	06.09.06
B	CONSENTS UPDATED, NOW IN GIS	MSB	JD	CR	01.11.18
C	CONSENTS UPDATED	CB	MA	CR	8.07.20

SCALE (A3) 1:15,185

PROJECT TITLE

GARRYMERE
WATER SAFETY PLAN

SHEET TITLE

APPENDIX B
COMMUNITY DRINKING WATER PROTECTION ZONE

PLAN No 2700

FILE 2700-sht3-c (Well Protection)

VERSION C

SHEET 03

APPENDIX 2D: Filtration And UV Compliance Documents

Sourced from Garrymere Source Upgrade Design Report (TRIM 190725104673)

ÖVGW
ÖSTERREICHISCHE VEREINIGUNG FÜR DAS GAS- UND WASSERFACH

Österreichische Vereinigung für das Gas- und Wasserfach
A-1010 Wien, Schubertring 14
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E-Mail: office@ovgw.at / Internet: www.ovgw.at
Akkreditiert durch das Bundesministerium
für Wissenschaft, Forschung und Wirtschaft

ÖVGW GEPRÜFT

ÖVGW-Zertifikat

über die Verleihung des Rechtes
zur Führung der ÖVGW-Qualitätsmarke Wasser

Registrierungsnummer
W 1.610

Geltungsdauer
bis Ende November 2018

Inhaber
Xylem Water Solutions Herford GmbH
Boschstraße 4-14
32051 Herford
DEUTSCHLAND

◆ Vertrieb in Österreich
Xylem Water Solutions Austria GmbH
Ernst Vogel Straße 2
2000 Stockerau

Hersteller
Xylem Water Solutions Herford GmbH / DE

Prüfungsart
Verlängerungsprüfung

Prüfbericht
417.303 vom 23. Dezember 2015

Qualitätsstandards/Prüfrichtlinien
• PW 806 Ausgabe Juli 2007

Produkt
UV-Desinfektionsanlage mit der Typenbezeichnung

Spektron 30e

Bauform:
L-Bauform, Einlauf axial, Auslauf radial

Typprüfung gemäß:
ÖNORM M 5873-1, Verfahren B

Strahlertechnologie:
Niederdruck

Anzahl der Strahler:
1

Typenbezeichnung des Anlagensensors:
SO 20101

Typenbezeichnung der UV-Strahler:
ECORAY VLR 30

Leistung der UV-Strahler:
285 Watt

Anschluss:
Flansch DN 80

Druckstufe:
PN 10/16

Weitere Angaben siehe Seite 2

ZVR 818158001

Die Verleihung erfolgt unter Zugrundelegung der Allgemeinen Geschäftsbedingungen GW 30 ÖVGW-Qualitätsmarke Produkte Gas & Wasser „Voraussetzungen für die Zuerkennung der ÖVGW-Qualitätsmarke für Produkte der Gas- und Wasserversorgung."

Wien, am 4. Februar 2016

Dipl.-Ing. (FH) Alexander Schwanzer
Leiter der ÖVGW-Zertifizierungsstelle

ÖVGW
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ÖVGW GEPRÜFT

Produkt (Fortsetzung)

Tabelle 1: Zulässiger Betriebsbereich
(tabellarisch, in Schrittweite von jeweils einem Prozentpunkt der UV-Durchlässigkeit $\%T_{100}$)

UV-Transmission $\%T_{100}$ (100 mm)	UV-Transmission $\%T_{10}$ (10 mm)	Minimale Referenzbestrahlungsstärke E_{min} (Schaltpunkt) gemessen mit dem Referenzradiometer	Maximaler Durchfluss Q_{max}
%	%	W/m²	m³/h
< 6,5	< 76,1	beliebig	0,00
6,5	76,1	60,1	7,45
7,0	76,6	61,6	7,76
8,0	77,7	64,4	8,36
9,0	78,6	67,0	8,93
10,0	79,4	69,4	9,47
11,0	80,2	71,6	9,99
12,0	80,9	73,7	10,49
13,0	81,5	75,7	10,93
14,0	82,2	77,6	11,43
15,0	82,7	79,4	11,88
16,0	83,3	81,2	12,31
17,0	83,8	82,8	12,73
18,0	84,2	84,4	13,15
19,0	84,7	86,0	13,55
20,0	85,1	87,5	13,94
21,0	85,6	88,9	14,33
22,0	85,9	90,3	14,70
23,0	86,3	91,6	15,07
24,0	86,7	93,0	15,43
25,0	87,1	94,2	15,79
26,0	87,4	95,5	16,14
27,0	87,7	96,7	16,48
28,0	88,0	97,9	16,82
29,0	88,4	99,0	17,15
30,0	88,7	100,2	17,48
31,0	88,9	101,3	17,80
32,0	89,2	102,3	18,12
33,0	89,5	103,4	18,43
34,0	89,8	104,4	18,74
35,0	90,0	105,5	19,05

Dipl.-Ing (FH) Alexander Schwanzer
Leiter der ÖVGW-Zertifizierungsstelle

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UV-Transmission %T_{100} (100 mm)	UV-Transmission %T_{10} (10 mm)	Minimale Referenzbestrahlungsstärke E_{min} (Schaltpunkt) gemessen mit dem Referenzradiometer	Maximaler Durchfluss Q_{max}
%	%	W/m²	m³/h
36,0	90,3	106,5	19,35
37,0	90,5	107,4	19,65
38,0	90,8	108,4	19,94
39,0	91,0	109,3	20,23
40,0	91,2	110,3	20,52
41,0	91,5	111,2	20,80
42,0	91,7	112,1	21,09
43,0	91,9	113,0	21,36
44,0	92,1	113,8	21,64
45,0	92,3	114,7	21,91
46,0	92,5	115,6	22,18
47,0	92,7	116,4	22,45
48,0	92,9	117,2	22,72
49,0	93,1	118,0	22,98
50,0	93,3	118,8	23,24
51,0	93,5	119,6	23,50
52,0	93,7	120,4	23,75
53,0	93,8	121,2	24,01
54,0	94,0	121,9	24,26
55,0	94,2	122,7	24,51
56,0	94,4	123,4	24,75
57,0	94,5	124,1	25,00
58,0	94,7	124,9	25,24
59,0	94,9	125,6	25,43
60,0	95,0	126,3	25,62
61,0	95,2	127,0	25,81
62,0	95,3	127,7	25,99
63,0	95,5	128,4	26,18
64,0	95,6	129,0	26,36
65,0	95,8	129,7	26,54
66,0	95,9	130,4	26,72
67,0	96,1	131,0	26,90
68,0	96,2	131,7	27,07
69,0	96,4	132,3	27,25
70,0	96,5	133,0	27,42
71,0	96,6	133,6	27,59
72,0	96,8	134,2	27,77

Dipl-Ing (FH) Alexander Schwanzer
Leiter der ÖVGW-Zertifizierungsstelle

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ÖVGW GEPRÜFT

UV-Transmission $\%T_{100}$ (100 mm)	UV-Transmission $\%T_{10}$ (10 mm)	Minimale Referenzbestrahlungsstärke E_{min} (Schaltpunkt) gemessen mit dem Referenzradiometer	Maximaler Durchfluss Q_{max}
%	%	W/m²	m³/h
73,0	96,9	134,9	27,93
74,0	97,0	135,5	28,10
75,0	97,2	136,1	28,27
76,0	97,3	136,7	28,44
77,0	97,4	137,3	28,60
78,0	97,5	137,9	28,76
79,0	97,7	138,5	28,93
80,0	97,8	139,0	29,09
81,0	97,9	139,6	29,25
82,0	98,0	140,2	29,40
83,0	98,2	140,8	29,56
83,2	98,2	140,9	29,59
84,0	98,3	141,3	29,59
85,0	98,4	141,9	29,59
86,0	98,5	142,4	29,59
87,0	98,6	143,0	29,59
88,0	98,7	143,5	29,59
89,0	98,8	144,1	29,59
90,0	99,0	144,6	29,59
91,0	99,1	145,2	29,59
92,0	99,2	145,7	29,59
93,0	99,3	146,2	29,59
94,0	99,4	146,8	29,59
95,0	99,5	147,3	29,59
96,0	99,6	147,8	29,59
97,0	99,7	148,3	29,59
98,0	99,8	148,8	29,59
99,0	99,9	149,3	29,59
100,0	100,0	149,8	29,59

Dipl-Ing (FH) Alexander Schwanzer
Leiter der ÖVGW-Zertifizierungsstelle

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ÖVGW GEPRÜFT

Tabelle 2: Daten zur Überprüfung des Anlagenradiometers

Referenzbestrahlungsstärke E_{ref} gemessen mit einem Referenzradiometer [1)]	Kleinster zulässiger Messwert des Anlagenradiometers E_{ref}	Größter zulässiger Messwert des Anlagenradiometers E_{ref}
W/m²	W/m²	W/m²
< 60,1	unzulässig	unzulässig
60,1	45,9	77,4
61,6	47,0	79,3
64,4	49,2	83,0
67,0	51,1	86,3
69,4	53,0	89,4
71,6	54,7	92,3
73,7	56,3	95,0
75,7	57,8	97,6
77,6	59,3	100,0
79,4	60,7	102,4
81,2	62,0	104,6
82,8	63,3	106,8
84,4	64,5	108,8
86,0	65,7	110,8
87,5	66,8	112,7
88,9	67,9	114,6
90,3	68,9	116,4
91,6	70,0	118,1
93,0	71,0	119,8
94,2	72,0	121,5
95,5	72,9	123,1
96,7	73,8	124,6
97,9	74,7	126,2
99,0	75,6	127,6
100,2	76,5	129,1
101,3	77,3	130,5
102,3	78,2	131,9
103,4	79,0	133,3
104,4	79,8	134,6
105,5	80,5	135,9
106,5	81,3	137,2
107,4	82,0	138,5
108,4	82,8	139,7
109,3	83,5	140,9
110,3	84,2	142,1
111,2	84,9	143,3

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ÖVGW GEPRÜFT

Referenzbestrahlungsstärke E_{ref} gemessen mit einem Referenzradiometer [1)]	Kleinster zulässiger Messwert des Anlagenradiometers E_{ref}	Größter zulässiger Messwert des Anlagenradiometers E_{ref}
W/m²	W/m²	W/m²
112,1	85,6	144,5
113,0	86,3	145,6
113,8	86,9	146,7
114,7	87,6	147,8
115,6	88,2	148,9
116,4	88,9	150,0
117,2	89,5	151,1
118,0	90,1	152,1
118,8	90,7	153,1
119,6	91,3	154,2
120,4	91,9	155,2
121,2	92,5	156,2
121,9	93,1	157,1
122,7	93,7	158,1
123,4	94,2	159,1
124,1	94,8	160,0
124,9	95,4	160,9
125,6	95,9	161,9
126,3	96,4	162,8
127,0	97,0	163,7
127,7	97,5	164,6
128,4	98,0	165,5
129,0	98,5	166,3
129,7	99,1	167,2
130,4	99,6	168,0
131,0	100,1	168,9
131,7	100,6	169,7
132,3	101,1	170,6
133,0	101,5	171,4
133,6	102,0	172,2
134,2	102,5	173,0
134,9	103,0	173,8
135,5	103,4	174,6
136,1	103,9	175,4
136,7	104,4	176,2
137,3	104,8	176,9
137,9	105,3	177,7
138,5	105,7	178,5
139,0	106,2	179,2

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ÖVGW GEPRÜFT

Referenzbestrahlungsstärke E_{ref} gemessen mit einem Referenzradiometer [1]	Kleinster zulässiger Messwert des Anlagenradiometers E_{ref}	Größter zulässiger Messwert des Anlagenradiometers E_{ref}
W/m²	W/m²	W/m²
139,6	106,6	180,0
140,2	107,1	180,7
140,8	107,5	181,4
140,9	107,6	181,6
141,3	107,9	182,2
141,9	108,4	182,9
142,4	108,8	183,6
143,0	109,2	184,3
143,5	109,6	185,0
144,1	110,0	185,7
144,6	110,4	186,4
145,2	110,9	187,1
145,7	111,3	187,8
146,2	111,7	188,5
146,8	112,1	189,1
147,3	112,5	189,8
147,8	112,9	190,5
148,3	113,2	191,1
148,8	113,6	191,8
149,3	114,0	192,5
149,8	114,4	193,1

[1] Schrittweise der Angabe der Referenzbestrahlungsstärken in maximal 1,5% der Differenz zwischen größter und kleinster Referenzbestrahlungsstärke E_{ref}, bezogen auf den Leistungs-/Auslegungsbereich.

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POSSIBLE TEMPLATE FOR ASSESSING CARTRIDGE FILTER COMPLIANCE

5.12.1 Log credit assessment - CUNO High Flow Polypropylene 1 micron cartridge filter

To obtain 2.0 protozoa log credits for cartridge filtration, the following requirements must be met during periods when the filtered water is being produced.

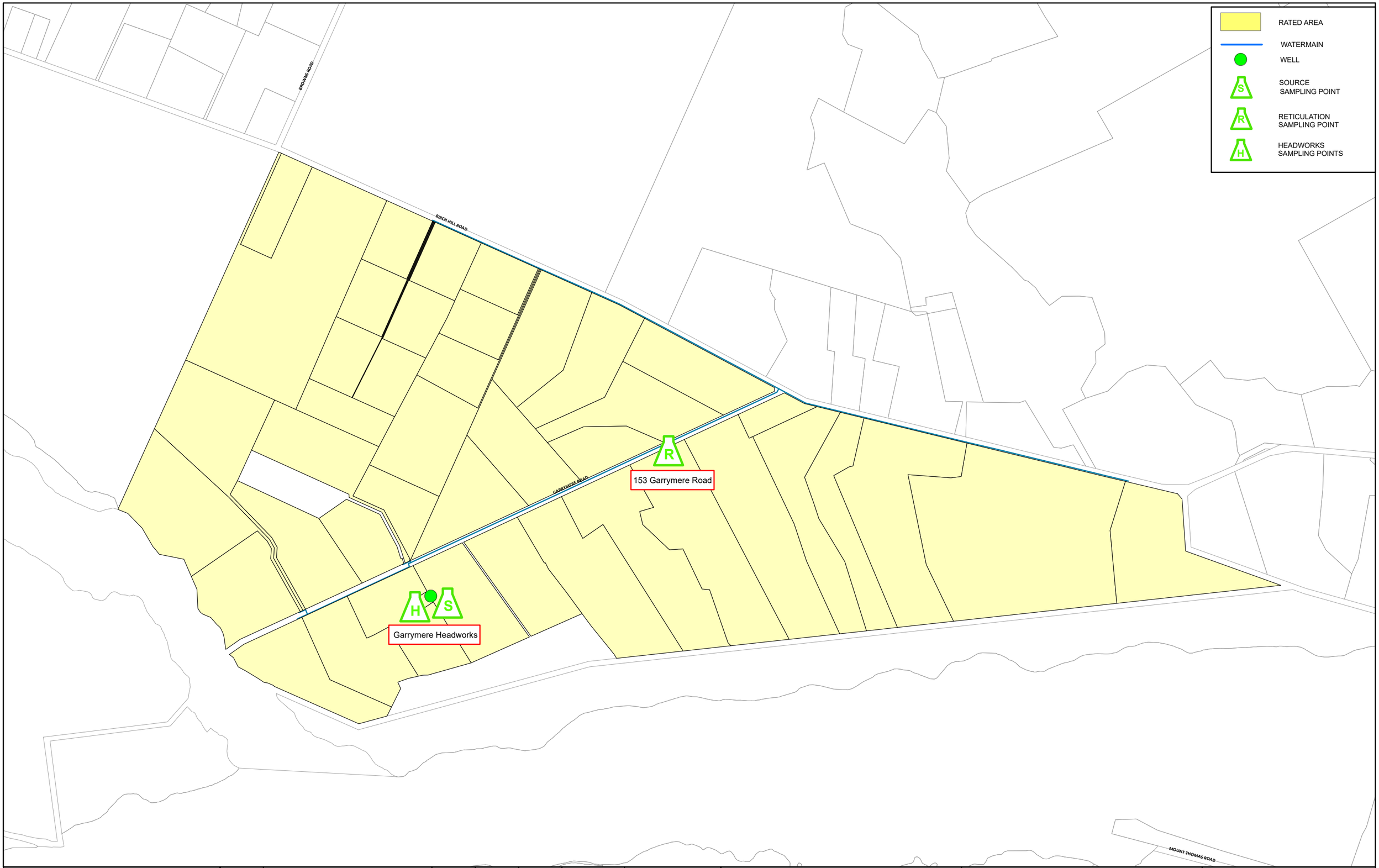
DWSNZ REQUIREMENT	STATUS
1. Each cartridge has a certified *Cryptosporidium* or cyst removal efficiency of at least 3 log. Water suppliers may adopt the supplier's certification provided: (a) it meets one of the following:	OK - achieved 3.5 log removals at 350 mL/min on a 90 mm cross-section of the cartridge. See appendix
i) the *Membrane Filtration Guidance Manual* (USEPA 2005), which contains detailed guidance on developing challenge test protocol and conducting the test for membrane processes that relate to these requirements ii) the (oo)cyst reduction conditions of *Drinking Water Treatment Units: Health effects*, NSF/ANSI 53 (NSF and ANSI 2002a, and subsequent revisions) a standard formally recognised by the Ministry of Health as being equivalent, e.g. AS/NZS 4348:1995 in conjunction with AS/NZS 3497:1998 (updated 2001).	Tested to AS/NZS 4348:1995. Also see last bullet point.
(b) an appropriately accredited inspection body has performed the testing	MicroAquaTech, accredited by IANZ for protozoa counts
(c) the installed equipment is identical (or validated as equivalent) to the equipment tested during the certification process	Each cartridge has a moulded label that identifies it as a CUNO High Flow 1 micron filter
(d) the tests are made on entire units, including filtration media, seals, filter housing and other components integral to the process. Because this is usually impracticable for larger units, see (e)	No. Used the alternative (e), as follows
(e) a certificated cartridge filter can fail due to its operation or its assembly, i.e. "its seals and other components integral to the process". Using a cartridge that satisfies the challenge test requirements is acceptable if: • the cartridge is single-open-ended (SOE), plug-in style, sealed in the housing with o-rings	SOE with a single O-ring
• scaling up to multiple cartridges, the field cartridge is the same diameter and construction as the test cartridge and the cartridge is of uniform construction over its entire length with no joins or joiners; heat-bonded joins are suitable	When scaled up the cartridge will be the same construction without bonding

• an automatic air release valve is installed on the top of the filter housing to release any trapped air	That will be part of installation
• a default maximum headloss of 150 kPa is set unless the manufacturer can demonstrate that performance is maintained beyond that. Cartridges must be replaced before the terminal pressure drop is reached	Maximum Forward Differential Pressure (50 psid @ 68°F) 3.4 bar @ 20°C. Recommended Change-out 2.4 bar or 35 psi @ 20°C Differential Pressure
• new/replacement cartridges and plants that operate an on/off regime are run to waste for the first 5 minutes they come on-line	Yes
• all components are made from materials approved for use in water supply, e.g. ANSI/NSF Standard 61 or equivalent.	All component materials of the CUNO High Flow Polypropylene element are listed for food contact per 21 CFR. All standard CUNO High Flow Housings are designed, manufactured and tested in accordance with AS1210/ASME Code.
Requirements 2, 3, and 4 relate to filtrate monitoring	NA at present
Requirement 5 is covered in 1 (c)	NA
Requirement 6: A slow opening/closing valve is fitted ahead of the cartridge filter plant, and the filtrate passes either through a pressure surge valve or directly to a tank before any subsequent process or pumping.	Yes
Requirement 7: The flow through each housing is measured. A restrictor that maintains the flow below the certified maximum operating rate is fitted to each housing.	Yes. Max flow for 40 inch cartridge is 560 L/min, see appendix
Requirement 8: Differential pressure measurements across the housing are recorded to confirm that the minimum differential pressure always exceeds the differential pressure corresponding to a clean filter established during commissioning, and are kept within the manufacturer's recommendations.	Maximum differential pressure across a new housing expected to be 1.5 PSI (0.1 Bar)

Appendix

Available surface area in a 90 mm disc = 52.8 cm2
Area of 40 inch cartridge = 84542 cm2
Scale up factor = 1601
90 mm disc test flow = 350 mL/min = 0.35 L/min
maximum flow allowed for 40 inch = 0.35 x 1601 = 560 L/min
or for 60 inch cartridge: 560 x 60/40 = 840 L/min

APPENDIX 2E: Distribution Zone



WAIMAKARIRI DISTRICT COUNCIL

ISSUE	AMENDMENT	DRAWN	CHKD	APPD	DATE
A	FIRST ISSUE	MSB	OM	OM	30.04.07
B	SCHEME AREA EXTENDED	MSB	OM	OM	08.08.13
C	REDRAWN IN GIS AND UPDATE	MSB	JD	CR	01.11.18
D	UPDATED	CB	MA	CR	20.05.20

