Ashhurst Water Supply
Water Safety Plan

June 2017

This document was prepared by Palmerston North City Council, City Networks, Water and Waste Services Division.

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Version No.	Reason for Amendment	Date
0	FOR REVIEW BY DWA	2 June 2016
1	MINOR AMENDMENT	3 June 2016
2	AMENDMENT ACCORDING TO THE DWA'S RECOMMEDATIONS	18 July 2016
3	MINOR AMENDMENT	3 May 2017
4	MINOR AMENDMENT POST IMPLEMENTATION INSPECTION	12 June 2017

PNCC Reference No:	6887194

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1 Introduction

The Health Act, Part 2A Drinking Water, requires drinking-water suppliers to prepare and implement a Water Safety Plan (previously known as a Public Health Risk Management Plan) for their supplies.

This Water Safety Plan (WSP) for the Ashhurst Water Supply was prepared by Palmerston North City Council (PNCC). Representatives from PNCC's City Enterprises Water Treatment and City Networks Water Asset Management teams have been consulted and involved in the preparation of this WSP, including identification of the risks through participation in WSP workshops.

This WSP is based on the water supply systems and processes current at May 2016. This WSP will be briefly reviewed and updated annually in accordance with the Annual Compliance Reports and comprehensively reviewed and updated every five years and/or whenever there is a significant change made to the Ashhurst Water Supply. All reviews and updates will be completed by PNCC and the new WSP will be forwarded to the Drinking-Water Assessor. On approval of the WSP by the Drinking-Water Assessor, the approval report will be presented to the Council's Management Team prior to implementation of the WSP.

The key steps undertaken in preparing this Water Safety Plan for Ashhurst Water Supply comprise:

- Risk Assessment: The first part of the document identifies potential sources of contamination and the barriers preventing contamination resulting in health effects. Securing the safety of drinking water supplies is based on the use of multiple barriers, from source to consumer, to prevent the contamination of drinking water or to reduce contamination to levels which are not injurious to health. Possible events that might lead to contamination hazards are identified, preventive measures are considered and the level of risk to public health from these events is assessed.

- Risk Management: Based on the results of the risk assessment the second part of the document lists improvements to the supply with a programme for their introduction and the resources needed to do this.

Note this WSP considers risks to public health. It is acknowledged that staff or contractors' health may be at risk from a number of site specific