SCALE (A3) 1:12,000

SHEET TITLE: SUPPLY AREA

PROJECT TITLE: GARRYMERE WATER SAFETY PLAN

PLAN No 2700

FILE Garrymere Scheme Boundary - Jig.mxd

VERSION D

SHEET 02

WAIMAKARIRI DISTRICT COUNCIL

Garrymere Water Pipe Condition Assessment 2020

SCALE (A3)
1:8,000

DATE
22/06/2020

APPENDIX 2F: 2020 Full Chemical Test

ANALYTICAL REPORT

REPORT CODE **AR-20-NC-019320-01** REPORT DATE **12/11/2020**

For the attention of
Waimakariri District Council
Susan Dalzell
Private Bag 1005
RANGIORA
Wellington
NEW ZEALAND
Phone (03) 313 6136
Email Susan.dalzell@wmk.govt.nz

Copy to: records (records@wmk.govt.nz), Water Unit Admin (waterunitadmin@wmk.govt.nz), Williams

Contact for your orders: James Thornton **Order code:** EUNZCH-00062332

SAMPLE CODE **817-2020-00068583**

Client Reference:	SD20531		
Sampling Point	WDC-DW04:Bore for Garrymere, G00369		
Reception Date & Time:	03/11/2020 8:55	**Reception temperature:**	1.9 °C
Analysis Start Date & Time	03/11/2020 10:53	**Analysis Ending Date:**	12/11/2020
Sampled Date & Time	03/11/2020 08:55	**Sampler(s)**	Susan Dalzell
DWOL Purpose	Monitoring		

		RESULTS		LOQ	GUIDELINES
NW179	**Ammonia Nitrogen**				
	Ammoniacal nitrogen (N)	<0.01	mg/l	0.01	GV of 1.5 g/m³ ✓ Satisfactory
NW070	**Arsenic**				
	Arsenic (As)	<0.001	mg/l	0.002	
NW002	**Bicarbonate Alkalinity**				
	Bicarbonate alkalinity	39	mg CaCO3/l	1	
NW072	**Boron**				
	Boron (B)	<0.03	mg/l	0.0002	
NW075	**Calcium**				
	Calcium (Ca)	11.2	mg/l	0.001	
NW335	**Calcium Hardness**				
	Calcium hardness	30	mg CaCO3/l	1	
NW223	**Calcium Hardness by MS**				
	Calcium hardness	28	mg CaCO3/l	1	
NW297	**Carbonate**				
	Carbonate AUG	<1	mg CaCO3/l	1	
NW007	**Chloride**				
	Chloride (Cl)	5.61	mg/l	0.02	GV of 250 g/m³ ✓ Satisfactory
NW023	**Conductivity**				
	Conductivity	11.7	mS/m	0.1	
NW078	**Copper**				
	Copper (Cu)	0.0013	mg/l	0.0005	
ZM0JI	**Enumeration (MPN) of Total Coliforms and Escherichia coli**				
	Escherichia coli	<1	MPN/100 ml	1	MAV <1.0 Complies ✓ Satisfactory
	Total Coliforms	<1	MPN/100 ml	1	

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		RESULTS		LOQ	GUIDELINES	
NW006	**Fluoride**					
	Fluoride	0.10	mg/l	0.02	MAV of 1.5 g/m³	✓ Satisfactory
NW028	**Free Carbon Dioxide**					
	Carbon dioxide	8	mg CO2/l	1		
NW030	**Hardness**					
	Hardness	39	mg CaCO3/l	1		
NW079	**Iron**					
	Iron (Fe)	0.29	mg/l	0.0005		
NW082	**Magnesium**					
	Magnesium (Mg)	2.64	mg/l	0.0005		
NW083	**Manganese**					
	Manganese (Mn)	0.0016	mg/l	0.0005		
NW010	**Nitrate-N**					
	Nitrate-N	0.19	mg/l	0.01	MAV of 11.3 g/m³	✓ Satisfactory
NW195	**pH**					
	pH	7.0		0.1	GV of 7-8.5	✓ Satisfactory
NW087	**Potassium**					
	Potassium (K)	0.98	mg/l	0.001		
NW202	**Saturation Index**					
	Saturation Index (SI)	-1.70		-	GV of -1.5 to 0.5	✗ UnSatisfactory
NW203	**Silica**					
	Silica (SiO2)	11.0	mg/l	0.02		
NW091	**Sodium**					
	Sodium (Na)	7.40	mg/l	0.0005		
NW011	**Sulphate**					
	Sulphate	5.75	mg/l	0.02	GV of 250 g/m³	✓ Satisfactory
NW003	**Total Alkalinity**					
	Alkalinity total	39	mg CaCO3/l	1		
NW339	**Total Dissolved Solids**					
	Total dissolved Solids	57	mg/l	1		
NW210	**Total Non-Purgeable Organic Carbon**					
	Total Organic Carbon	0.7	mg/l	0.1	MAV of 2.0 g/m³	✓ Satisfactory
NW194	**Total Phosphorus**					
	Total phosphorus	<0.005	mg/l	0.005		
NW212	**Turbidity**					
	Turbidity	0.31	NTU	0.01	MAV of 2.5	✓ Satisfactory
NW096	**Zinc**					
	Zinc (Zn)	0.028	mg/l	0.0005		

CONCLUSION

Chloride is usually present in water sources as sodium chloride - or salt. The NZ Drinking Water Standards lists a Guideline Value of 250 g/m3, above which the water can taste salty and cause corrosion. The level of chloride in this sample is below the limit.

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Escherichia coli (*E. coli*) is found in the lower intestine of warm-blood animals and its presence in a water sample indicates faecal contamination. Drinking-Water Standards for New Zealand 2005 (Revised 2018), Maximum Acceptable Valve (MAV) for *E. coli* is <1/100mL (less than 1 per 100mL) of sample.

Non-fluoridated supplies can have naturally occurring fluoride levels ranging from zero to 0.5 g/m3. The Ministry of Health recommends that the concentration of fluoride in fluoridated drinking-water supplies be between 0.7 and 1.0 g/m3 and lists a Maximum Allowable Value of 1.5 g/m3. The level of fluoride in this sample complies with this limit.

Ammonia may be found in natural surface waters, but is more frequently found at elevated concentrations in anaerobic groundwaters. The NZ Drinking Water Standards lists a Guideline Value of 1.5 g/m3 above which the odour may be detected. The level of ammonia in this sample is below the limit.

Nitrate-Nitrogen is introduced to water supplies through fertiliser run-off, the breakdown of organic matter, and from septic tanks and effluent ponds. The NZ Drinking Water Standards lists a Maximum Allowable Value of 11.3 g/m3. The level of nitrate-nitrogen in this sample complies with this limit.

The Saturation Index is calculated using results from the pH, Alkalinity, Conductivity, and Calcium Hardness tests and is an indication of how corrosive the water is. The result for this sample indicates the water is corrosive.

Sulphate is present in some New Zealand soils and can cause taste problems at high levels. The NZ Drinking Water Standards lists a Guideline Value of 250 g/m3, above which the water can taste bad and smell of sulphur. The level of sulphate in this sample is below the limit.

Total Organic Carbon can be seen in water as particulate or sometimes colour (ie humic acid) and is not listed in the NZ Drinking Water Standards. However, the US EPA gives a maximum drinking water limit of 2 g/m3. The result for this sample is below this limit indicating there is very little organic matter in the water.

Turbidity in water is caused by the presence of fine suspended matter such as clay, silt, and other particles. The result for this sample passes the NZ Drinking Water Standards limit of 2.5 NTU.

LIST OF METHODS

NW002	**Bicarbonate Alkalinity:** APHA Method 4500-CO2 D	NW003	**Total Alkalinity:** APHA Method 2320 B
NW006	**Fluoride:** USEPA 300.0 mod.	NW007	**Chloride:** USEPA 300.0 mod.
NW010	**Nitrate-N:** USEPA 300.0 mod.	NW011	**Sulphate:** USEPA 300.0 mod.
NW023	**Conductivity:** APHA 2510 B	NW028	**Free Carbon Dioxide:** APHA Method 4500-CO2 B
NW030	**Hardness:** calculated	NW070	**Arsenic:** Std Methods ICP-MS 3125 mod.
NW072	**Boron:** Std Methods ICP-MS 3125 mod.	NW075	**Calcium:** Std Methods ICP-MS 3125 mod.
NW078	**Copper:** Std Methods ICP-MS 3125 mod.	NW079	**Iron:** Std Methods ICP-MS 3125 mod.
NW082	**Magnesium:** Std Methods ICP-MS 3125 mod.	NW083	**Manganese:** Std Methods ICP-MS 3125 mod.
NW087	**Potassium:** Std Methods ICP-MS 3125 mod.	NW091	**Sodium:** Std Methods ICP-MS 3125 mod.
NW096	**Zinc:** Std Methods ICP-MS 3125 mod.	NW179	**Ammonia Nitrogen:** APHA Method 4500-NH3 F
NW194	**Total Phosphorus:** APHA Method 4500-P F	NW195	**pH:** APHA Method 4500-H B
NW202	**Saturation Index:** APHA Method 2330 B	NW203	**Silica:** Std Methods ICP-OES 3120B mod.
NW210	**Total Non-Purgeable Organic Carbon:** APHA Method 5310 B	NW212	**Turbidity:** APHA Method 2130 B
NW223	**Calcium Hardness by MS:** Std Methods ICP-OES 3120B mod.	NW297	**Carbonate:** calculated
NW335	**Calcium Hardness:** calculated	NW339	**Total Dissolved Solids:** Internal Method, Gravimetry
ZM0JI	**Escherichia coli-Total Coliforms E (Water) [NZ] <1 >200 MPN/100 ml (0) Colilert -Q:** SMEWW 9223B; APHA 23rd Edition		

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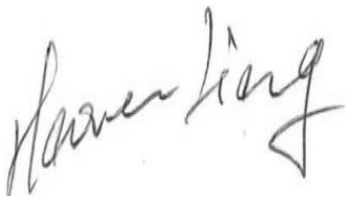
Signature



Haowen Liang Technician

Preeti Gaikwad Analytical Services Manager

EXPLANATORY NOTE

- ◆ test is not accredited
- ○ test is subcontracted within Eurofins group and is accredited
- ● test is subcontracted within Eurofins group and is not accredited
- □ test is subcontracted outside Eurofins group and is accredited
- ■ test is subcontracted outside Eurofins group and is not accredited

N/A means Not applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)

Eurofins General Terms and Conditions apply.

This document can only be reproduced in full; it only concerns the submitted sample. Results have been obtained and reported in accordance with our general sales conditions available on request.
The tests are identified by a five-digit code, their description is available on request.

Unless otherwise stated, all tests in this analytical report (except for subcontracted tests) are performed at 43 Detroit Drive, Rolleston, , Christchurch, NEW ZEALAND.

Accreditation does not apply to comments or graphical representations.

END OF REPORT

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APPENDIX 2G: Risk Checklist

Source		
S1	**Raw water**	
S1.1	Surface and Groundwater Sources	X
S1.2	Roof Water Sources	
S2	**Development of new supplies**	
S2	Development of New Supplies	
Treatment Processes		
P1	**Source abstraction**	
P1.1	Surface Water Abstraction – Rivers, Streams and Infiltration Galleries	
P1.2	Surface Water Abstraction – Lakes and Reservoirs	
P1.3	Ground Water Abstraction – Bores and Wells	X
P1.4	Ground Water Abstraction – Springs	
P2	**Water transmission**	
P2	Treatment Processes – Water Transmission	X
P3	**Pre-treatment storage**	
P3	Treatment Processes – Pre-Treatment Storage	X
P4	**Pre-treatment processes**	
P4.1	Algicide Application	
P4.2	Destratification	
P4.3	Pre-oxidation	
P4.4	Waste Liquor Reintroduction	
P5	**Coagulation/flocculation processes**	
P5.1	Conventional Coagulation/Flocculation/Sedimentation	
P5.2	Dissolved Air Flotation	
P5.3	Direct Filtration	
P6	**Filtration**	
P6.1	Rapid Sand Filtration	
P6.2	Slow Sand Filtration	
P6.3	Cartridge Filtration	X
P6.4	Diatomaceous Earth Filtration	
P6.5	Membrane Filtration	
P7	**Disinfection**	
P7.1	Chlorine Disinfection	X
P7.2	Chlorine Dioxide Disinfection	
P7.3	Ozone Disinfection	
P7.4	Ultraviolet Irradiation Disinfection	X
P8	**Aesthetic property adjustment**	
P8.1	pH Adjustment	X

P8.2	Iron and Manganese Removal	
P8.3	Softening	
P8.4	Trace Organics Removal	
P9	**Fluoridation**	
P9	Fluoridation	
P10	**Pump operation**	
P10	Pump Operation	X
P11	**Plant construction and operation**	
P11	Plant Construction and Operation	X
Distribution System		
D1	**Post-treatment storage**	
D1	Post-Treatment Storage	X
D2	**Reticulation network**	
D2.1	Construction Materials	X
D2.2	System Pressure	X
D2.3	Operation	X
D2.4	Backflow Prevention	X
General Elements		
G1	Staff Training	X
G2	Monitoring	X

APPENDIX 2H: Risk Assessment

	Element		Event	Cause	Applicable to supply	Hazard: Protozoa	Hazard: Bacteria/virus	Hazard: Chemical / Aesthetic	Hazard: Radiological	Hazard: Disruption to supply	Maximum Risk: Max Likelihood	Maximum Risk: Likelihood Rationale	Maximum Risk: Max Consequence	Maximum Risk: Consequence Rationale	Maximum Risk: Max Risk		Residual Risk: Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Residual Risk: Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.	Residual Risk: Modified Likelihood	Residual Risk: Likelihood Rationale	Residual Risk: Modified Consequence	Residual Risk: Consequence Rationale	Residual Risk: Residual Risk	Risk Acceptability: Level of Uncertainty	Risk Acceptability: Risk Acceptability	Risk Acceptability: Improvement Plan References
Raw Water - Surface and Groundwater Sources																											
S1.1.1		Source water receives discharge from, or is influenced by	Contaminated sites (sheep dips, offal, tannery pits and carcass pits)		x	x				Likely	Surface contaminant	Major	Microbial	High	A1	Historical Local Knowledge of Catchment	B1	Natural Filtration	Likely	Non-secure aquifer	Insignificant	Multiple treatment barriers in place to mitigate microbiological source contamination.	Medium	Certain	Acceptable	RAI1: Source Water Risk Management Plan
S1.1.5			Waste discharge to land		x	x	x	x			Water Abstracted Below Ground		< 5000 people		A2	ECan Discharge Consents	B11	Chlorine disinfection									
S1.1.6			Storage of hazardous substances				x										B12	UV Treatment									
S1.1.7	R1		Septic tanks		x	x											B14	Cartridge Filtration				Less undertanding around potential chemical contaminants, however full chemical testing demonstrates no acute or chronic chemicals in groundwater to date.					
S1.1.9			Surface impoundments		x	x											B8	Tankered Water									
S1.1.13			Faecal matter from livestock or feral animals		x	x																					
S1.1.15			Irrigation		x	x	x																				
S1.1.17			Fertiliser		x	x	x																				
P1.3.5.1		Contamination of the aquifer	Stock, septic tanks, chemicals in close proximity		x	x																					
P1.3.5.2			Aquifer is not secure		x	x																					
S1.1.2		Source water receives discharge from, or is influenced by	Domestic or industrial processes				x	x		Rare	Surface contaminant	Moderate	Chemical	Low	A1	Historical Local Knowledge of Catchment	B1	Natural Filtration	Very Rare		Insignificant		Low	Certain	Acceptable	
S1.1.8			Urban or industrial run-off				x				Water Abstracted Below Ground		<5000 people		A2	ECan Discharge Consents	B13	pH Adjustment									
S1.1.14	R2		Agrichemicals (incl.stock dip) or poisons				x								A15	SCADA Alarm	B14	Cartridge Filtration									
S1.1.16			Sediments or agrichemicals from forestry				x										B8	Tankered Water									
S1.1.18			Geothermal activity				x	x																			
S1.1.19			Mineral deposits				x																				
S1.1.4		Source water receives discharge from, or is influenced by	Landfill site		x	x	x	x		Rare	Surface contaminant	Major	Microbial	Medium	A1	Historical Local Knowledge of Catchment	B1	Natural Filtration	Very Rare		Insignificant		Low	Certain	Acceptable	
	R3										Water Abstracted Below Ground		< 5000 people		A2	ECan Discharge Consents	B12	UV Treatment									
																	B11	Chlorine disinfection									
																	B8	Tankered Water									
S1.1.11		Source water receives discharge from, or is influenced by	Waste disposal down holes or bores		x	x	x			Possible	The LWRP has rules around decommissioning of wells, however, there is no requirement for anyone to report that they have decommissioned a bore or provide evidence	Major	Microbial	High	A15	SCADA Alarm	B1	Natural Filtration	Unlikely	Nearby decommissioned/ not used wells from previous drilling attempt	Insignificant	Multiple treatment barriers in place to mitigate source contamination.	Low	Certain	Acceptable	
S1.1.12	R4		Abandoned or decommissioned wells		x	x							< 5000 people				B11	Chlorine disinfection									
																	B12	UV Treatment									
																	B14	Cartridge Filtration									
																	B8	Tankered Water									
S1.1.21	R5	Source water receives discharge from, or is influenced by	Algal bloom			x	x			Rare	Source connected to Ashley River	Moderate		Low	A3	Partnership with Regional Council			Rare	Testing while Ashley River is in bloom has shown no anatoxins within the raw water	Moderate	IRP to implement in the event toxins are detected	Low	Certain	Acceptable	RAI5: Duplicate source
Source Abstraction - Bores and Wells																											
S1.1.22		Source water receives discharge from, or is influenced by	Insufficient water					x		Rare	No issues for 20 years	Major	>24 hours disruption to supply	Medium	A1	Historical Local Knowledge of Catchment	B9	Storage	Rare		Major	Likely to have 4 - 8 hours of disruption to get tankered water	Medium	Estimate	Unacceptable	RAI5: Duplicate Source
P1.3.1.1	R6	Not enough source water available for abstraction	Drought					x							A4	Water Conservation / Water Restrictions	B8	Tankered Water				Type B PMs are not a viable long term measure. Therefore consequence is still major					
P1.3.1.2			Resource consent limitations					x							A2	ECan Discharge Consents											
P1.3.6.2		Too little water can be drawn from intake to meet demand	Catastrophic intake failure					x																			
P1.3.6.6			Screens damaged or clogged					x																			
P3.1.1		Not enough source water available to meet demand	Inadequate raw water supply.					x																			
D1.1.1		Not enough water in post-treatment storage to meet demand	Insufficient supply of raw water					x																			
P1.3.2.1		Contamination of bore/well during construction	Cross-contamination of drilling equipment		x	x				Possible		Major	Microbial	High	A5	External Contractor Review	B6	New Pumps Commissioning Plan	Very Rare		Insignificant	Any residual contamination following chlorination will be flushed out of the system	Low	Certain	Acceptable	
P1.3.2.2	R7		Residual substances used in drilling				x						< 5000 people		A6	Specification Documents & Hygienic Practices	B5	Well Flushing									
															A7	Well Drilling Standards	B7	New Well Commissioning Plan									
P1.3.3.1		Contaminated water getting into the bore/well from shallower depths	Corrosion and cracks in bore casing		x	x				Possible		Major	Microbial	High	A15	SCADA Alarm	B11	Chlorine disinfection	Possible	Assessment based on 100 year life of the well	Insignificant	Multiple treatment barriers in place.	Low	Certain	Acceptable	
P1.3.4.2		Contaminated water getting into the bore/well from the surface	Bore/well head or casing damaged		x	x									A5	External Contractor Review	B12	UV Treatment									
P1.3.3.2	R8	Contaminated water getting into the bore/well from shallower depths	Drawdown bringing contaminants		x	x									A6	Specification Documents & Hygienic Practices	B14	Cartridge Filtration									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Element		Event	Cause		Hazard					Maximum Risk									Residual Risk					Risk Acceptability		
2					Applicable to supply	Protozoa	Bacteria/virus	Chemical / Aesthetic	Radiological	Disruption to supply	Max Likelihood	Likelihood Rationale	Max Consequence	Consequence Rationale	Max Risk	Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.		Modified Likelihood	Likelihood Rationale	Modified Consequence	Consequence Rationale	Residual Risk	Level of Uncertainty	Risk Acceptability	Improvement Plan References
58	P1.3.4.1			Inappropriate bore/well head design or poor construction		x	x									A8	Inspections as per SLA											
59	P1.3.4.3		Contaminated water getting into the bore/well from the surface	Contamination sources too close to the bore/well head		x	x									A11	Well Head Exclusion Zone											
60	P1.3.4.4			Bore/Well situated in low ground		x	x									A23	Backflow Prevention Programme Designed by Qualified Person											
61																A30												
62																A47	Site Security											
63																											
64	P1.3.4.5	R9	Contaminated water getting into the bore/well from the surface	Back - siphoning		x	x				Very Rare		Major	Microbial	Low	A35	Tank Configuration	B11	Chlorine disinfection	Very Rare	Backflow prevention provided by the air gap at top of raw water storage pre treatment	Insignificant		Low	Certain	Acceptable	
65														< 5000 people				B12	UV Treatment								
66																		B14	Cartridge Filtration								
67																											
68	P1.3.6.1		Too little water can be drawn from intake to meet demand	Damage to the pump or bore/well head by animals						x	Unlikely	Animals near well head	Moderate	8- 24 hr disruption	Medium	A11	Well Head Exclusion Zone	B8	Tankered Water	Rare		Insignificant		Low	Certain	Acceptable	RAI5: Duplicate Source
69	P1.3.6.5			Vandalism sabotage						x						A18	Trained and Qualified Water Unit Reticulation Staff	B9	Storage								
70	P3.1.2	R10	Not enough source water available to meet demand	Inability to transmit water from source to pre-treatment storage.						x						A4	Water Conservation / Water Restrictions										
71	D1.1.4		Not enough water in post-treatment storage to meet demand	Inability to transmit water						x																	
72																											
73	P1.3.6.3	R11	Too little water can be drawn from intake to meet demand	Pump failure						x	Possible	12 power failures recorded by SCADA between 1/01/2019 to 1/06/2020	Moderate	4-8hr disruption	Medium	A15	SCADA Alarm	B8	Tankered Water	Very Rare		Moderate	Likely to have 4 - 8 hours of disruption to get tankered water	Low	Certain	Acceptable	
74	P1.3.6.4			Power failure						x						A17	Portable Generator	B9	Storage								
75																											
76	**Water Transmission**																										
77	P2.1.1			Mains breaks		x	x			x	Unlikely	Plastic Pipe in distribution age 1990s and later	Major	Microbial	Medium	A6	Specification Documents & Hygienic Practices	B4	New Water Main Chlorine Testing	Rare		Insignificant		Low	Certain	Acceptable	
78	P2.1.2		Contamination gets into the trunk mains	Air release valves entrain contaminated water or air	N/A	x	x							< 5000 people		A9	Asset Age Assessment and Renewals Programme	B5	Well Flushing								
79	P2.1.3	R12		Leaks		x	x									A15	SCADA Alarm	B11	Chlorine disinfection								
80	P2.1.4			Incidental damage		x	x									A18	Trained and Qualified Water Unit Reticulation Staff	B12	UV Treatment								
81	P2.1.5			Poor repairs of breaks, leaks, incidental damage		x	x											B14	Cartridge Filtration								
82	P2.4.1		No flow through the trunk mains	Mains breaks						x																	
83																											
84	P2.2.1		Sediment containing contaminants stirred up	Sediment or biofilm allowed to					x		Unlikely		Moderate		Medium			B11	Chlorine disinfection	Unlikely		Insignificant		Low	Certain	Acceptable	
85	P2.2.2	R13		Velocity too high					x									B12	UV Treatment								
86																		B14	Cartridge Filtration								
87																											
88	P2.3.1		Contamination gets into open channel conduits and break-pressure tanks	Stock access to the channel and break tanks	N/A	x	x																				
89	P2.3.2	R14		Surface run-off and sub-surface leaching of contaminated water	N/A	x	x																				
90	P2.3.3			Deterioration of water quality	N/A	x	x																				
91	P2.3.4			Collapse of the channel sides	N/A	x	x																				
92																											
93																											
94	**Pre-treatment Storage**																										
95																											
96	P3.1.3	R15	Not enough source water available to meet demand	Leak in pre-treatment storage.						x	Rare		Moderate		Low	A9	Asset Age Assessment and Renewals Programme	B8	Tankered Water	Rare	New tanks unlikely to leak	Minor	Redundancy in tanks	Low	Estimate	Acceptable	
97																											
98	P3.2.1			Access by humans, animals or birds.	x	x					Unlikely		Major		Medium	A32	Locked Storage Tank/ Reservoir	B11	Chlorine disinfection	Very Rare		Insignificant		Low	Estimate	Acceptable	
99	P3.2.2			Unauthorised access, vandalism, or sabotage.	x	x	x									A47	Site Security	B12	UV Treatment		New locks on site and new fencing around perimeter 2020		Any microbiological contamination will be treated by various water treatment measures				
100	P3.2.3	R16	Introduction of contaminating material into tank or reservoir	Leaching from, or corrosion of, construction materials.			x									A8	Inspections as per SLA	B14	Cartridge Filtration								
101	P3.2.4			Entry of roof drainage.	x	x										A6	Specification Documents & Hygienic Practices										
102	P3.2.7			Introduction of contaminants by run-off or see page from land use activities.	x	x																					
103																											
104	P3.2.5	R17	Introduction of contaminating material into tank or reservoir	Entry of contaminated groundwater (for in-ground tanks).	N/A																						
105	P3.2.6			Animal entry at upstream source (animals trapped and destroyed by action of inlet control valves on tanks).	N/A																						
106																											
107	P3.3.1	R18	Development, or re-suspension, of sediment within tank or reservoir	Sediment/ slime accumulation and release.					x		Unlikely		Minor		Low	A15	SCADA Alarm	B14	Cartridge Filtration	Rare		Insignificant		Low	Estimate	Acceptable	
108																											
109	P3.4.1	R19	Development of oxygen-deficient conditions within tank or reservoir	Thermal stratification of reservoirs or lakes.	N/A																						
110																											
111	P3.4.2	R20	Development of oxygen-deficient conditions within tank or reservoir	Accumulated organic sediment becomes biologically active (tanks).		x	x				Rare	Raw tank is 30 m3	Major		Medium	A15	SCADA Alarm	B11	Chlorine disinfection	Very Rare		Insignificant		Low	Estimate	Acceptable	
112																		B12	UV Treatment								
113																		B14	Cartridge Filtration								
114																											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Element		Event	Cause		Hazard					Maximum Risk								Residual Risk							Risk Acceptability	
2					Applicable to supply	Protozoa	Bacteria/virus	Chemical / Aesthetic	Radiological	Disruption to supply	Max Likelihood	Likelihood Rationale	Max Consequence	Consequence Rationale	Max Risk	Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.	Modified Likelihood	Likelihood Rationale	Modified Consequence	Consequence Rationale	Residual Risk	Level of Uncertainty	Risk Acceptability	Improvement Plan References
115	P3.5.1	R21	Algal bloom	Development of conditions favouring algal growth: e.g. nutrient source, warmth, sunlight	N/A			x																			
116																											
117																											
118	**Filtration - Cartridge Filtration**																										
119	P6.3.1.1			Incorrect type of cartridge filter		x	x	x			Possible		Major		High	A25	Maintenance	B9	Storage	Rare		Minor		Low	Estimate	Acceptable	
120	P6.3.1.2			Damage to the seal (cartridge or filter housing).		x	x	x								A27	Trained and Qualified Water Unit Supply Operators	B11	Chlorine disinfection								
121	P6.3.1.3			Cartridge is incorrectly seated.		x	x	x								A30	Designed by Qualified Person	B12	UV Treatment								
122	P6.3.1.4	R22	Filter not removing particles down to 2-3 µm in size	Failure of cartridge.		x	x									A38	Standard Operating Procedures				Multiple detection methods on site to alert if filters not performing function		Following treatments can provide some disinfection until filter is remediated.				
123	P6.3.1.5			Contamination of filter housing when changing the cartridge.		x	x	x								A15	SCADA Alarm										
124	P6.3.1.6			Flow too high for cartridge design.		x	x	x																			
125																											
126	P6.3.2.1	R23	Filter not removing target chemical contaminants	Incorrect type of cartridge filter for the type of chemical to be removed.	N/A			x																			
127	P6.3.2.2			Contaminant breakthrough (caused by rupture or exhaustion).	N/A			x																			
128																											
129	P6.3.3.1	R24	Growth of germs in the filter	Filter used in the wrong situation or beyond its capacity.		x	x				Unlikely		Major	Microbial	Medium	A25	Maintenance	B11	Chlorine disinfection	Rare		Insignificant		Low	Estimate	Acceptable	
130																A27	Trained and Qualified Water Unit Supply Operators	B12	UV Treatment								
131																A15	SCADA Alarm										
132																											
133	**Disinfection - Chlorine Disinfection**																										
134	P7.1.1.1			Dosing malfunction			x				Likely		Major	Microbial	High	A8	Inspections as per SLA	B2	Redundancy	Very Rare		Minor	Chlorine is a secondary treatment, primary treatment methods will treat water for protozoa and bacteria	Low	Certain	Acceptable	
135	P7.1.1.2			Dose control sensor incorrectly calibrated			x							< 5,000		A15	SCADA Alarm	B9	Storage		Multiple malfunction detection methods on site						
136	P7.1.1.3			Dose controller set point incorrect			x									A25	Maintenance	B12	UV Treatment								
137	P7.1.1.4			High chlorine demand & poor dose control			x									A27	Trained and Qualified Water Unit Supply Operators	B13	pH Adjustment								
138	P7.1.1.5			Power failure			x									A36	Chlorine Analyser										
139	P7.1.1.6		Not enough free available chlorine	Chlorine supply exhausted			x									A42	Chemical Supply Contractors										
140	P7.1.1.7			Low concentration in dosing solution			x									A43	Handheld Equipment Calibrated										
141	P7.1.1.8			Insufficient chlorine reaching dosing point			x									A45	Chlorine Stockpiles										
142	P7.1.1.9			Inadequate output from chlorine booster			x																				
143	P7.1.1.10	R25		FAC monitoring samples taken incorrectly			x																				
144	P7.1.1.11			Method of FAC measurement incorrect			x																				
145	P7.1.1.12			pH too high																							
146	P7.1.2.1			Dosing malfunction				x																			
147	P7.1.2.2			Dose control sensor incorrectly calibrated				x																			
148	P7.1.2.3			Dose controller set point incorrect				x																			
149	P7.1.2.4			Low chlorine demand & poor dose control				x																			
150	P7.1.2.5		Too much free available chlorine	Chlorine solution concentration too high				x																			
151	P7.1.2.6			Spillage of chlorine concentrate into dosing solution				x																			
152	P7.1.2.7			Chlorine overdose at a chlorine booster station	N/A			x																			
153	P10.2.1		Incorrect chemical dosing leads to poor treatment	Incorrect dosing		x	x	x																			
154	P10.2.2			Monitoring equipment fail		x	x																				
155																											
156	P7.1.3.1	R26	Excessive formation of chlorination by-products	Natural organic matter in water being chlorinated				x			Rare		Moderate	Aesthetic	Low	A15	SCADA Alarm	B14	Cartridge Filtration	Rare		Insignificant	Chlorination after filter	Low	Certain	Acceptable	
157																A29	Proactive/Reactive Flushing Programme										
158																A39	Service Request System										
159																											
160	**Disinfection - UV Disinfection**																										
161	P7.4.1.1			Inadequate UV intensity at the required wavelength		x	x			x	Unlikely		Major		Medium	A15	SCADA Alarm	B9	Storage	Rare		Insignificant		Low	Estimate	Acceptable	
162	P7.4.1.2			Time of exposure to UV is inadequate due to poor flow rate control, incorrect dose calculation or low water temperature.		x	x									A17	Portable Generator	B11	Chlorine disinfection								
163	P7.4.1.3	R27	UV dose too low	Excessive colour or turbidity		x	x	x								A27	Trained and Qualified Water Unit Supply Operators	B14	Cartridge Filtration								
164	P7.4.1.4			Power supply fail		x	x									A25	Maintenance										
165	P7.4.1.5			No monitoring or incorrect monitoring		x	x																				
166	P7.4.1.6			Incorrect measurement of UV or calibration		x	x																				
167																											
168	P7.4.2.1	R28	Water is reinfected or germs revive after treatment	Resuscitation due to natural process		x	x				Rare		Major		Medium			B11	Chlorine disinfection	Very Rare		Moderate	Chlorine would deal with the virus and bacterial reviving + minor protozoal treatment	Low	Estimate	Acceptable	
169																											
170	**Aesthetic Property Adjustment - pH Adjustment**																										
171	P8.1.1.1			Dosing malfunction				x			Possible		Moderate	Aesthetic	Medium	A17	Portable Generator	B9	Storage	Rare		Minor		Low	Certain	Acceptable	
172	P8.1.1.2			Dose control sensor incorrectly calibrated				x								A18	Operator Staff										
173	P8.1.1.3			Dose controller set point incorrect				x								A25	Maintenance										
174	P8.1.1.4			Power failure				x								A27	Trained and Qualified Water Unit Supply Operators										
175	P8.1.1.5		pH level too high	Chemical supply exhausted				x								A42	Chemical Supply Contractors										
176	P8.1.1.6	R29		Chemicals used incorrectly or poor quality				x								A45	Chlorine Stockpiles										

	Element		Event	Cause	Applicable to supply	Hazard: Protozoa	Hazard: Bacteria/virus	Hazard: Chemical / Aesthetic	Hazard: Radiological	Hazard: Disruption to supply	Maximum Risk: Max Likelihood	Maximum Risk: Likelihood Rationale	Maximum Risk: Max Consequence	Maximum Risk: Consequence Rationale	Maximum Risk: Max Risk	Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.	Residual Risk: Modified Likelihood	Residual Risk: Likelihood Rationale	Residual Risk: Modified Consequence	Residual Risk: Consequence Rationale	Residual Risk: Residual Risk	Risk Acceptability: Level of Uncertainty	Risk Acceptability: Risk Acceptability	Risk Acceptability: Improvement Plan References
P8.1.1.7				Insufficient solution reaching the dosing point				x																	
P8.1.1.8				Chemicals cannot be dosed at a high enough rate				x																	
P8.1.2.1			pH level too low	Same causes as for pH level too high				x																	
P8.1.2.2				Chemical supply exhausted				x																	
Pump Operation																									
P10.1.1				Pump failure due to mechanical failure or overload		x	x				Possible		Major		High	A15	SCADA Alarm	B2	Redundancy	Rare		Minor	Chlorine provides residual disinfection to minimise consequence.	Low	Certain	Acceptable	
P10.1.2		R30	Changes in pressure, or water hammer, suck contaminants into the water	Pump failure due to no power		x	x									A17	Portable Generator	B11	Chlorine disinfection		Multiple malfunction detection methods on site					RAI5: Duplicate source
P10.1.3				Pump failures due to flooding or other damage		x	x																		
P10.3.1		R31	Changes in pressure from the bore suck contaminants into the water	Failure of bore pump		x	x				Possible		Major		High	A17	Portable Generator	B11	Chlorine disinfection	Rare		Insignificant	Multiple treatment barriers in place	Low	Certain	Acceptable	RAI5: Duplicate source
																		B14	Cartridge Filtration							
																		B12	UV Treatment							
Plant Construction and Operation																									
P11.1.1				Poor plant design		x	x				Possible		Major		High	A8	Inspections as per SLA	B11	Chlorine disinfection	Very Rare		Minor		Low	Estimate	Acceptable	
P11.1.2				Structural failure of part of the plant		x	x									A25	Maintenance	B12	UV Treatment							
P11.1.6			Treatment plant cannot produce water of satisfactory quality	Inadequate security measures to prevent vandalism/sabotage		x	x									A30	Designed by Qualified Person	B14	Cartridge Filtration		Multiple malfunction detection methods in place to identify any issues with treatment process, and experienced operators will respond and resolve any issue that arises.		Multiple treatment barriers in place				
P11.1.7				Event affecting the source		x	x									A41	Locked Headworks Building										
P11.1.10				Destruction by fire or explosion		x	x																				
P11.1.11		R32		Lack of chemicals due to industrial action		x	x																				
P11.2.1				Structural failure of part of the plant						x																	
P11.2.2				Inadequate plant design						x																	
P11.2.3			Treatment plant cannot produce enough water	Inadequate maintenance resulting in mechanical failure						x																	
P11.2.4				Inadequate security measures to prevent vandalism/sabotage						x																	
P11.2.5				Destruction by fire or explosion						x																	
P11.2.7				Natural disasters						x																	
P11.1.3				Inadequate maintenance resulting in mechanical failure		x	x				Possible		Major		High	A15	SCADA Alarm	B2	Redundancy	Very Rare		Major		Low	Estimate	Acceptable	
P11.1.5				Inadequate monitoring		x	x									A25	Maintenance	B12	UV Treatment		Multiple malfunction detection methods in place to identify any issues with treatment process, and experienced operators will respond and resolve any issue that arises.						
P11.1.8		R33	Treatment plant cannot produce water of satisfactory quality	Unhygienic practices		x	x									A27	Trained and Qualified Water Unit Supply Operators	B11	Chlorine disinfection				Multiple treatment barriers in place				
P11.1.9				Inadequate labelling of chemicals				x								A31	Sampling Procedures	B14	Cartridge Filtration								
P11.1.11				Lack of chemicals due to industrial action		x	x									A38	Standard Operating Procedures										
P11.1.12		R34	Treatment plant cannot produce water of satisfactory quality	Power failure						x	Rare	Power failure will result in all treatment processes stopping including all pumps and reticulation pumps and therefore risk relates to disruption of supply only.	Minor		Low	A15	SCADA Alarm			Rare		Minor		Low	Certain	Acceptable	
P11.2.6			Treatment plant cannot produce enough water	Power failure						x						A17	Portable Generator										
Distribution System - Post Treatment Storage																									
D1.1.2			Not enough water in post-treatment storage to meet demand	Insufficient water treatment capacity						x	Unlikely		Moderate		Medium	A4	Water Conservation / Water Restrictions	B9	Storage	Rare	Raw and treated design flows are comparable	Minor		Low	Estimate	Acceptable	
D1.1.3		R35	Not enough water in post-treatment storage to meet demand	Inadequate post-treatment storage capacity						x						A30	Designed by Qualified Person	B2	Redundancy								
																		B8	Tankered Water							
D1.1.5			Not enough water in post-treatment storage to meet demand	Leakage from storage facility						x	Unlikely		Moderate		Medium	A25	Maintenance	B8	Tankered Water	Very Rare		Minor		Low	Estimate	Acceptable	
		R36														A4	Water Conservation / Water Restrictions	B2	Redundancy								
																A9	Asset Age Assessment and Renewals Programme										
																A8	Inspections as per SLA										
D1.2.1				Access by animals/birds		x	x				Possible		Major		High	A32	Locked Storage Tank/ Reservoir	B11	Chlorine disinfection	Very Rare		Moderate		Low	Certain	Acceptable	
D1.2.2				Unauthorised access/ vandalism/ sabotage		x	x	x								A47	Site Security				Multiple malfunction detection methods in place to identify any issues with treatment process, and experienced operators will respond and resolve any issue that arises.		Multiple systems in place to ensure any contamination is detected and there is chlorine residual in treated water				
D1.2.3				Human access for sampling		x	x									A8	Inspections as per SLA										
D1.2.4				Leaching/ corrosion from construction material				x								A36	Chlorine Analyser										
D1.2.5		R37	Introduction of contaminated material into service reservoir	Entry of roof drainage		x	x									A15	SCADA Alarm										
D1.2.6				Entry of contaminated groundwater		x	x									A37	Storage Tank / Reservoir Drainage Backflow Prevention										
D1.2.8				Chemical contamination from incorrect dosing				x																			
D1.2.9				Backflow from drains		x	x																				
D1.2.7		R38	Introduction of contaminated material into service reservoir	Animal entry from upstream source	N/A	x	x																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Element		Event	Cause		Hazard					Maximum Risk									Residual Risk					Risk Acceptability		
2					Applicable to supply	Protozoa	Bacteria/virus	Chemical / Aesthetic	Radiological	Disruption to supply	Max Likelihood	Likelihood Rationale	Max Consequence	Consequence Rationale	Max Risk	Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.		Modified Likelihood	Likelihood Rationale	Modified Consequence	Consequence Rationale	Residual Risk	Level of Uncertainty	Risk Acceptability	Improvement Plan References
239	D1.3.1	R39	Development, or re-suspension, of sediment within tank or reservoir	Sediment/ slime accumulation & release				x			Unlikely		Moderate		Medium	A15	SCADA Alarm	B11	Chlorine disinfection	Very Rare		Moderate		Low	Certain	Acceptable	
240																A39	Service Request System										
241																A33	Reservoir Cleaning										
242																											
243	D1.4.1	R40	Chlorine contact time too short	Storage tanks too small			x				Rare		Major		Medium	A30	Designed by Qualified Person		UV Treatment	Very Rare	UV reactor and cartridge filtration provide extra treatment barriers	Insignificant		Low	Certain	Acceptable	
244	D1.4.2			Short circuiting			x											B12 B14	Cartridge Filtration								
245																											
246	**Distribution - Construction Materials**																										
247																											
248	D2.1.1.1			Poor quality materials.				x			Very Rare		Major		Low	A6	Specification Documents & Hygienic Practices	B11	Chlorine disinfection	Very Rare		Moderate		Low	Reliable	Acceptable	
249	D2.1.1.4	R41	Dissolution of chemical from construction materials	Materials insufficiently resistant to dissolution by the water and the surrounding environment.				x								A30	Designed by Qualified Person										
250	D2.1.3.1		Entry of chemical contaminants through pipe materials	Inappropriate materials in use (predominantly occurs with plastic pipes)				x								A1	Historical Local Knowledge of Catchment										
251	D2.3.1.7		Introduction of contaminating material into the distribution system	Inappropriate materials used		x	x									A39	Service Request System										
252																											
253																											
254	D2.1.1.2	R42	Dissolution of chemical from construction materials	Inadequate flushing of new materials.				x			Rare		Moderate		Low	A9	Asset Age Assessment and Renewals Programme			Very Rare		Moderate		Low	Certain	Acceptable	
255	D2.1.1.3			Inadequate maintenance or replacement of worn materials.				x								A18	Trained and Qualified Water Unit Reticulation Staff										
256																A19	Water Unit Stand over										
257																A38	Standard Operating Procedures										
258																											
259	D2.1.2.1	R43	Germs enter the distribution system through failed construction materials	Deterioration of distribution system, leading to ingress of micro-organisms.		x	x				Rare		Major		Medium	A6	Specification Documents & Hygienic Practices	B11	Chlorine disinfection	Very Rare		Moderate	Chlorine treats for bacteria not protozoa	Low	Certain	Acceptable	
260	D2.1.2.2			Biofilm development sustaining pathogens		x	x									A9	Asset Age Assessment and Renewals Programme										
261																											
262	D2.1.4.1	R44	No water available	Material Failure						x	Possible		Moderate		Medium	A9	Asset Age Assessment and Renewals Programme	B8	Tankered Water	Rare		Minor		Low	Certain	Acceptable	
263																A18	Trained and Qualified Water Unit Reticulation Staff										
264																											
265	**Distribution System - System Pressure**																										
266	D2.2.1.1	R45	Introduction of contamination by pressure fluctuations	Mains pressure failure or high instantaneous demand		x	x				Rare		Major		Medium	A20	Constant Positive Pressure System	B9	Storage	Very Rare		Major	Chlorine treats for bacteria not protozoa	Low	Certain	Acceptable	
267	D2.2.1.2			Pipe failure or accidental penetration		x	x									A28	BeforeUDig	B11	Chlorine disinfection								
268	D2.2.1.3			Unpredicted event such as major fire		x	x									A18	Trained and Qualified Water Unit Reticulation Staff	B2	Redundancy								
269	D2.2.1.4			Failure of network pumps		x	x									A25	Maintenance										
270	D2.2.1.5			Failure of bore pumps		x	x									A22	Leakage Detection										
271	D2.3.1.1		Introduction of contaminating material into the distribution system	Breaks, leaks, incidental damage to water mains		x	x									A15	SCADA Alarm							WDC cannot rule out there will never be damage to the distribution due to reasons outside their control. Chlorine residual can treat microbiological contamination however not protozoa. There is no practical solution				
272	D2.3.1.3			System pressure drop		x	x																				
273	D2.3.4.1		Failure to maintain sufficient water pressure	Insufficient water available from the source/plant						x																	
274	D2.3.4.2			Leaks in reticulation						x																	
275	D2.3.4.3			Transmission pump failure						x																	
276																											
277	D2.2.2.1	R46	Resuspension of sediment or biofilm within the mains by pressure fluctuation	Sediment or biofilm allowed to develop				x			Possible		Moderate		Medium	A20	Constant Positive Pressure System	B5	Well Flushing	Rare	Possible to flush distribution at the extremity at the last toby box. Not ideal however so improvement needed	Insignificant		Low	Certain	Acceptable	RAI4: New sampling /distribution flushing point by furthest property
278	D2.2.2.2			Significant fluctuations in reticulation pressure				x										B11	Chlorine disinfection								
279	D2.3.2.1		Re-suspension of contaminants in sediments in the distribution system	Sediment or biofilm allowed to develop				x																			
280	D2.3.2.2			Water velocity too high				x																			
281																											
282	**Distribution System - Operation**																										
283																											
284	D2.3.1.2			Affected area not correctly isolated		x	x				Likely		Major		High	A18	Trained and Qualified Water Unit Reticulation Staff	B11	Chlorine disinfection	Rare		Moderate	Chlorine treats for bacteria not protozoa	Low	Certain	Acceptable	RAI4: New sampling /distribution flushing point by furthest property
285	D2.3.1.4	R47	Introduction of contaminating material into the distribution system	Flow direction in affected area unknown		x	x									A26	GIS Mapping Programme										
286	D2.3.1.5			Standard hygiene practices not adopted		x	x									A27	Trained and Qualified Water Unit Supply Operators										
287	D2.3.1.6			Inadequate staff training		x	x									A31	Sampling Procedures										
288	D2.3.1.8			Inadequate flushing & disinfection practices		x	x									A38	Standard Operating Procedures										
289	D2.3.1.9			Unsuitable temporary bypass		x	x									A20	Constant Positive Pressure System										
290	D2.3.1.10			Contamination during sampling		x	x									A6	Specification Documents & Hygienic										
291	D2.3.3.4		Development of sediment or biofilm	Poor repair practices allowing colonisation				x																			
292	D2.3.3.5			Inadequate cleaning programme				x																			
293																											
294	D2.3.1.11	R48	Introduction of contaminating material into the distribution system	Unsatisfactory location of water pipes		x	x				Rare		Major		Medium	A30	Designed by Qualified Person	B11	Chlorine disinfection	Very Rare		Moderate	Chlorine treats for bacteria not protozoa	Low	Certain	Acceptable	
295																A6	Specification Documents & Hygienic Practices										
296																											

1	Element		Event	Cause		Hazard					Maximum Risk								Residual Risk							Risk Acceptability		
2					Applicable to supply	Protozoa	Bacteria/virus	Chemical / Aesthetic	Radiological	Disruption to supply	Max Likelihood	Likelihood Rationale	Max Consequence	Consequence Rationale	Max Risk	Preventative Measures (Type A) Prevent the hazard reaching the consumer by disrupting pathways. Reduce the likelihood of the hazardous event occurring		Preventative Measures (Type B) Reduce the concentration of the hazard in the water. Generally a treatment process.		Modified Likelihood	Likelihood Rationale	Modified Consequence	Consequence Rationale	Residual Risk	Level of Uncertainty	Risk Acceptability	Improvement Plan References
297	D2.3.3.1		Development of sediment or biofilm	Poor chemical water quality leaving treatment plant				x			Possible		Major		High	A27	Trained and Qualified Water Unit Supply Operators	B11	Chlorine disinfection	Very Rare		Minor	Multiple Treatment sources	Low	Estimate	Acceptable	RAI4: New sampling /distribution flushing point by furthest property
298	D2.3.3.2	R49		Poor microbiological water quality leaving plant		x	x									A36	Chlorine Analyser	B12	UV Treatment									
299	D2.3.3.3			Water flows too low resulting in decay of chlorine		x	x									A15	SCADA Alarm	B14	Cartridge Filtration									
300																												
301																												
302																												
303	**Distribution System - Backflow Prevention**																											
304	D2.4.1.1	R50	Water pressure in the distribution system lower than pressure in supplied premises	A pressure drop in the reticulation system		x	x				Rare		Major		Medium	A20	Constant Positive Pressure System	B11	Chlorine disinfection	Very Rare		Moderate	Chlorine treats for bacteria not protozoa	Low	Certain	Acceptable	
305	D2.4.1.2			An elevated pressure in the premise above system		x	x									A15	SCADA Alarm											
306																												
307	D2.3.1.12		Introduction of contaminating material into the distribution system	Cross connections		x	x	x			Possible		Major		High	A6	Specification Documents & Hygienic Practices	B11	Chlorine disinfection	Rare	Flow and pressure monitors to ensure consistent pressure delivered from water headworks. Network model in place to ensure that delivery pressure is adequate.	Moderate	Chlorine residual minimises consequence for bacteria, but not protozoa. Standard tobies have non-return valve on them, audits required to gain confidence that these are in place, and that tanks have overflow pipe as additional barrier	Low	Estimate	Acceptable	RAI3: Audit of backflow prevention for restricted connections
308	D2.4.2.1			Backflow prevention device connected improperly		x	x	x								A18	Trained and Qualified Water Unit Reticulation Staff											
309	D2.4.2.2	R51		Illegal cross connection to the reticulation system		x	x	x								A23	Backflow Prevention Programme											
310	D2.4.2.3		No, inadequate, faulty, or incorrectly installed backflow prevention device	Fail safe backflow device removed		x	x	x								A22	Leakage Detection											
311	D2.4.2.4			No backflow device installed		x	x	x								A26	GIS Mapping Programme											
312	D2.4.2.5			Failure of backflow device		x	x	x																				
313	D2.4.2.6			Vandalism or accidental damage		x	x	x																				
314																												
315	**General - Staff Training**																											
316	G1.1.1		Introduction of microbiological, & inadequate inactivation or removal	Inadequate training		x	x				Likely		Major		High	A27	Trained and Qualified Water Unit Supply Operators	B9	Storage	Very Rare		Minor		Low	Confident	Acceptable	
317	G2.1.2	R52	Introduction of chemical, & inadequate inactivation or removal	Inadequate training				x								A31	Sampling Procedures	B11	Chlorine disinfection									
318																A38	Standard Operating Procedures	B12 B14	UV Treatment Cartridge Filtration									
319																												
320																												
321	**General - Monitoring**																											
322	G2.1.1			Inappropriate / incorrect sampling		x	x	x			Likely		Major		High	A27	Trained and Qualified Water Unit Supply Operators	B9	Storage	Unlikely		Moderate	Multiple treatment barriers in place	Medium	Reliable	Acceptable	RAI2: New software to improve reporting systems
323	G2.1.2			Inadequate / incorrect test equipment or uncalibrated		x	x	x								A31	Sampling Procedures	B11	Chlorine disinfection									
324	G2.1.3	R53	Incorrect water quality data used for supply management	Inadequate reagents		x	x	x								A38	Standard Operating Procedures	B12	UV Treatment									
325	G2.1.4			Inappropriate method or incorrect calibration		x	x	x								A15	SCADA Alarm	B14	Cartridge Filtration									
326	G2.1.5			Inadequate monitoring records		x	x	x																				
327	G2.1.6			Failure of staff to follow analytical methods		x	x	x																				
328	G2.1.7			Use of non MoH approved laboratory		x	x	x																				
329	**Note: Grey rows are not relevant to this supply**																											

APPENDIX 3A: Operational Monitoring Relating To Preventative Measures

Number	Preventative Measure	Description	Monitoring / inspection task	Operational Monitoring					Records	Critical Limit	Corrective Action
				What	Where	How	When	Who			
A1	Historical Local Knowledge of Catchment	Obtain all information available about known contaminated sites in the catchment, monitor raw water quality to confirm that any changes in catchment characteristics are not affecting raw water quality.	Assessment task	Desktop search using available data and resources	WDC Office	HAIL, LLUR, TRIM, Waimap	When required or every 5 years	WSP author	WSP	High risk land use establishes in SPZ with inadequate conditions to protect source	Alter risk assessment as necessary
A2	ECan Discharge Consents	• ECan consents database is available online to search for consents near scheme sources; • ECan discharge resource consents restrict activities within the CDWPZ by regulating potentially hazardous activities leading to ground contamination	Assessment task	Receive notification from Esan if activity is proposed within the CDWPZ. Check already approved activities within the CDWPZ	WDC Office	Esan Database, or email notification (Water asset inbox)	Every WSP update (5 yearly) or when a new activity is proposed	Water Asset Manager	TRIM	High risk activity proposed within the CDWPZ with inadequate conditions to protect source	Make a submission to inform consenting officer of areas of concern, to ensure these are considered in decision making processes.
A3	Partnership with Regional Council	Partnership includes: • Bi-annual meeting of senior managers from Environment Canterbury and our Council to identify and resolve issues that arise between our organisations; • Monthly Waimakariri Water Zone Committee meetings, attended by WDC and ECan staff. The water zone committee is joint WDC/ ECan committee; • Quarterly meetings with ECan compliance monitoring staff to discuss issues with resource consents compliance (first meeting October 2020); • Quarterly meeting for the Canterbury Operations Forum / Engineering Managers Forum. This is attended by ECan and TA Staff; • Review and submissions on ECan resource consent applications with CDWPZ; • Participation in the Canterbury Drinking Water Reference Group (CDWRG); • Investigation and monitoring of the decommissioning of wells via CDWRG to ensure abandoned wells that may affect a community drinking supply are adequately capped; • Communication of anatoxins testing in Ashley River during the summer;	Refer to external stakeholder engagement section of Component 1 (Commitment to Drinking-Water Quality Management)								
A4	Water Conservation / Water Restrictions	Restriction processes are available and can be triggered by a number of conditions related to pressure and reserve volume, see Component 7.	Monitoring task	Flow rates / reservoir levels / weather forecast / demand patterns	SCADA data	Review data from flowmeters and reservoir level sensors, and respond to SCADA alarms	Continuous (SCADA alerts)	Operators receive SCADA alerts	SCADA	Reservoir alarm or low reticulation pressure	Investigate and issue water restrictions if there is considered to be a risk of an outage
A5	External Contractor Review	External contractors are reviewed during tender evaluation to ensure they have experience undertaking works, good track record and appropriate qualifications to undertake the work to an acceptable standard. PDU are in the process of developing a contractors panel, which has a list of pre-qualified contractors who are capable of completing a range of activities.	Assessment task	Suitability to undertake the works (experience undertaking works, good track record and appropriate qualifications)	WDC Office	Tender Evaluation / Prequalification panel	Contract tender	Tender Evaluation Teams	TRIM	Minimum acceptable score as per the tender evaluation	Only suitable contractors may undertake the works. If contractor performs poorly, this will be addressed during construction, and considered as part of next evaluation process.
A6	Specification Documents & Hygienic Practices	All Council projects require design and construction to comply with specification documents such as the Engineering Code of Practice (ECoP), Hygiene Code of Practice for Works on Public Water Supplies (HCOP) & other NZ standards. These standards are specified in each contract to ensure quality control. Specifications cover aspects such as materials, testing & hygienic practices (including chlorination).	Minimum Standards	Ensures suitable materials (pipes and fittings) are used for pipe construction, correct labelling of pipes (prevent accidental cross connections), minimum installation depths and separation distances with other pipes, sterilisation, flushing and testing undertaken for new pipelines and/or cut-in to existing pipelines.	WDC Office & on site/distribution	Design checked against ECOP, new works tested in accordance with ECOP & work on distribution in accordance with HCOP	Design and Construction	Designer and Contractor, Water Unit reticulation staff oversee cut-ins & submit reports to Water Engineer	WDC website, TRIM & stand over documentation	As per ECOP &/or HCOP not being followed resulting in contamination in reticulation	Re-design, re-work, re-commission and/or contamination in distribution IRP
A7	Well Drilling Standards	All new wells are required to follow NZS4411:2001 which includes the requirement for sanitation and flushing of drinking supply wells.	Minimum Standards	Specification	Well head	Ensure construction is in accordance with NZS4411:2001	Construction of new well	The Engineers Rep to Contract	TRIM	As per standard	Re-work
A8	Inspections as per SLA	SLA inspections includes: • Well head inspections • Reservoir inspections	Inspection task	Well head inspection and reservoir inspection	Well head and reservoir	Visual checks as per SLA	Varies (refer SLA)	Operators	Paper records saved to TRIM	Water ingress points or security concerns	Repair reservoir/well head if minor work. If major issue, inform water operations team.
A9	Asset Age Assessment and Renewals Programme	Capital works programme to repair assets based on age, condition, vulnerability and criticality. Asset condition assessment is completed through burst analysis, pipe age and leakage calculation. Critical pipes are renewed well before end of life.	Assessment task	Identifying pipes to be renewed	Reticulation	Renewals model	Annually	Network planning	Waimap Layer	Pipe performance based on recorded pipe bursts	Renew the pipe once end of life reached, as indicated by renewals model
A10	Secure Aquifer	Obtaining water from a secure aquifer system provides an effective barrier to contamination. Disinfection of the water occurs naturally through the groundwater residence time, natural filtration of particles occurs through aquifer and water from the shallower depths are unable to penetrate through the confining layer.	Assessment task	Well drilling into confined aquifer	New wells	Compliance with Section 4.4 of the DWSNZ	At time of drilling	Water Asset Manager to get consultant to carry out assessment	TRIM	Non-compliance	Drill another well or achieve DWSNZ compliance using treatment methods
A11	Well Head Exclusion Zone	There is an exclusion zone around the well to prevent livestock from entering the area	Inspection task	Visual check	Well head	Inspect if the fence is secure and in good condition	Varies (refer SLA)	Operator	Paper records saved to TRIM	In poor condition/broken	Investigate cause and repair
A12	Locked Well Head Enclosure	Well head within a locked enclosure (caged/chamber or fenced)	Inspection task	Visual check	Well head	Inspect lock is in place and functional	Varies (refer SLA)	Operator	Paper records saved to TRIM	In poor condition/broken	Investigate cause and replace
A13	Elevated Well Head	Concrete pad around well and elevated above 100 year flood level	Assessment task	Design parameter	WDC Office	Desktop analysis at design stage, taking into account flood map outputs.	Design process	Designer	As-Built and Waimap	Below 100 year storm flood level	During design: Modify design. Otherwise include in risk assessment, consider re-work or add additional protective measures
A14	Well Head Backflow Prevention	There is backflow prevention to ensure no backflow into the well. This may be provided by check valve, testable double check, or air-gap at tanks.	Inspection task	Visual check	Well head	Inspect correct check valve in place and in good condition	Varies (refer SLA)	Operator	Paper records saved to TRIM	Incorrect check valve and/or poor condition	Replace with a good condition check valve
A15	SCADA Alarm	Alarms are detailed in SLA Appendix I and TRIM 210823136989	Continuous monitoring	Turbidity, pressure differential across cartridge filters, FAC, pH, raw/treated tank inlet flow, outflow from treated tank, reservoir level, mains pressure, power supply	Headworks	Critical SCADA alarms tested as per requirements in SLA, to ensure alarm activates as it should.	Continuous	Analysers/Meters within headworks records data and the Control Systems Engineer analyses it. Water Unit notified when the site needs to be attended to.	SCADA	Each element of SCADA has its own trigger level as outlined in the CCP	As per CCP

Number	Preventative Measure	Description	Monitoring / inspection task	Operational Monitoring					Records	Critical Limit	Corrective Action
				What	Where	How	When	Who			
A16	On-site Generator	One onsite Generator at headworks in case of power failure.	Inspection task	Fuel level, overall condition of equipment and pipework, and test-run under regular load conditions.	Headworks	Manually	Monthly - general run test Quarterly - servicing and report	Water Unit Operator/generator maintenance contractor	Electronic Log Book	Does not operate under regular load during monthly test	Report provided by generator maintenance contractor every quarter with any recommendations. To be actioned by 3 Waters operations team member
A17	Portable Generator	Portable generator 15 kVA available in the Water Unit yard and portable 55 kVA generator stored at the Pegasus Headworks.	Inspection task	Fuel level, overall condition of equipment and pipework, and test-run under regular load conditions.	Water Unit Yard and Pegasus Headworks	Manually	Monthly - general run test Quarterly - servicing and report	Water Unit Operator/generator maintenance contractor	TRIM	Does not operate under regular load during monthly test	Report provided by generator maintenance contractor every quarter with any recommendations. To be actioned by 3 Waters operations team member
A18	Trained and Qualified Water Unit Reticulation Staff	Council's Water Unit reticulation staff undertake water supply pipeline repairs, stand overs, renewals, backflow prevention device installations and tests, and capital works. Using in house staff who are trained and have experience in the District constructing and repairing water mains, provides confidence in their ability to undertake water projects to a high standard. A reticulation team is on call 24/7 to undertake emergency response for the reticulation and at the plants.	Review task	Check staff members training and qualification requirements, and If any refresher courses are required.	Water Unit office	Check promapp training register for any expiring qualifications	Ongoing oversight	Water Unit administration staff	Promapp	Refresher/expiry in coming year	Book relevant staff into required courses to maintain competencies / qualifications
A19	Water Unit Stand over	Council's Water Unit undertake stand overs for non-Water Unit staff connecting to Council operated water supply. A reticulation staff member who has made successful connections with years of experience will attend the stand over process to ensure correct hygiene practices are followed.	Inspection task	Ensure contractors are using correct hygiene practices when connecting to water supply	Reticulation	An application to connect to supply is submitted by an external contractor	As required	Water Unit reticulation staff	Hygiene Audit to TRIM folder WAT-02-03-01	Does not comply with Hygiene Code of Practice	Do not allow work to begin if preparation for cut in is not up to hygiene standards. Water Unit staff member to guide non-Water Unit contractor, if required. Water Operations Team notified if remedial actions are required.
A20	Constant Positive Pressure System	Surface pumps are automatic and/or on VSDs to ensure positive pressure is maintained at all locations within the reticulation. Positive pressure is one of the barriers preventing contamination entering the network.	Continuous monitoring	Mains pressure	Reticulation	In-line pressure sensor	Continuous with SCADA alarm	Water Unit Operator	SCADA	Negative pressure or low pressure	· Adjust pump speed · Investigate and remedy cause of pressure change
A21	Inspection/Approval of Subdivision and Council Capital Works	Council's Project Delivery Unit ensures work complies with Council design and construction requirements for new capital works funded by Council, and those completed by developers.	Inspection task	Undertake review of design drawings submitted, and oversee construction in the field to ensure it complies with standards / approved design	Reticulation	Review design when submitted, and inspect construction in the field during construction stage	As required	PDU	TRIM	Does not meet standard	Resign and/or re-work to ensure minimum requirements are met
A22	Leakage Detection	Leakage levels on schemes are monitored through annual night flow reporting, which would also detect potential illegal connections that may increase system flow. Monitoring of levels will then trigger follow up actions depending on changes. See Section 2 for information about the scheme's annual leakage results.	Monitoring task	Leakage	Reticulation	Annual night flow reporting	Annually	Network Planning Team	TRIM	All schemes to achieve an ILI of B or better	Investigate cause of high leakage results, consider upgrades, as per Water Conservation Strategy
A23	Backflow Prevention Programme	All low, medium and high risk sites are required to have backflow prevention devices. This is implemented as per Council's Backflow Prevention Policy which specifies backflow preventers be installed only by an Independently Qualified Person who is also a certified plumber. High hazard sites and restricted residential supplies require a multi backflow prevention system. High hazard sites have a dual check valve at the boundary in the toby box and a Reduced Pressure Zone device within the property boundary. Residential restricted connections achieve backflow through a check valve in the toby box as part of their service connection, and an air gap at their tank. Annual backflow prevention device testing is undertaken by the Water Unit and recorded on Council systems to ensure the programme is being implemented.	Inspection task	Backflow prevention devices. Survey properties to ensure each property has correct risk level backflow prevention device installed.	At point of supply and/or at tank (restricted supply)	Backflow survey of properties to identify risk level of property, device installed to match risk level, then testing of testable backflow prevention device at properties.	Annually	Water Unit reticulation staff, 3 Waters and PDU	WAT-02-02-02 – Backflow Prevention Survey Report WAT-02-02-01 – Backflow Testing Report 190319036125 – Backflow Testing Register	Incorrect backflow prevention device for property risk, fails the test,	Upgrade, install or fix backflow prevention device
A24	Business Continuity Plans	Business Continuity Plans and procedures to ensure that the business can continue to operate in an unforeseen event, to ensure that levels of service are still met.	Refer to Component 1 (Commitment to Drinking-Water Quality Management)								
A25	Maintenance	Maintenance of water supply elements to be undertaken by the Water Unit during routine checks, in response to SCADA alarms and service requests.	Maintenance task	Routine checks, SCADA alarm and/or service request	Headworks and reticulation	Inspection of system following information being received about issue	As required and/or as per SLA	Water Unit Operator/ Water Unit reticulation service person	AMIS system for reticulation works, log book for headworks works.	Maintenance not completed as per schedule and/or KPI	Undertake overdue maintenance Re-prioritise work Review schedule
A26	GIS Mapping Programme	Council has a Geospatial Information System (GIS and WaiMap) which maps all assets owned by Council, including all pipes. Asbuilts for pipelines and designs are given to the Asset Information Management (AIM) team within Council who upload them into GIS. This is added to a layer with all water pipelines and other reticulation assets within the District which is visible to on call Council staff on any electronic device.	Refer to Component 8 (Documentation and Reporting)								
A27	Trained and Qualified Water Unit Supply Operators	Council's Water Unit Operations Staff undertake sampling, testing, headworks checks, inspections of headworks elements as per SLA and in response to alarms. Supply operators have adequate training to ensure competent operators are maintaining the sites, as seen in Table 1.3. The newly introduced rotational operator system will ensure redundancy in competency for all Council water schemes. Using a trained contractor who has experience in the site including under supervision of a team leader with years of experience in all locations, provides confidence in their ability to perform to a high standard. They are considered an essential service and are on call 24/7.	Operational task	Check staff members training and qualification requirements, and If any refresher courses are required.	Water Unit office	Check promapp training register for any expiring qualifications	Ongoing oversight	Water Unit administrative staff	Promapp	Refresher/expiry in coming year	Book relevant staff into required courses to maintain competencies / qualifications
A28	BeforeUDig	Using this service allows contractors to be aware of the presence of water mains, and critical mains require a permit before working in vicinity. Plans are automatically generated when requested so that any contractor who requires plans can access them at any time for either planned or emergency works. Council provides a locate service (at cost) to ensure mains are not damaged by third parties. Council may specify specific protective measures for works near critical mains.	Review task	Plans are automatically generated for Before-u-dig from the Council's GIS mapping system. Review of proposals to work near critical mains are undertaken when works are proposed.	Design office and contractors office	Request plans from BeforeUDig for relevant area	As required	Designer and Contractor	Design file	Works proposed in same vicinity as critical infrastructure	Works modified to avoid clash, alternative design may be required.
A29	Proactive/Reactive Flushing Programme	The Water Unit undertake proactive and reactive flushing following new pipeline installations, in response to a service request from residents or in response to a potential contamination event i.e. high turbidity. All new pipelines are required to be super-chlorinated, then flushed as part of commissioning processes.	Operational task	Reticulation flushing of new mains, as part of planned maintenance as per SLA, or in response to service request.	Reticulation	Open up the reticulation to allow treated water to flush through until adequate water quality is achieved	As required	Water Unit reticulation staff	Work order (WO) from AMIS	Service request, turbidity > 2 NTU, customer complaint about chlorine taste, chlorine level less than 0.2 mg/L	Flush the reticulation, report results back to Water Operations Team if quality within required parameters cannot be achieved.

Number	Preventative Measure	Description	Monitoring / inspection task	Operational Monitoring					Records	Critical Limit	Corrective Action
				What	Where	How	When	Who			
A30	Designed by Qualified Person	WDC engages qualified structural engineers to design new buildings and qualified design engineers to design headworks and pipelines.	Review task	Prior to construction the designs must be reviewed by a qualified design engineer	Engaged consultant's office & WDC office	For works commissioned by Council the checks are made at the time the Engineer is engaged. For works done by a Developer the subdivisions engineer will ensure that work has been completed by qualified person prior to accepting the design. Structural Engineering designs require a producer statement prior to approval. Building consent officers check building designs prior to approval.	Before approval of the design	Water Asset Manager for works commissioned by Council; Sub Divisions Team for development; Building Consent Team for building consents.	Development - resource consent, Council commissioned works - project folder in TRIM, Building Consent - building consent folder in TRIM	The design will not be accepted if it is not provided by a suitably qualified engineer.	Request design be reviewed by suitably qualified engineer
A31	Sampling Procedures	Sampling procedures are carried out by trained Water Unit staff who have completed Level 3 Sampling and Site Analysis for Water Treatment NZQA qualifications, as a minimum. Sampling points throughout the District are made of copper. Prior to taking each sample they are flamed, as part of the WDC sampling procedure. Both of these factors minimises the likelihood of contaminants being introduced to the sample during the sampling process. Samples are taken to the Water Unit Laboratory for evaluation. The laboratory has been independently assessed and passed by an authoritative accreditation body, meaning it is IANZ accredited.	Monitoring task	Best practice sampling procedure followed. Water samples are taken to get tested for E. Coli & total coliforms	Sampling Points & Water Unit Laboratory	Testing procedures	As required as per SLA	Water Unit Operator	Promapp, TRIM and DWO	E. Coli and/or total coliforms are detected	Refer to IRP for microbiological contamination, contamination in distribution, &/or loss of source water quality. Consider updating sampling procedures
A32	Locked Storage Tank/ Reservoir	Opening in storage tanks / reservoirs have lockable lids/ openings.	Inspection task	Ensure there are locks on the storage tanks/reservoirs	Storage tanks/reservoirs	Check the opening	Site inspections as per SLA	Water Unit Operator	Paper records saved to TRIM	Storage tank/reservoir without lock	Arrange for a new lock to be installed
A33	Reservoir Cleaning	The SLA includes 5 yearly cleaning of reservoir(s).	Maintenance task	Clean reservoir as per Promapp process	Headworks	Drain, clean out and inspect interior condition of reservoir. Concrete tanks have structural check	Five yearly	Water Unit Operator	TRIM	Five yearly clean not completed. Interior condition of reservoir is poor.	Complete overdue cleaning. Review maintenance schedule
A34	Hydraulic Modelling	Checking hydraulics of the system within a model to ensure the system can maintain adequate pressure and provide for demand.	Monitoring task	Hydraulic modelling	WDC Office	Assessing the distribution system	Annually, and in response to requests for new connections	PDU - Network Planning Team	TRIM	Inadequate pressure meaning supply cannot meet required level of service	Ensure that upgrades are programmed and completed as condition of new connections taking place, or in response to issues being identified.
A35	Tank Configuration	Tanks are configured to avoid 'dead spots'/ short circuiting, filling from the top and draining from the bottom.	Design task	Avoid short circuiting in tanks	Headworks	Tank configuration	During design	Design engineer	Drawings and as-builts	Short circuiting occurs due to incorrect configuration	Re-design or re-work
A36	Chlorine Analyser	Chlorine analyser is located at the outlet of the headworks and calibrated as per DWSNZ requirements, and as per Promapp process.	Monitoring task	Chlorine analyser	Headworks	Measuring free available chlorine	Continuous	Control Systems Engineer and Water Unit Operators	SCADA records	Refer site specific CCP	Refer site specific CCP and relevant Promapp process.
A37	Storage Tank / Reservoir Drainage Backflow Prevention	All tanks with drains have means of preventing backflow between the reservoir and the point of discharge.	Design task	Overflow outlet pipe on reservoir/tanks	Headworks	Overflow pipe at a lower elevation than the inlet pipe for treated water	During design	Design engineer	As-builts	Outlet at higher elevation to the inlet pipe or does not exist, or non-return valve / mesh fitted at outlet	Install a new outlet pipe at correct elevation
A38	Standard Operating Procedures	Refer Component 4 – Operation Procedures.	Operational task	Carry out jobs as per the agreed standard operating procedures outlined in the Service Level Agreement	Headworks, Distribution, WDC office, Water Unit office	Regular meetings, updates, service requests, KPI, capital works	Daily	Water Unit & 3 Waters	TRIM, minutes, collector app, output sheets, AIMIS	Duties not being performed within agreed time frames or to agreed standards	Complete overdue work and reconsider set timeframes if not achievable
A39	Service Request System	Customer complaints and queries are lodged via WDC Service Request System and responded to within required timeframes with KPI.	Inspection and monitoring	Service request received by customer services, 3 Waters and/or Water Unit	WDC Office, Water Unit office, on-site	Operator to attend site after service request received	As required	Water Unit Operator	Tech1 updated with what was required for the job	Not responded to within required timeframe as per KPI	Arrange for an urgent site visit, consider evaluating response times
A40	Headworks Bypass	The system contains a headworks bypass. Refer to Section 2.1.3	Design task	Headworks bypass	Headworks	Having pipework available for water to bypass specific tanks/reservoirs	As required	Design engineer	As-builts	Bypass leaking, broken, does not exist	Repair or replace. If does not exist, consider installing
A41	Locked Headworks Building	Headworks building is fully locked without windows to prevent unauthorised entry.	Inspection task	Lock on the headworks building	Headworks	WDC lock	As required as per SLA	Water Unit Operator	Log book	No lock on headworks	Arrange for a new lock to be installed
A42	Chemical Supply Contractors	Regular filling of chlorine tanks undertaken by dedicated contractor (Ian Coombes). Ixom supply soda ash.	Operational task	Reliable chemical suppliers regularly refill chemical stocks	Headworks	Supply chemical stocks to headworks	As required	Water Unit operator monitors levels as per SLA, contact Ian Coombes & Ixom to provide supply	Log book	Does not provide supply prior to running out	Contact relevant supplier
A43	Handheld Equipment Calibrated	Online monitoring verified as per relevant Promapp process to meet DWSNZ requirements. Handheld meters calibrated externally (chlorine analyser 6 monthly and some equipment annually). Refer to Component 5 (Verification monitoring programme) for more information.	Monitoring task	Handheld equipment	Headworks and reticulation	Refer to Promapp process	Weekly	Water Unit Operator	Via Collector app to record when verifications / calibrations completed. Process stored in Promapp.	As per individual process for individual equipment.	Calibrate equipment. Send away if required for re-calibration/service at Hach every 6 months.
A44	Labelled Chemical Tanks	Chemical tanks (chlorine, pH correction chemicals) are all labelled.	Inspection task	Ensure all chemical tanks are labelled	Headworks	Permanent marker and/or stick on labels	Weekly	Water Unit Operator	Photo records, collector app	No label	Mark the container with the chemical within
A45	Chlorine Stockpiles	Multiple sources and suppliers of chlorine and soda ash. Stockpiles exist at Water Unit Yard and Gammans Creek Headworks.	Inspection task	Adequate stockpiles of chlorine on site	Headworks	Ian Coombes delivers sodium hypochloride	As required	Ian Coombes delivers, Water Unit Operators to ensure adequate stockpile on site	Collector app, output sheet and invoices	Inadequate stockpile of chlorine	Call Ian Coombes for a delivery. Consider if need to increase quantity delivered.

Number	Preventative Measure	Description	Monitoring / inspection task	Operational Monitoring					Records	Critical Limit	Corrective Action
				What	Where	How	When	Who			
A46	Flood Mapping	Flood risk and flood depth mapping of source and headworks sites.	Design task	Assess flood levels to ensure no unacceptable risk in terms of flooding	Headworks and well head sites	Load layers on Waimap	At design stage for new sites, or as upgrades undertaken	Design engineer	Waimap layer & Water Safety Plan	Source and/or headworks below the flood depth displayed on Waimap. In some cases headworks floor below flood level may be acceptable if all critical equipment / electrical cabinets are above flood level.	Design: Raise potential entrance points above elevation Post design: Construct additional defences to the flooding
A47	Site Security	Site has adequate fencing, locks and protection to prevent access to the site from either the public or livestock	Inspection task	Fence, gates & locks	Headworks and well head sites	Visual inspection	Weekly	Water Unit Operator	Photo records, collector app	Broken fence, broken lock	Fix the fence or arrange fencing contractor to repair the fence. Arrange for a new lock to replace damaged one.
B1	Natural Filtration	Natural filtration is provided by soil layers between the surface and extraction screens of the bore. Natural filtration is able to filter out larger contamination sources such as pathogens (bacteria, viruses and protozoa) and some chemicals. The effectiveness of natural filtration is dependent on the depth to the screens, as the deeper the well the more likely the pathogen will no longer be active and pose risk to the consumer. A secure source will have sufficient filtration to remove all potential microbiological contaminants, while a non-secure source have still have a certain about of treatment provided, even if not 100% removal.	Natural characteristics, assessed at design stage.	Depth to well extraction screens below ground level, and microbiological removal characteristics of soil, depending on density and profile of layers	Desktop assessment	For secure sources, secure bore criteria are assessed. For non-secure, specific hydrogeological study undertaken, or assessment of catchment type, and water quality data assist in determining the level of removal being achieved.	Design	Design engineer	Secure water application (for secure sources). Water Safety Plan Component 2.	Source water remains in limits that treatment plant is designed for	IRP - loss of source water quality, treatment failure, chemical contamination, &/or microbiological contamination
B2	Redundancy	Redundancy on a water supply can be achieved by having back-up wells/multiple wells, treated storage capacity on-site and/or multiple surface pumps, to minimise the consequence of any one element of the water supply failing at any given time. This is sometimes referred to as the 'N+1' rule, where the Network Planning team assesses the minimum number of a given asset type to meet requirements, then allows one extra for redundancy.	Assessment Task	Assess if scheme has adequate redundancy in wells, storage and surface pumps for 50 year growth	Desktop assessment of headworks assets	Activity management plan (AMP), risk assessment and Water Safety Plan	AMP: 3 yearly Risk assessment & WSP: As required or 5 yearly	Network Planning Team for AMPs, 3 Waters Team and PDU Engineer for WSP	TRIM, WDC website for AMPs	Insufficient redundancy to meet 'N+1' rule	Add redundancy item to improvement plan for the scheme
B3	Standby Chlorination	When a water quality threshold value is exceeded or an event which increases contamination risk occurs on an un-chlorinated supply, standby chlorination can be implemented. Chlorination can be used to reduce any potential consequence of these indicators prior to a contamination event occurring. Water quality is monitored via SCADA which has set threshold values for a range of parameters at critical locations in the water treatment plant to alert the Water Unit & 3 Waters Unit of changes to water quality and/or shut down the plant.	Operational task	Routine sampling to detect any contamination	Headworks & reticulation	Testing samples for E.coli, total coliforms, turbidity, pH & FAC	As required depending on scheme, see Component 5	Water Unit Operators	DWO and TRIM	Water quality parameter on SCADA threshold exceeded or event occurs posing contamination threat to supply	IRP - microbiological contamination, loss of source water, &/or contamination in distribution
B4	New Water Main Chlorine Testing	Sterilisation and pressure testing is undertaken for new pipelines prior to connection into the distribution system.	Inspection task	New water main adequately sterilised such that it is free of contamination prior to connection to the main water supply system	Reticulation	Sterilisation and pressure testing of new water mains	As required	Contractors do physical work PDU project manager to check results prior to sign off Water Engineer to view that this sign-off has been received prior to approving cut-in.	TRIM	No sterilisation and/or pressure test is unacceptable	New water main not connected to main distribution system, and sterilisation process repeated. Contractor to rework and/or re test water main and re-submit results
B5	Well Flushing	If the well's turbidity alarm is activated the well head can be flushed until better quality water enters the system. Commissioning plans are developed for new wells which include minimum flushing requirements and testing, see B8.	Monitoring task	Well head	Headworks	SCADA monitors the turbidity levels from the bore, which will alert operators if raw water quality outside of target range	Continuous	SCADA alters Water Unit Operator, who will undertake the flooding	Log Book	Turbidity >2 NTU for greater than 2 minutes	SCADA shuts down headworks to allow the well to be flushed prior to raw water going through the treatment process
B6	New Pumps Commissioning Plan	Sterilisation and pressure testing is undertaken for new pumps. 1% chlorine is used on all new pumps prior to connecting. Negative E.coli readings/3 Waters approval must confirmed prior to commissioning of a new well pump. Surface pumps are required to be cleaned and sprayed with chlorine.	Operational task	A pump commissioning plan is to ensure the new pump is in an acceptable condition prior to the pump being connected to the live system.	Headworks	Sterilisation and testing as part of commissioning process for new pumps. Minimum details provided in Hygiene Code of Practice	Plan submitted as part of works for new pump, checks made before commissioning	Contractors do physical work. PDU or 3 Waters project manager to check results prior to sign off.	TRIM	No sterilisation and/or pressure test is unacceptable	New well head not commissioned. Contractor to rework and/or re test well head and re-submit results to project manager
B7	New Well Commissioning Plan	A specific commissioning plan is prepared prior to any new well being commissioned. This process is then overseen by a qualified engineer. This will include processes for ensuring adequate sterilisation, flushing and testing is undertaken before the well is connected to the live system.	Operational task	A well commissioning plan to ensure the new well is in an acceptable condition prior to the well being connected to the live system	Headworks	Well commissioning plan	As required	Contractors do physical work. PDU project manager to check results prior to sign off.	TRIM	Well commissioning plan not followed/does not exist	Determine where plan was not followed, remedy problems and progress using well commissioning plan
B8	Tankered Water	MOH tankers list has contractors that can provide 24/7 service for tankered potable water for emergencies (https://www.drinkingwater.org.nz/carriers/carriersfornzregion.asp?NZRegion=NZNZ03) . Their tankers are registered to supply potable drinking-water. Tankered water can be hooked into the treatment process at the headworks so that supply to consumers is not disturbed and a constant supply of water is available. Tankers can also refill residents' tanks when there is a localised problem within the supply.	Operational task	Tank refill at the headworks or at individual properties, as a short term solution to an issue with supply.	Headworks & Distribution	If well is unable to supply raw water tank at headworks, tankered water can be discharged directly into raw water tank to maintain supply. If there is a localised issue affecting just a small number of properties at the edge of the reticulation network, a tanker may be used to supply individual properties directly into their tanks to allow more time for reticulation repairs (if required).	In response to issue	Water tankers are acquired at discretion of Water Asset Manager, as per the Insufficient Supply of Water IRP	Incident Log, TRIM document 210319046556	SCADA indicating there is an issue with the well/raw water. Service request received from customer about water quality.	Tanker to be used in response to issue. If unsustainable, longer term solution to be investigated.

Number	Preventative Measure	Description	Monitoring / inspection task	Operational Monitoring					Records	Critical Limit	Corrective Action
				What	Where	How	When	Who			
B9	Storage	Storage tanks / reservoirs exist and are in service for this scheme. This can allow time for repairs to be carried out on the source / transmission main system before there is a loss of supply. Storage also helps with maintaining positive pressure in the reticulation to (minimising backflow risk, see A23, by reducing the likelihood of running out of water / system losing pressure).	Monitoring task	Multiple storage tanks are available to provide adequate volumes of water for repair work associated with source, transmission line, or treatment system, and provide positive pressure in the distribution system.	Headworks	SCADA alarms notify of upstream issues, likely resulting in a low reservoir alarm, pump fault alarm, or treatment system alarm. Scheme will then run off storage until issue resolved and treatment system back in operation.	Continuous monitoring. Operators respond as required.	Water Unit Operators respond to issues	SCADA records of tank level, Log Book details repairs carried out, Incident Log indicates if any Level 3 or greater 'Loss of Source' incidents have taken place.	Storage tanks volume low to trigger low reservoir alarm	Water Unit Operator to attend site to investigate cause and remedy.
B10	Connection with West Eyreton Supply	Not applicable to water supply scheme. Cust: The water supply line for the Summerhill supply crosses the Cust supply. Currently there is an air gap (removed section of pipe) between two supplies. In the event of an emergency, water from West Eyreton supply could be used to provide Cust Water Supply if works are undertaken to connect these pipes.	Operational task	Disconnect Cust from headworks and connect the Summerhill supply	Reticulation	Emergency works on the main supply	As required	Water Unit reticulation staff		Emergency event	Connect the Cust distribution to the Summerhill supply and disconnect Cust from the headworks
B11	Chlorine disinfection	Sodium hypochlorite solution added to all rural schemes for residual disinfection.	Monitoring task	Chlorine residual is within range	Headworks & reticulation	Dosing system achieves target dose rate, chlorine analyser and handheld meters ensure it is within range.	Systems managed as per SLA	Water Unit Operator	Collector App, electronic lab book, and DWO for sampling records. Log Book for operational activities	See Critical Control Point Plan	Determine cause of out of range chlorine residual. Remedy as required
B12	UV Treatment	UV disinfection is used to treat bacteria, viruses and protozoa	Operational task	UV disinfection is operating within design limits	Headworks	Check the UV intensity, flow, UV transmissivity and turbidity entering UV reactor, using manual samples and continuous data from SCADA, as per SLA and DWSNZ requirements	As defined in SLA and DWSNZ documents	Water Unit Operator to operate and run system, Water Engineer to produce monthly reports	SCADA for continuous data, Collector App for data collected in the field TRIM for monthly reports	See Critical Control Point Plan for UV disinfection	See critical control point plan for relevant actions for different ranges of results
B13	pH Adjustment	Soda ash solution added to increase pH of water.	Operational task	Soda ash added to raw water to bring pH within target limits	Headworks	Manual samples and continuous data from SCADA to ensure system is within target range	Soda ash continuously added when water being treated, checks undertaken as per SLA (weekly site visits)	Water Unit Operator	SCADA Collector App	See critical control point plan	See critical control point plan for relevant actions for different ranges of results
B14	Cartridge Filtration	CUNO high flow 1HF40H housings with maximum size of filter in downstream filter housing system being 5 micron. 1, 5 and 25 micron filters available onsite. These filters remove particulate matter from the water to ensure the effectiveness of the UV system, plus provide protozoal removal.	Monitoring task	Cartridge filters are functioning correctly	Headworks	Pressure differential across filters, turbidity leaving filter unit pre entry to UV unit, flow rate and cartridge age	Checks as part of weekly visit, as per SLA	Water Unit Operator undertakes operational checks, Water Engineer includes in monthly compliance reporting	SCADA Collector App	See critical control point plan for cartridge filtration	See critical control point plan for relevant actions for different ranges of results
B15	Biological Filter	The Pegasus headworks has biological filters on the primary and Chinnerys Road sources. The primary source has 2x0.65-0.58 ES sand media 600-900mm depth and the Chinnerys Road source has 2x Filtec gravity filter with 0.8mm-1.2mm sand media (5m high, 3m diameter). They remove 90% of manganese from the raw water, and the primary filter improves turbidity for effective UV treatment following filtration.	Monitoring task	Biological filters are functioning correctly	Headworks	TBC	TBC	TBC	TBC	TBC	TBC

Note: Grey rows are not relevant to this supply

APPENDIX 4A: Water Unit Processes

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
Water Unit Administration Processes	Complete a Planned Water Shut Down Notification	Published	29-Jun-18	22-Oct-20	Sherrianne Nation
	Complete an Unplanned Water Shut Down Notification	In Progress	2-Nov-18	12-Oct-20	Sarah Starkey
	Conduct Water Unit Monthly Billing	Unpublished	10-Sep-20	10-Sep-20	Sarah Starkey
	Manage Water Unit Contract Works	Unpublished	24-Aug-20	29-Oct-20	Promapp Promaster
	Manage Water Unit Incoming Work	Unpublished	20-Aug-20	29-Oct-20	Promapp Promaster
	Report and Remedy Any Issues or Defects (Plant/Equipment)	In Progress	8-Nov-18	31-Jul-20	Sarah Starkey
	TRAINING Record Water Unit Meeting Minutes SARAH	Unpublished	17-Sep-20	17-Sep-20	Sarah Starkey
	Undertake Parks & Reserves Irrigation Isolations or Repairs	Published	19-Feb-20	25-Mar-20	Charlotte Browne
Water Unit Management Processes	Define Information Required from Hire Companies	In Progress	9-Nov-18	17-Sep-20	Sarah Starkey
	Use 'Before U Dig' Service	In Progress	19-Sep-18	16-Nov-20	Sherrianne Nation
	Clear Sewer Blockages	In Progress	7-Oct-19	2-Dec-20	Sarah Starkey
	Clear Stormwater Drains (Kaiapoi)	Published	7-Nov-18	2-Nov-20	Sherrianne Nation
	Complete a Backflow Survey	In Progress	13-Nov-18	27-Oct-20	Sarah Starkey
	Complete Annual Backflow Tests (Boundary Only)	In Progress	29-Jun-18	17-Sep-20	Sarah Starkey
	Complete Backflow Installations	Published	13-Nov-18	2-Nov-20	Sherrianne Nation
	Complete Cleanup of Sewer Overflow (Private/Public Property)	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Complete Disinfection and Testing of New Water Main	In Progress	28-Jul-18	12-Oct-20	Sarah Starkey
	Complete Effluent Area Wave Band Repairs	Published	28-Jul-18	2-Nov-20	Sherrianne Nation
	Complete Fire Hydrant/Flushing Point Flushing	Published	29-Jun-18	6-Aug-20	Sherrianne Nation
	Complete Flush Tank Flushing	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Complete Inspection and Service of Control Valves	Published	13-Nov-18	2-Nov-20	Sherrianne Nation
	Complete Inspection of Air Release Valve (Sewerage/Water)	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Complete Installation of a New Water Connection	Published	31-Oct-18	12-Nov-20	Promapp Promaster
	Complete Installation of Trench Box (Shields)	Published	27-Jun-18	12-Nov-20	Promapp Promaster
	Complete Marking for a Toby Box	Published	29-Jun-18	2-Nov-20	Sherrianne Nation

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
Water Unit Reticulation Processes	Complete Pipeline Inspections	Published	18-Sep-18	2-Nov-20	Sherrianne Nation
	Complete Programmed Restrictor Testing	In Progress	13-Nov-18	31-Jul-20	Sarah Starkey
	Complete Sewer Overflow Cleanup (Waterways and Streams)	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Complete Sewer Pipeline Cleaning	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Complete Sewer Pipeline Repairs	In Progress	28-Jul-18	5-Nov-20	Sarah Starkey
	Complete Shut Down of Water Supply	In Progress	29-Jun-18	30-Jun-20	Sarah Starkey
	Complete Site Tidy-Up and Pack-Down, if required	Published	31-Oct-18	2-Nov-20	Sherrianne Nation
	Complete Water Pipeline Repairs	Published	29-Jun-18	12-Nov-20	Promapp Promaster
	Cut, Handle and Dispose of Asbestos Cement Pipe	Published	9-Dec-19	2-Nov-20	Sherrianne Nation
	Install a New Fire Hydrant	Published	12-Jul-19	12-Nov-20	Promapp Promaster
	Operate a Pump (Trash/Volume)	In Progress	28-Jun-18	22-Oct-20	Sarah Starkey
	Operate a Trench Rammer	Published	8-Nov-18	2-Nov-20	Sherrianne Nation
	Operate CCTV Equipment	In Progress	28-Jun-18	5-Nov-20	Sarah Starkey
	Operate the Stihl Power Broom (petrol)	Published	1-Nov-18	13-Oct-20	Daniel Burt
	Operate the Water Blaster	Published	28-Jun-18	2-Nov-20	Sherrianne Nation
	Paint a Fire Hydrant	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Paint a Sewer Valve Lid	Published	30-Oct-18	15-Apr-20	Promapp Promaster
	Paint a Valve	Published	30-Oct-18	2-Nov-20	Sherrianne Nation
	Reinstate Work Site Surfaces to Good Condition	In Progress	29-Jun-18	17-Apr-20	Phil Drozdowski
	Repair a Sluice Valve	Published	29-Jun-18	7-Dec-20	Sherrianne Nation
	Repair or Replace a Fire Hydrant	Published	29-Jun-18	2-Nov-20	Sherrianne Nation
	Repair or Replace Toby Valves or Replace Toby Box	In Progress	29-Jun-18	14-Apr-20	Charlotte Browne
	Repair or Replace Tuahiwi Domestic Pumps	Published	12-Jul-18	2-Nov-20	Sherrianne Nation
	Repair or Replace Water Meters	In Progress	29-Jun-18	5-Nov-20	Sarah Starkey
	Repair Sewer Benching	Published	2-Nov-18	7-Dec-20	Sherrianne Nation
	Replace Restrictor Housing	Published	29-Jun-18	7-Dec-20	Sherrianne Nation
	Replace Sewer Manhole Lid and Frame	Published	13-Dec-18	7-Dec-20	Sherrianne Nation
	Replace Sewer Vent Box (with Confined Space Entry)	Published	29-Jun-18	2-Mar-20	Daniel Burt
	Replace Valve Cast Frame and Lid	Published	2-Nov-18	2-Nov-20	Sherrianne Nation
	Apply Environmental Controls in Water Unit Work	Published	2-Nov-18	8-Oct-20	Sherrianne Nation

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
	Complete a Job Safety Analysis (JSA) Risk Assessment	Published	29-Jun-18	1-Oct-20	Sherrianne Nation
	Complete a Lift Using the Hiab	In Progress	27-Jun-18	23-Apr-20	Charlotte Browne
	Complete a Site Specific Safety Plan (SSSP)	Published	4-Oct-18	15-Apr-20	Promapp Promaster
	Complete Annual Checks on Certified Anchor Points	Published	29-Jul-18	1-Oct-20	Sherrianne Nation
	Complete Inspection of Fixed Vertical Ladders	Published	13-Dec-18	3-Nov-20	Sherrianne Nation
	Complete Isolations (Lockout/Tagout)	Published	28-Jun-18	10-Feb-20	Caitlin Mills
	Complete Pumping Station Spraying	In Progress	29-Jul-18	18-Sep-20	Sarah Starkey
	Complete Site Audit/Inspection (Maintenance or Contract)	Published	27-Jun-18	22-Sep-20	Sherrianne Nation
	Complete Tasks with Chemicals/Hazardous Substances at Water Treatment Plants	Published	27-Jun-18	16-Jun-20	Sherrianne Nation
	Complete Test and Tag on Electrical Equipment	Published	15-Nov-18	16-Jun-20	Sherrianne Nation
	Conduct Water Unit Work Safely During Covid-19 Pandemic Level 1	Published	4-Jun-20	18-Sep-20	Sherrianne Nation
	Conduct Water Unit Work Safely During Covid-19 Pandemic Level 2	Published	4-May-20	29-Sep-20	Sherrianne Nation
	Conduct Water Unit Work Safely During Covid-19 Pandemic Level 3	Published	23-Apr-20	29-Sep-20	Sherrianne Nation
	Excavate a Trench	Published	28-Jun-18	12-Nov-20	Promapp Promaster
	Load or Unload an Excavator	Published	27-Jun-18	17-Feb-20	Caitlin Mills
	Locate Registered Dialysis Patients (Locations from DHB)	Published	29-Nov-18	3-Nov-20	Sherrianne Nation
	Locate Services for EMERGENCY OR DAY WORK (<5 Days)	Published	1-Nov-18	15-Apr-20	Promapp Promaster
	Locate Services for PROGRAMMED WORK (>5 Days)	Published	31-Oct-18	17-Feb-20	Caitlin Mills
	Maintain Personal Safety and Resolve Conflict	Published	28-Jun-18	25-Aug-20	Sherrianne Nation
	Operate a Battery or Petrol Chainsaw	Published	5-Nov-18	15-Apr-20	Promapp Promaster
	Operate a Forklift	Published	31-May-18	22-Sep-20	Sherrianne Nation
	Operate a Handheld Battery Drill	Published	5-Nov-18	7-Dec-20	Sherrianne Nation
	Operate a Hydrovac Excavator	Published	27-Jun-18	17-Feb-20	Caitlin Mills
	Operate a Plate Compactor	Published	22-Jun-18	17-Feb-20	Caitlin Mills
	Operate a Roller	In Progress	28-Jun-18	22-Oct-20	Sarah Starkey
	Operate an Electric Reciprocating Saw	In Progress	5-Nov-18	31-Jul-20	Sarah Starkey
	Operate an Excavator	In Progress	31-May-18	24-Jan-20	Phil Drozdowski

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
Water Unit Safe Work Processes	Operate Boat on Sewer Ponds	In Progress	28-Jul-18	18-Sep-20	Sarah Starkey
	Operate C.A.T.4 Cable Locator	Published	2-Nov-18	1-Oct-20	Sherrianne Nation
	Operate Electric or Battery Grinder	Published	5-Nov-18	9-Jan-20	Caitlin Mills
	Operate Hilti Drill (Electric)	Published	1-Nov-18	9-Jan-20	Caitlin Mills
	Operate the 3M/DBI Sala Confined Space Rescue System (Davit Arm)	Published	17-Dec-18	3-Nov-20	Sherrianne Nation
	Operate the Petrol Wet Saw (Concrete Saw)	Published	28-Jun-18	12-Nov-20	Promapp Promaster
	Practise General Hygiene and Cleanliness While Carrying Out Water Unit Work	Published	6-Apr-20	18-Sep-20	Sherrianne Nation
	Prepare for Entry to a Confined Space (Water Unit Tasks)	Published	29-Jul-18	9-Jan-20	Caitlin Mills
	Prepare for Water Unit Work Safely	Published	31-May-18	15-Apr-20	Promapp Promaster
	Prevent Discomfort, Pain and Injury (Manual Handling) in Water Unit Tasks	Published	27-Jun-18	7-Dec-20	Sherrianne Nation
	Pull off Motorway onto Parnhams Drain	Published	29-Jul-18	22-Sep-20	Sherrianne Nation
	Refuel Plant or Equipment	Published	28-Jun-18	17-Feb-20	Caitlin Mills
	Report or Respond to ECan in an Environmental Event	Published	29-Jun-18	22-Sep-20	Sherrianne Nation
	Respond to a Communications Cable Strike	Published	1-Nov-18	17-Feb-20	Caitlin Mills
	Respond to a Fuel Spill	Published	28-Jun-18	17-Feb-20	Caitlin Mills
	Respond to a Gas Pipe Strike	Published	1-Nov-18	17-Feb-20	Caitlin Mills
	Respond to a Machine or Plant Roll Over	Published	1-Nov-18	10-Feb-20	Caitlin Mills
	Respond to an Electrical Cable Strike (Vehicle or Plant)	Published	25-May-18	17-Feb-20	Caitlin Mills
	Respond to Boat Capsize/Man Overboard	Published	22-Jun-18	25-Aug-20	Sherrianne Nation
	Respond to Caustic Soda Liquid (5 - 45%), Sodium Carbonate (Dense Soda Ash) or Sodium Hypochlorite Solution (10-15% available Chlorine) Spill	Published	15-Nov-18	17-Feb-20	Caitlin Mills
	Set Up Traffic Management	Published	27-Jun-18	8-Oct-20	Sherrianne Nation
	Use a Handsaw	Published	29-Jun-18	22-Sep-20	Sherrianne Nation
	Use a Trailer Mounted Portable Generator	In Progress	27-Jun-18	17-Sep-20	Sarah Starkey
	Use Extension Ladders & Ladders (not Vertical Fixed Ladders)	Published	28-Jun-18	25-Aug-20	Sherrianne Nation
	Use Fall Arrest Systems	Published	28-Jun-18	1-Oct-20	Sherrianne Nation
	Use Fixed Vertical Ladders (Not Portable or Extension Ladders)	Published	13-Dec-18	22-Sep-20	Sherrianne Nation

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
	Use INREACH Device when Working After Hours	Published	27-Jun-18	3-Nov-20	Sherrianne Nation
	Use Power Tools Safely	Published	27-Jun-18	17-Feb-20	Caitlin Mills
	Use Small Portable Generator	In Progress	28-Jun-18	21-Sep-20	Sarah Starkey
	Use Three Points of Contact	Published	27-Jun-18	31-Jul-20	Sarah Starkey
Water Unit Technician Processes	Collect Drinking Water Samples	In Progress	12-Jun-18	1-Dec-20	Sarah Starkey
	Collect Free Available Chlorine (FAC) Sample	Published	30-Mar-20	7-Dec-20	Sherrianne Nation
	Complete Grit Wash Cleanout at Rangiora Wastewater Treatment Plant	Unpublished	5-Dec-18	22-Sep-20	Sherrianne Nation
	Complete Inspection and Maintenance of Water Pump Stations and Headworks	Published	27-Aug-18	28-May-20	Darryn Williams
	Complete Mixing and Dosing of Sodium Hypochlorite (15%)	Published	15-Nov-18	28-May-20	Darryn Williams
	Complete Monitoring and Operation of Fernside Sewer Treatment Plant (STP)	Published	21-Nov-18	7-Apr-20	Darryn Williams
	Complete Monitoring and Operation of Loburn Lea Sewer Treatment Plant (STP)	Unpublished	21-Nov-18	22-Sep-20	Sherrianne Nation
	Complete Monitoring and Operation of Oxford Sewerage Treatment Plant (STP)	Published	22-Nov-18	7-Apr-20	Darryn Williams
	Complete Monitoring and Operation of Rangiora Wastewater Treatment Plant Inlet Works	Published	1-Nov-18	3-Mar-20	Darryn Williams
	Complete Monitoring and Operation of Sewer Ponds	Published	28-Jun-18	3-Mar-20	Darryn Williams
	Complete Monitoring and Operation of Sewer Treatment Plants	Published	21-Nov-18	3-Mar-20	Darryn Williams
	Complete Monitoring of Ocean Outfall	In Progress	22-Nov-18	20-Mar-20	Sarah Starkey
	Complete Pumping Station General Garden Maintenance	Published	29-Jul-18	2-Nov-20	Darryn Williams
	Complete Pumping Station Mowing	Published	29-Jul-18	3-Mar-20	Darryn Williams
	Complete Reservoir Cleaning and Recommissioning (Disinfection and Flushing)	In Progress	27-Jun-18	7-Jul-20	Sherrianne Nation
	Complete Scheduled Monitoring of Caustic Soda (30%) levels	Published	8-Nov-18	3-Mar-20	Darryn Williams
	Complete Screen Clean or Maintenance at Waste Water Treatment Plants	Published	22-Nov-18	3-Mar-20	Darryn Williams

Group Name	Process Name	Status	Created Date	Modified Date	Modified By
	Complete Sewer Pump Inspection	Published	15-Nov-18	3-Mar-20	Darryn Williams
	Complete Sewer Pump Station Maintenance	Published	28-Jul-18	28-May-20	Darryn Williams
	Complete Sewer Wet Well Cleaning	Published	28-Jul-18	3-Mar-20	Darryn Williams
	Complete Sewer Wet Well Repairs	Published	28-Jul-18	7-Apr-20	Darryn Williams
	Complete Sodium Bi-carbonate Mixing/Dosing	Published	27-Aug-18	3-Mar-20	Darryn Williams
	Complete Waste Water Sampling	Published	29-Jul-18	7-Apr-20	Darryn Williams
	Complete Water Treatment using Chlorine	Published	21-Nov-18	3-Mar-20	Darryn Williams
	Complete Well Inspections and Audits	Unpublished	27-Aug-18	22-Sep-20	Sherrianne Nation
	Conduct In-House Bacteriological Tests	Unpublished	18-Jun-18	1-Dec-20	Sarah Starkey
	Monitor Ponds System	Unpublished	27-Aug-18	22-Sep-20	Sherrianne Nation
	Move From Wastewater to Potable Water Plants	Published	30-Mar-20	22-Sep-20	Sherrianne Nation
	Plan & Schedule Testing of Drinking Water	Unpublished	2-Aug-18	22-Sep-20	Sherrianne Nation
	Process Request for Private Water Testing	Unpublished	9-Aug-18	22-Sep-20	Sherrianne Nation
	Repair Sewer Pump Blockages	Published	29-Jun-18	7-Apr-20	Darryn Williams
	Respond to Caustic Soda (30%) Alarms	Unpublished	8-Nov-18	22-Sep-20	Sherrianne Nation
	Respond to Positive Result from E.coli in Drinking Water	Unpublished	12-Jun-18	22-Sep-20	Sherrianne Nation
	Response to E coli Contamination of Drinking Water	Unpublished	6-Nov-19	22-Sep-20	Sherrianne Nation
	Use and Maintain Handheld Water Testing Equipment	In Progress	6-Aug-21	2-Sep-21	Sarah Starkey
	Use and Maintain Online Water Testing Equipment	In Progress	6-Aug-21	2-Sep-21	Sarah Starkey
	Use and Maintain Water Testing Equipment	In Progress	6-Aug-21	2-Sep-21	Sarah Starkey
Water Unit Training Processes	Assess Competency of Water Unit Personnel	Published	14-Jan-19	9-Jan-20	Caitlin Mills
	Manage Water Unit Training	Published	14-Sep-20	29-Oct-20	Sherrianne Nation
	Record Competency Assessment results for Water Unit Personnel	Published	14-Jan-19	21-Sep-20	Sarah Starkey
	Select and Record "Competent Persons" to Train or Assess Competency at Water Unit	In Progress	14-Jan-19	22-Oct-20	Sarah Starkey

APPENDIX 4B: Water Unit Competencies

Reference no.	Title
WU_C001	Complete a Lift using the Hiab
WU_C002	Complete a Take-5 Assessment
WU_C003	Complete Excavation of a Trench
WU_C004	Complete Loading/Unloading of Excavator On/Off Truck
WU_C005	Complete Work Alone
WU_C006	Enter Confined Spaces
WU_C007	Locate Services for EMERGENCY or DAY WORK (<5 days)
WU_C008	Locate Services for PROGRAMMED WORK (>5 days)
WU_C009	Operate a C.A.T.4 Cable Locator
WU_C010	Operate a Handheld Drill (Battery)
WU_C011	Operate a Hydrovac Excavator
WU_C012	Operate a Plate Compactor
WU_C013	Operate a Trench Rammer
WU_C014	Operate an Excavator
WU_C015	Operate Asbestos Saw (Battery)
WU_C016	Operate Chainsaw (Battery and Petrol)
WU_C017	Operate Concrete Saw (Petrol)
WU_C018	Operate Electric or Battery Grinder
WU_C019	Operate Hilti Masonry Drill (Electric)
WU_C020	Operate the Water Blaster
WU_C021	Prepare for Water Unit Work Safely
WU_C022	Refuel Plant or Equipment
WU_C023	Respond to Boat Capsize / Man Overboard
WU_C024	Set Up Traffic Management
WU_C025	Use Power Tools
WU_C026	Work Safely at Heights

APPENDIX 4C: Critical Control Point Plan

Critical Control Point Process Summary
Garrymere Water Supply

A Critical Control Point (CCP) is a point, step or procedure at which controls can be applied and a water safety hazard can be prevented, eliminated or reduced to an acceptable level.

Garrymere Headworks

The Garrymere Water Supply abstracts non-secure bore water from the Garrymere Well. The raw water undergoes cartridge filtration, UV disinfection, pH correction (caustic soda) and chlorine disinfection (sodium hypochlorite) before entering the Garrymere reticulation.

The cartridge filtration and UV protection provide 4 log protozoa removal in accordance with Drinking Water Standards New Zealand (DWSNZ). The pH correction is undertaken for aesthetic purposes and is not considered a critical control point in itself. However, it is influential on the effectiveness of chlorination so is incorporated in the CCP. Chlorine provides further disinfection and ensures there is residual disinfection in the distribution zone.

Critical Control Points:

- CCP-03 Permanent Chlorination (Non-Secure Source)
- CCP-04 pH Correction
- CCP–05 UV Treatment
- CCP–06 Cartridge Filtration

CCP-03 Permanent Chlorination (Non-Secure Source)

A variable speed pump adds sodium hypochlorite to the water in flow paced manner, to achieve target FAC concentration of 0.5 mg/L.

Process Objectives:

i. Provide a **secondary (to UV treatment) disinfection critical control point** to inactivate bacterial, viral and some protozoan pathogens that may have entered the water supply system upstream of the dosing point.
ii. Provide **residual disinfection quality control point** to help inactivate pathogens entering downstream of the dosing point.

Operational day-to-day monitoring of control process	
What	Chlorine residual (FAC) in mg/L
When	Continuous, on-line & manual check by operators when on site.
Where	Continuous data from chlorine analyser located in headwork building reticulation pump room. Manual samples from treated water sample tap in treatment building. Manual samples from treated water sample tap in reticulation network.
How	Continuous data from chlorine analyser connected to SCADA recording both pre and post treated water tanks. Manual data from operator's hand-held chlorine analyser.
Who	WDC operator records manual readings in tablet which is linked to TechOne when visiting site. WDC operator(s) alerted by SCADA via mobile phone when result is outside of target range.
Records	All data are recorded digitally to the Council SCADA system, and accessible to Council staff and Operators using the Datran software. The manual data is stored in TechOne via tablets for manual readings.

Sites: Garrymere Headworks		
CCP-03: Permanent Chlorination (Non-Secure Source)		
Process performance criteria at the operational monitoring point.		***Correction required if performance criteria are not met.***
Target Range	FAC Range 0.3 - 1.0 mg/L FAC Target = 0.5 mg/L	**Operator** to check accuracy of reading with handheld instrument during routine operational checks.
Action Limits	FAC <0.3 mg/L (10 min duration) FAC >1.0 mg/L (10 min duration)	SCADA system sends an alarm to operators. **Duty Operator** to attend site, **check accuracy of reading with handheld instrument** and resolve by trying the following tasks in order to achieve target range: - **Check for faults with dose pump.** - **Check if pH within target range.** - **Check for faults with line to analyser.** - **Calibrate analyser.** - **Replace dose pump with spare if faulty.**
Critical Limits	FAC <0.2 mg/L (15 min duration) FAC >1.6 mg/L (15 min duration)	**Duty Operator to shut down well pump and treatment pumps, if they have not already been triggered to by SCADA.** Operate the supply from treated water tank storage until problem rectified and parameters return within critical limits. **Duty Operator** to notify **Duty Supervisor** and discuss additional measures to identify and rectify fault / provide assistance if required**.** **Duty Supervisor** to notify **Water Asset Manager / Water Operations Team Leader** and consider additional interventions (shock dosing reservoirs) if risk of running out of water or non-chlorinated water being sent out before problem rectified. **Water Asset Manager** to notify **DWA** if inadequately disinfected water needs to be supplied or has been supplied (only if chlorine dosing system failure happened at same time as UV system failure). **Water Asset Manager** in consultation with **DWA**, considers the need to **issue a boil water notice.** If chlorine dosing pump unavailable, SCADA will shut down treatment plant upstream of treated water tanks.

<0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	>1.6
Critical	Action		Target Range							Action						Critical

Figure 1: Summary of target, action and critical range (free available chlorine concentration, mg/L)

CCP-04 pH Correction

A variable speed pump adds soda ash to the water in flow paced manner, to achieve target pH values.

Process Objectives:

i. Provide **aesthetic quality control point** to maintain the pH within aesthetic guidelines limits.

Operational day-to-day monitoring of control process	
What	pH
When	Continuous, online and manual check by operators when on site (weekly).
Where	Manual samples from treated water sample tap in the treatment building. Continuous data from chlorine analyser located in headwork building reticulation pump room.
How	Chlorine/pH monitor connected to SCADA system. Manual data from operator's hand-held pH analyser.
Who	WDC operator(s) alerted by SCADA via mobile phone when result is outside of target range. WDC operator records manual readings in tablet which is linked to TechOne when visiting site. If pH affects chlorine levels outside of target range, operators will be alerted via mobile phone with a high / low chlorine alarm too.
Records	All data is recorded digitally to the Council SCADA system, and accessible to Council staff and Operators using the Datran software. The manual data is stored in TechOne via tablets for manual readings.

Site: Garrymere Headworks		
CCP-04: pH Correction		
Process performance criteria at the operational monitoring point.		***Correction required if performance criteria are not met.***
Target Range	pH 6.8 – 7.2	**Operator** to check accuracy of reading with handheld instrument during routine operational checks.
Action Limits	pH < 6.8 for more than 10 minutes pH > 7.2 for more than 10 minutes	SCADA system sends an alarm to operators. **Duty Operator** to attend site, **check accuracy of reading with handheld instrument** and resolve by trying the following tasks in order to achieve target range: - **Check for faults with dose pump.** - **Check for faults with line to analyser.** - **Replace dose pump with spare if faulty.**
Critical Limits	pH < 6.6 pH > 8.0	SCADA system sends an alarm to operators. **Duty Operator consider shutting down well and treatment pumps, if they have not already been triggered to by SCADA,** and operate the supply from storage until problem rectified and parameters return within critical limits. **Duty Operator** to notify **Duty Supervisor** if assistance required**.** **Duty Supervisor** to notify **Water Asset Manager / Water Operations Team Leader** if likely to be longer timeframe until solution found (> 24 hours). As pH treatment is for aesthetic purposes, **Water Asset Manager** is not required to notify **DWA** unless the pH contributes to the failure of disinfection. If soda ash dosing pump unavailable, SCADA shuts down treatment plant upstream of treated water tanks.

< 6.6	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	> 8.0
Critical	Action		Target Range					Action								Critical

Figure 2: Summary of target, action and critical range (pH of water leaving treatment plant)

CCP – 05 UV Treatment

The UV disinfection unit available at Garrymere is a Wedeco Spektron 30e. It is a 10 bar rated unit that achieves compliance by measuring UV intensity against recorded flow to confirm that it has achieved a compliant dose. The UV unit in conjunction with Cartridge filtration (with a 5 micron or smaller filter cartridge in the downstream housing) achieves 4 log credits in accordance with DWSNZ Section 10.

Turbidity is monitored after the cartridge filtration and before the UV disinfection as low turbidity is a requirement for effective UV disinfection.

Process Objectives:

ii. Provide a **primary disinfection critical control point** to inactivate protozoan, bacterial and viral contaminants that may have entered the water supply system upstream of the dosing point.

Operational day-to-day monitoring of control process	
What	UV Intensity (W/m^2) Flow (L/s) UVT (%) Turbidity of water entering the UV reactor (NTU)
When	Turbidity, UV Intensity and flow are measured continuously. UVT is measured manually by handheld instrument as part of weekly operator checks.
Where	Turbidity is measured after the second cartridge filter and before the UV unit in the treatment container. The turbidity meter is located on the wall of the treatment container above the first filter housing (above the sink). UV Intensity is measured by the UV unit internally and compared to flow to confirm it is achieving a compliant dose. UVT is measured by operators between the cartridge filter units and the UV disinfection unit.
How	Continuous on-line turbidity analyser, flow meter and UV intensity connected to SCADA. Hand held hach/thermos fisher turbidity meter for manual sampling. Real Tech portable UVT meter UVT – 045010 for UVT manual sampling
Who	WDC operator records manual readings of UVT, UV Intensity and turbidity in tablet which is linked to TechOne when visiting site. WDC operator(s) alerted by SCADA via mobile phone when result is outside of target range
Records	All data is recorded digitally to the Council data management system (Datran system for data received through SCADA, TechOne system for manual measurements), and accessible to Council staff and Operators.

Site: Garrymere Headworks		
CCP – 05: UV Treatment		
Process performance criteria at the operational monitoring point.		***Correction required if performance criteria are not met.***
Target Range	• UV intensity: >target[#] Target range varies with flow and UVT. System will alarm if target not achieved. *Example 60 W/m² at 2.06 L/s* *149.8 W/m2 at 8.2 L/s* • Turbidity < 1 NTU	**Operator** to perform checks of - UV reference sensor monthly to confirm recorded UV intensity is accurate. - UVT using handheld meter weekly. - Verify turbidity meter weekly and calibrate turbidity meter every 90 days (turbidity meter alerts when calibration due).
Action Limits	• Unable to achieve compliant UV dose (up to 3 minute duration) • Turbidity > 1 and <2 NTU	**Design System Response:** SCADA system sends an alarm, treatment pumps stop and UV sleeps when flow reduces to zero for 30 minutes. If UV not called to run within 30 minutes of zero flow or thermal cut out reached UV unit shuts down. SCADA system sends an alarm. **Duty Operator** to respond by: - Calibrating equipment if measurements not consistent with handheld units. - Identifying if the well is producing water with parameters outside of target range, take offline, flush to waste and see if water quality improves before bringing backonline. - Replacing bulb or ballast on UV unit if unit is not achieving target dose, or if a component fails (these critical spares are held on site). - Check the cartridge filter housing units if turbidity value is high, to determine what is causing the high recording.

Critical Limits	• Unable to achieve compliant dose (> 3 minute duration) • Turbidity > 2 NTU for greater than 2 minutes	**Design System Response:** Treatment pumps stop and UV sleeps when flow reduces to zero for 30 minutes. If UV not called to run within 30 minutes of zero flow or thermal cut out reached, UV unit shuts down. SCADA system sends an alarm. Treatment pumps stop and UV sleeps when flow reduces to zero for 30 minutes. If UV not called to run within 30 minutes of zero flow or thermal cut out reached UV unit shuts down. **Duty Operator to Respond by:** Shut down well pump and treated water pumps, if they have not already been triggered to by SCADA, and continue to try to resolve issue by carrying out steps above. Operators are able to restart the headworks remotely three times within 30 minutes before attending site. **Duty Operator** to notify **Duty Supervisor.** **Duty Supervisor** to notify **Water Asset Manager / Water Operations Team Leader** who will inform **DWA** if inadequately treated water needs to be supplied or has been supplied to the community. **Water Asset Manager** in consultation with **DWA**, considers the need to **issue a boil water notice.**

 # Target value is based on internal equation within the units that generate alarms based on combination of flow rate and intensity (W/m^2).

0 - 1	>1	>2
Target range	Action	Critical

Figure 4. Summary of target, action and critical ranges for turbidity, measured in NTU

CCP – 06 Cartridge Filtration

At Garrymere there are two CUNO high flow 1HF40H 40'' cartridge filtration units configured in series. The effectiveness of the filters is a function of the flow, filter size (1, 5 or 25 micron) and differential pressure across each filter housing. The UV unit in conjunction with Cartiridge filtration (with a 5 micron or smaller filter cartridge in the downstream housing) achieves 4 log credits in accordance with DWSNZ Section 10, Table 10.1.

To assess when the filters need to be changed, the pressure before and after the filters is monitored by the SCADA system. If a filter change is not triggered by pressure, filters are changed every three months.

Process Objectives:

i. Provide an **critical control point** for cartridge filtration to achieve 1 log protozoal removal as part of overall treatment system, and;
ii. To achieve sufficient particle removal to ensure that downstream UV disinfection system is effective .

Operational day-to-day monitoring of control process	
What	Pressure differential across the cartridge filters Turbidity Cartridge filter age Flow
When	Continuous monitoring of flow and pressure differential across the cartridge filters. Continuous turbidity monitoring and weekly operator checks.
Where	Pressure difference between upstream and downstream of each cartridge filter. Turbidity measured after downstream cartridge filter and pre UV.
How	The maximum flow of the pump set is inhibited such that it does not exceed the maximum flow and pressure range of the cartridge filter units. Each cartridge filter housing has a pressure transducer upstream and downstream to monitor the pressure differential across each filter. This is logged into SCADA and checked against the manual pressure gauges on each side of the filter housings on site by the technicians. Continuous on-line analysers connected to SCADA to monitor flow and turbidity and hand held hach/thermos fisher turbidity meter for manual sampling.
Who	WDC operator(s) alerted by SCADA via mobile phone when result is outside of target range and operators review pressure differential on manual gauges when on site doing site inspections.
Records	All data is recorded digitally to the Council data management system (Datran system for data received through SCADA)

Site: Garrymere Headworks		
Cartridge filtration		
Process performance criteria at the operational monitoring point.		***Correction required if performance criteria are not met.***
Target Range	• Pressure differential across a single filter < 240 kPa • Turbidity <1 NTU	**Operator** to perform checks of - Verify turbidity meter weekly and calibrate turbidity meter every 90 days (turbidity meter alerts when calibration due). - Operators should check the age of each filter in use as filters have a design life of three months and should be changed on a regular basis.
Action Limits	• Pressure differential across a single filter: > 240 kPa but < 340kPa. • Turbidity > 1 and <2 NTU	**System Response:** SCADA system sends alert to duty operator to notify of issue. **Duty Operator** to respond by: - Check manual gauges on upstream and downstream sides of each filter housing to ensure pressure transducer differential pressure consistent with manual pressure gauges. - Identifying if the well is producing water with parameters outside of target range, take offline, flush to waste and see if water quality improves before bringing backonline. - Replacing the cartridge filter if unit is not achieving target dose, or if a component fails (these critical spares are held on site).

Critical Limits	• Pressure differential across a single filter: >340 kPa • Turbidity > 2 NTU for greater than 2 minutes	**System Response:** SCADA system sends an alarm. Treatment pumps ramp down and switch off and UV sleeps when flow reduces to zero for 30 minutes. If UV not called to run within 30 minutes of zero flow or thermal cut out reached UV unit shuts down. **Duty Operator to respond by:** Shut down well pumps and treated water pumps, if they have not already been triggered to by SCADA, and continue to try to resolve issue by carrying out steps above. **Duty Operator** to notify **Duty Supervisor.** **Duty Supervisor** to notify **Water Asset Manager / Water Operations Team Leader** who will inform **DWA** if inadequately treated water needs to be supplied or has been supplied to the community. **Water Asset Manager** in consultation with **DWA**, considers the need to **issue a boil water notice.**

0 kPa - 240 kPa	240 – 340 kPa	>340 kPa
Target range	Action	Critical

Figure 5. Summary of target, action and critical control points for pressure differential across an individual filter

0 - 1	>1	>2
Target range	Action	Critical

Figure 6. Summary of target, action and critical ranges for turbidity, measured in NTU

APPENDIX 5A: Drinking-Water Monitoring Programme 2021

Location	Well	Site	Min Samples per Quarter	Max Days between Samples	Min days of week	Number of sample points	Quarter				Total Samples per Year	Compliance with DWSNZ
							1	2	3	4		
Rangiora	Rangiora Reticulation	Zone	22	6	7	1	38	37	35	36	146	166%
	Rangiora Smith Street source	Source	1	135	1	4	16	12	12	12	52	325%
	Ayers Street Wells Raw	Backup Source	0	0	0	2	2	0	2	0	4	NA
	Dudley Park Wells Raw	Backup Source	0	0	0	2	0	0	0	0	0	NA
	South Belt Headworks	Plant	1	135	1	1	15	14	14	14	57	1425%
	Ayers Street Headworks	Plant	1	135	1	1	15	14	14	14	57	1425%
	Total		**25**			**11**	**86**	**77**	**77**	**76**	**316**	**316%**
Kaiapoi	Kaiapoi Reticulation	Zone	19	8	6	1	37	37	35	36	145	191%
	Kaiapoi Darnley Sq Headworks	Plant	1	135	1	1	13	13	13	13	52	1300%
	Kaiapoi Peraki St Headworks	Plant	1	135	1	1	13	13	13	13	52	1300%
	Kaiapoi Source (Porter Peraki Ashley Rugby Sewell Davie Rinaldi)	Source	1	135	1	7	21	21	21	21	84	300%
	Total		**22**				**84**	**84**	**82**	**83**	**333**	**378%**
Woodend	Pegasus Reticulation	Zone	13	11	5	1	27	28	26	27	108	208%
	Woodend Reticulation	Zone	13	11	5	1	27	28	26	27	108	208%
	Woodend Gladstone Park source (GP1 & GP2)	Source	1	135	1	2	6	6	6	6	24	300%
	Woodend Chinnerys Road source	Source	0	0	0	1	1	0	1	0	2	NA
	Woodend Chinnerys Road headworks	Plant	1	135	1	1	14	15	13	14	56	1400%
	Pegasus Source (EQ1, EQ2, EQ3, PW1)	Source	1	135	1	4	12	12	12	12	48	300%
	Pegasus Plant	Plant	1	135	1	1	14	15	13	14	56	1400%
	Total		**30**				**101**	**104**	**97**	**100**	**402**	**335%**
Oxford Urban	Oxford Urban Reticulation	Zone	13	11	5	1	21	19	21	19	80	154%
	Oxford Urban Domain Road Well 1 Source	Source	1	135	1	1	2	2	2	2	8	200%
	Oxford Urban Domain Road Well 2 Source	Source	1	135	1	1	2	2	2	2	8	200%
	Oxford Urban Gammans Creek Raw	Backup Source	0	0	0	1	1	0	1	0	2	NA
	Domain Road Headworks	PLant	1	135	1	1	7	7	7	7	28	700%
	Total		**16**				**33**	**30**	**33**	**30**	**126**	**197%**
	Waikuku Beach Reticulation	Zone	13	11	5	1	27	28	26	27	108	208%

Location	Well	Site	Min Samples per Quarter	Max Days between Samples	Min days of week	Number of sample points	Quarter				Total Samples per Year	Compliance with DWSNZ
							1	2	3	4		
Waikuku Beach	Kings Ave Raw Combined Wells	Source	N/A	N/A	N/A	1	6	6	6	6	24	NA
	Waikuku Beach Camp Ground Raw	Source	0	0	0	1	1	0	1	0	2	NA
	Waikuku Beach Kings Ave Treated	Plant	26	5	6	1	32	32	32	32	128	123%
	Total		**39**				**66**	**66**	**65**	**65**	**262**	**168%**
Cust	Cust Reticulation	Zone	3	45	2	1	8	7	7	7	29	242%
	Cust Headworks	Plant	1	135	1	1	3	3	3	3	12	300%
	Cust Springbank source (well 2)	Source	1	135	1	1	4	4	4	3	15	375%
	Cust Springbank source (well 1)	Source	1	135	1	1	4	4	4	3	15	375%
	Total		**6**				**19**	**18**	**18**	**16**	**71**	**296%**
Mandeville - Fernside	Mandeville Two Chain Rd Headworks	Plant	26	5	6	1	31	30	29	31	121	116%
	Two Chain Road Bore 2	Source	3	45	1	1	3	3	3	3	12	100%
	Mandeville Tram Rd Raw	Backup Source	0	0	0	1	1	0	1	0	2	NA
	Mandeville Reticulation	Zone	13	11	5	1	17	15	17	15	64	123%
	Fernside Well (Raw)	Backup Source	0	0	0	1	1	0	1	0	2	NA
	Total		**42**				**53**	**48**	**51**	**49**	**201**	**120%**
Ohoka	Ohoka Well 2 (raw)	Source	1	135	1	1	3	3	3	3	12	300%
	Ohoka Well 1 (raw) - NITRATE	Source	1	135	1	1	1	1	1	1	4	100%
	Ohoka Well 1 (raw)	Backup Source	0	0	0	1	1	1	1	1	4	NA
	Ohoka Headworks (treated)	Plant	1	135	1	1	3	3	3	3	12	300%
	Ohoka Reticulation	Zone	3	45	2	1	6	6	6	6	24	200%
	Total		**6**				**14**	**14**	**14**	**14**	**56**	**233%**
Garrymere	Garrymere Headworks	Plant	13	13	5	1	17	15	17	16	65	125%
	Garrymere Well (raw)	Source	0	0	0	1	3	3	3	3	12	NA
	Garrymere Reticulation	Zone	3	45	2	1	4	4	4	5	17	142%
	Total		**16**				**24**	**22**	**24**	**24**	**94**	**147%**
Poyntzs	Poyntzs Rd Headworks	Plant	13	13	5	1	17	19	16	17	69	133%
	Poyntzs Rd Reticulation	Zone	3	45	2	1	4	4	4	4	16	133%
	Poyntz Road NITRATE	Zone	3	45	0	1	4	4	4	4	16	133%

Location	Well	Site	Min Samples per Quarter	Max Days between Samples	Min days of week	Number of sample points	Quarter				Total Samples per Year	Compliance with DWSNZ
							1	2	3	4		
	Poyntzs Road Well (raw)	Source	0	0	0	1	1	1	1	1	4	NA
	Total		**19**				**26**	**28**	**25**	**26**	**105**	**138%**
Summerhill	Summerhill Reticulation	Zone	3	45	2	1	4	5	5	4	18	150%
	Total		**3**				**4**	**5**	**5**	**4**	**18**	**150%**
West Eyreton	West Eyreton Well 1 (Raw)	Source	1	135	1	1	2	2	2	2	8	200%
	West Eyreton Well 2 (Raw)	Backup Source	0	0	0	1	1	0	1	0	2	NA
	West Eyreton Well 3 (Raw)	Source	1	135	1	1	2	2	2	2	8	200%
	West Eyreton Plant (post treatment)	Plant	1	135	1	1	2	2	2	2	8	200%
	West Eyreton Reticulation	Zone	3	45	2	1	4	5	5	4	18	150%
	Total		**6**				**11**	**11**	**12**	**10**	**44**	**183%**
Oxford Rural 1	Rockford Road River Intake Raw	Backup Source	0	0	0	1	1	0	1	0	2	NA
	McPhedrons Road Headworks	Plant	3	45	1	1	7	6	7	6	26	217%
	McPhedrons Road Raw Water	Source	3	45	1	1	7	6	7	6	26	217%
	Rockford Road Deep Well Headworks	Plant	3	45	1	1	7	6	7	6	26	217%
	Oxford Rural No.1 Deep Well Raw Water	Source	3	45	1	1	7	6	7	6	26	217%
	Oxford Rural 1 Reticulation	Zone	13	11	5	1	17	15	17	15	64	123%
	Total		**25**				**46**	**39**	**46**	**39**	**170**	**170%**
Oxford Rural 2	Coopers Creek Raw	Backup Source	0	0	0	1	1	0	1	0	2	NA
	Oxford Rural 2 Gammans Booster Station	Zone	0	0	0	1	1	1	1	1	4	NA
	Oxford Rural 2 Bay Booster Station	Zone	0	0	0	1	1	1	1	1	4	NA
	Oxford Rural 2 Reticulation (Gammans zone)	Zone	13	11	5	1	17	15	17	15	64	123%
	Oxford Rural 2 Reticulation (Bay zone)	Zone	13	11	5	1	17	15	17	15	64	123%
	Total		**26**				**37**	**32**	**37**	**32**	**138**	**133%**
Total	Source					27	88	80	84	78	330	
	Backup Source					13	13	5	13	5	36	
	Plant		94	1476	34	16	210	207	203	205	825	
	Zone		166	417	65	19	281	274	274	268	1097	
	Total		**260**				**592**	**566**	**574**	**556**	**2288**	**220%**

APPENDIX 5B: Service Request June 2017 – June 2021

Application ID	Full Details	Company/ Surname[1]	Primary Address[1]	Received On	Source	Resolution
WA1701052	Water - No Supply - Public - Brent has no water, just noticed 20 minutes ago, unsure how long supply has been off. I Called WU, no known issues.			13/10/2017 9:24:16 AM	Phone	Talked to owner. Everything is working now. job cancelled
WA1901478	Can we please check the pressures along Garrymere Rd and Birch Hill Rd to confirm there are no obvious issues, i.e. closed valve or leak causing the issues in Garrymere. Phil, can you please ring me to discuss plan first? Thanks.			6/12/2019 9:55:58 AM	Phone	All checked and completed.
WA2000752	Backflow survey at all Water Treatment Plant sites. As discussed with Phil, we need Arch to carry out a backflow survey of all our water sites to identify any backflow risks and recommend suitable backflow devices. Can he please coordinate with the Technicians team to carry out this survey? Thanks.			24/06/2020 5:05:59 PM	Phone	Arch is completing these will be put on TRIM.
WA2000979	Water - Low Flow/Pressure - Caller advised that he has very low water pressure. Please call him to advise when you can be there to check the restrictor.			24/08/2020 11:45:41 AM	Phone	Flow Check - Toby filters very dirty.

Application ID	Full Details	Company/ Surname[1]	Primary Address[1]	Received On	Source	Resolution
WA2001093	Water - Water Maintenance. replace restrictor and box			23/09/2020 2:56:13 PM	SnpSndSlv	Replaced Restrictor and Box.
WA2001094	Water - Water Maintenance. replace restrictor and box			23/09/2020 3:28:51 PM	SnpSndSlv	Replace Restrictor and Box
WA2001361	Water - Water Leak - the Council water tanks on Alastair's property for the Garrymere Water Scheme are overflowing and water is gushing everywhere, need some urgent attention. Called the Water Unit and spoke with Billie			30/11/2020 11:24:15 AM	Phone	Cancelled: Technicians not Retic undefined. *** 01.12.2020 Call back not actioned as job cancelled according to resolution - CW **
WA2100105	Water - No Service - NO water from about 4pm Passed to Water Unit			26/01/2021 6:39:00 PM	AfterHours	Completion Comments: Cancelled: Owners called back to say they found problem. Broken pipe on a trough which emptied tank. No action by water unit
WA2100320	Water - Water Leak - Water is leaking between the road and the toby box on the Garrymere Road side of the property. Water is pooling and the ground is getting quite soft in the driveway. *** 11032021 - Paul called back this morning to advise the water leak is now a fountain and is starting to affect the tar seal on the road - quite an amount of water is coming out now and needs urgent attention. DMC			9/03/2021 8:51:21 AM	Phone	Completion Comments: Broken fitting on the main, replaced with new one 12.03.2021 voicemail left to advise of outcome RL
WA2100333	Water - Water Leak. Notes: Water leak probably on lateral coming off main. Name: Josh Palmer. Email:			10/03/2021 12:10:17 PM	SnpSndSlv	Completion Comments: Cancelled: Same job as 551 Garrymere road

Application ID	Full Details	Company/ Surname[1]	Primary Address[1]	Received On	Source	Resolution
	joshua.palmer@wmk.govt.nz Telephone: 0220672593					

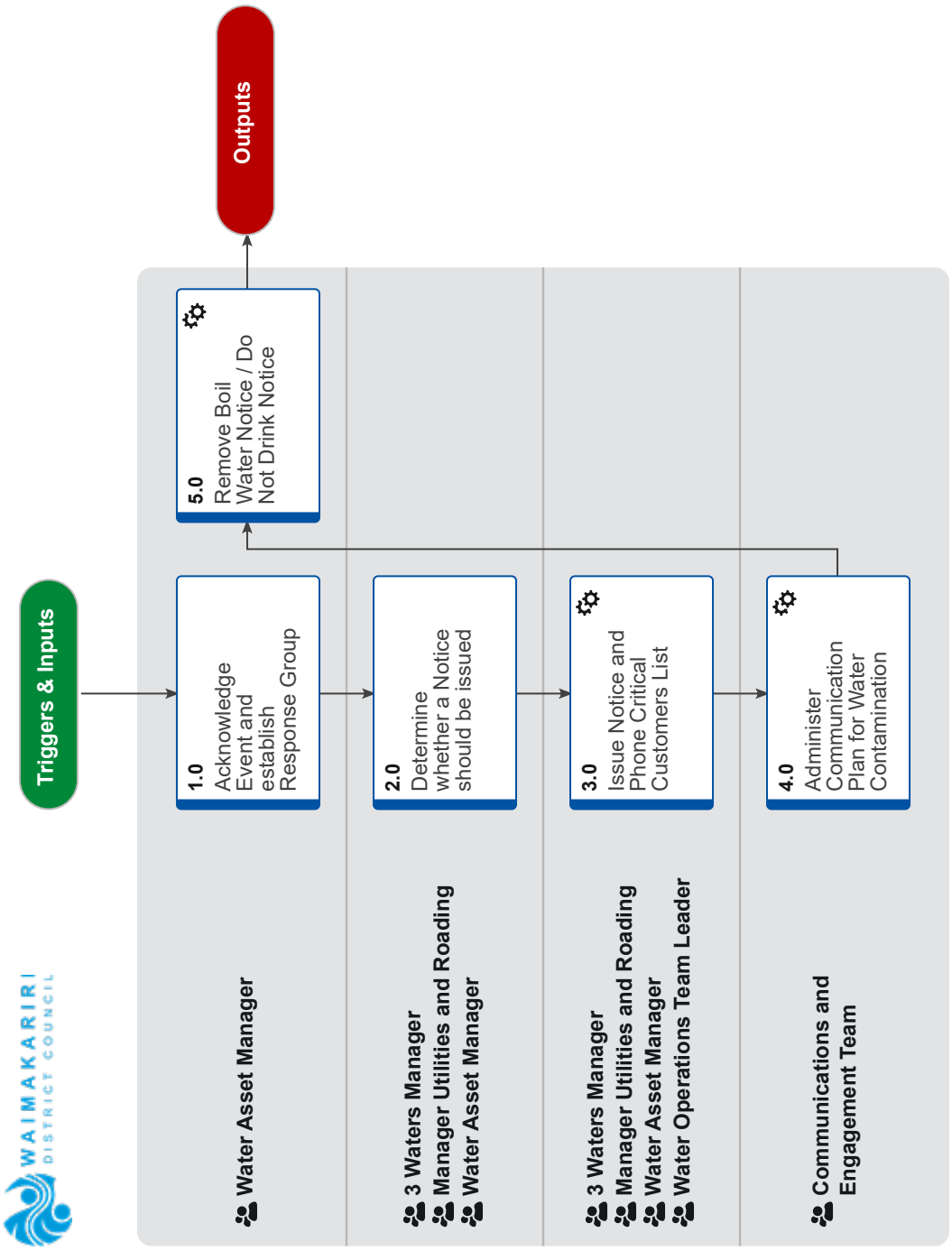
1. *Consumer details removed for privacy*

APPENDIX 7A: Key Contact Details For Incident And Emergency Response Plans

Organisation	Name	Contact
Taumata Arowai	Website - For issues that may affect the safety or compliance of drinking-water	Taumata Arowai Website
	24/7 phone - For when there is immediate risk to public health	04 889 8350
WDC Asset Managers	Colin Roxburgh (Water Asset Manager)	colin.roxburgh@wmk.govt.nz 021 481 873
	Caroline Fahey (Water Operations Team Leader)	caroline.fahey@wmk.govt.nz 027 406 5138
	Kalley Simpson (3 Waters Manager)	kalley.simpson@wmk.govt.nz 021 223 3428
	General	water.asset@wmk.govt.nz 0800 965 468
WDC Water Unit	Darryn Williams (Technicians Team Leader)	darryn.williams@wmk.govt.nz 021 416 488
	After Hours	03 311 8900
Nairn Electrical	North Canterbury Branch	03 313 6104
Water Force	Rangiora Branch	03 310 7550

APPENDIX 7B: Issuing Boil Water And Do Not Drink Notices Promapp Process

Issue a Boil Water Notice / Do Not Drink Notice [In Progress] v0.4



Issue a Boil Water Notice / Do Not Drink Notice [In Progress] v0.4

Summary

Objective
To describe how to issues a boil water notice or do not drink notice in the event that a supply become contaminated and is no longer considered safe to drink.

Owner Kalley Simpson

Expert Libica Hurley

Procedure

1.0 Acknowledge Event and establish Response Group
Water Asset Manager

a Alert 3 Waters Manager and Utilities & Roading Manager.

b Establish a Response Group with the Utilities & Roading Manager, 3 Waters Manager, Water Operations Team Leader and any other relevant staff.

2.0 Determine whether a Notice should be issued
3 Waters Manager, Manager Utilities and Roading, Water Asset Manager

a Consider the need to issue either a Boil Water Notice or Do Not Drink Notice.

NOTE **What examples of events may trigger the issuance of a notice?**
* Colin to provide

NOTE **What if the 3 Waters Manager is not available to approve the Notice?**
In the absence of the 3 Waters Manager, the Manager Utilities and Roading or Project Delivery Unit Manager may fulfil the role described for the 3 Waters Manager.

b Inform the Communications and Engagement Manager that a notice is being issued, and provide information relevant for the Council's website (including FAQ).

NOTE **What information should be provided to Communications Team?**
a. Description of event
b. What to do (i.e. boil, or 'Do not drink')
c. Description of affected scheme boundaries
d. Notification of any extra measures (i.e. if chlorine has been added to otherwise non-chlorinated scheme).
e. Info on what to do if you have symptoms (go to doctor)
f. Regularity of updates

3.0 Issue Notice and Phone Critical Customers List
3 Waters Manager, Manager Utilities and Roading, Water Asset Manager, Water Operations Team Leader

a Issue the notice via Tech1.

How to issue a Boil Water Notice using E Text in Tech1 Emergency Notices
trim://170609058980/?open

b Inform Community and Public Health of the Notice, including advice of alternative fill points.

c Contact people on the Critical Customers List for the relevant scheme, via phone to inform them of the notice. This may not be required in all events. Staff Resource for calling to be provided by U&R Department.

Critical Customers List
trim://210303035519/?open

4.0 Administer Communication Plan for Water Contamination Event
Communications and Engagement Team

a Receive information from the 3 Waters Team (Water Asset Manager, 3 Waters Manager, Water Operations Team Leader).

b Email Customer services, Chief Executive, Water Unit Manager and Operators, Elected members (Councillors & Community Boards) to inform them of the event.

c Add information to the website as per note.

NOTE **What information should be uploaded to the website?**
a. Description of event
b. What to do (i.e. boil, or 'Do not drink')
c. Description of affected scheme boundaries
d. Notification of any extra measures (i.e. if chlorine has been added to otherwise non-chlorinated
scheme).
e. Info on what to do if you have symptoms (go to doctor)
f. Regularity of updates
g. Upload FAQ - TRIM Record No. 210519080007

d Inform local media of points a) to f) depending of the severity of the event.

e Share story on social media, monitor and respond, and provide updates throughout the duration of the event.

f Consider the need for extra measures depending on severity of event and level of public health risk (i.e. hand deliver letters, VMS boards). To be determined by Comms and U&R.

5.0 Remove Boil Water Notice / Do Not Drink Notice
Water Asset Manager

a Concluding the event the notice can be lifted. This decision can only be made by 3 Waters Manager and Manager Utilities & Roading.

b Inform Communications and Engagement Manager, Customer Services, Chief Executive, Water Unit Manager, Elected Members (Councillors & Community Boards) to inform them the notice is lifted.

c Issue an E Text in Tech1 advising Customer that the notice is lifted, this is the same process as 2.0.

APPENDIX 7C: Boil Water Notice Template

Waimakariri District Council
215 High Street
Private Bag 1005
Rangiora 7440, New Zealand
Phone 0800 965 468

Our Reference: WAT-06-02.05 / 210528086679

Day Month Year

WARNING
BOIL WATER NOTICE

Routine sampling has detected product contamination in the scheme name water supply on date.

Residents on the scheme name water supply need to use boiled tap water or store-bought bottled water for drinking, cleaning teeth, making ice, washing dishes and preparing food until further notice.

Boiling water will kill all disease causing organisms. Electric jugs with a cut-off switch can be used as long as they are full – allow the water to come to the boil and switch off. Do not hold the switch down to increase the boiling time. If boiling water in a pan, place the water in a clean metal pan and bring to a rolling boil for **one minute**. Care should be taken to avoid scalding injuries. Boiled water should be covered and allowed to cool in the same container. The taste will improve if allowed to stand for a few hours before use.

The supply is being chlorinated but it is important that the water used for drinking, cleaning teeth, making ice, washing dishes and preparing food is brought to a rolling boil before use. Stored water and ice should be disposed of. For further information regarding water supply, see the Council's website for a list of frequently asked questions or phone customer services at 0800 965 468.

Please follow this advice to avoid gastroenteritis and other serious illnesses. If you do feel unwell, please seek medical advice from your GP or call Healthline on 0800 611 116.

Please share this information with friends, family and neighbours, who are on the same water scheme as you. Especially those who may not have received this notice directly (for example, people in holiday homes, and businesses). You can do this by posting this notice in a public place or distributing copies by hand.

Updates to this notice will be provided to the public though the Council's website (waimakariri.govt.nz) and social media platforms.

Yours sincerely

Kalley Simpson
3 Waters Manager

APPENDIX 7D: Do Not Drink Water Template

Waimakariri District Council
215 High Street
Private Bag 1005
Rangiora 7440, New Zealand
Phone 0800 965 468

Our Reference: WAT-06-02.05 / 210528086682

Day Month Year

WARNING
DO NOT DRINK - WATER NOTICE

Routine sampling has detected product contamination in the scheme name water supply on date.

As a precautionary measure do to NOT drink your water from scheme name water supply until further notice. Boiling the water WILL NOT make it safe to drink!

Symptoms associated with product when consumed include symptoms x, y and z – preferably attach health advisor sheet. If you or someone you know exhibits any of these symptoms contact your health care provider. Please also notify the Canterbury public health officials at 03 364 1777.

Bottled water is available from your local supermarket. Do not use tap water for drinking, cooking or preparing food until further notice. Boiling water will not remove contamination, rather increase its concentration in water. For further information regarding water supply, see the Council's website for a list of frequently asked questions or phone customer services at 0800 965 468.

The Council are working alongside Canterbury District Health Board to investigate this issue and options to resolve it. Additional information regarding the product contamination is available on the Councils website 24/7.

Please share this information with friends, family and neighbours, who are on the same water scheme as you. Especially those who may not have received this notice directly (for example, people in holiday homes and businesses). You can do this by posting this notice in a public place or distributing copies by hand.

Updates to this notice will be provided to the public though the Council's website (waimakariri.govt.nz) and social media platforms.

Yours sincerely

Kalley Simpson
3 Waters Manager

APPENDIX 10A: Water Safety Plan Annual Review Template

Performance Evaluation of WDC WSPs – 12 month review					
Area	**Check**	**Detail**	**Action required**	**Person responsible**	**Date**
Capital Upgrades	Have any upgrades occurred within the schemes? Are any of these upgrades a major change which could trigger a WSP update?				
Management	Have roles or responsibilities changed in the last 12 months? Have personnel changed in the last 12 months?				
Training	Are all new staff aware of WSPs? Are all new staff adequately trained for their job role and aware of public health risks?				
WSP document maintenance	Have any key water supply documents been updated in the last 12 months? • Incident Response Plans • Improvement plan / budget changes. • SLA Do all staff and operators have the latest version of the WSPs?				

Performance Evaluation of WDC WSPs – 12 month review					
Area	**Check**	**Detail**	**Action required**	**Person responsible**	**Date**
Legislation/standards	Review changes on legislation/standards				
Tracking incidents and improvements	Have there been any incidents affecting any of the water supplies in the last 12 months? What actions were taken to remedy the incident? Was the action taken effective? Have any improvements been identified? Have the improvements/preventative measures identified in the WSP been actioned? Is this incident likely to be applicable to any other scheme?				
Tracking operational procedures	Have the 'what to check' and 'corrective actions' (operational procedures) identified in the WSP been added to the appropriate manual or operational contract?				

Performance Evaluation of WDC WSPs – 12 month review					
Area	**Check**	**Detail**	**Action required**	**Person responsible**	**Date**
	Have 'lessons learned' following an incident been incorporated into operational procedures?				
Assessing	Has the risk register been updated in line with completed improvements (upgraded and new assets) and operational changes?				
Risks	Have the water supplies been assessed for new risks? Have these risks been recorded in the WSP risk register?				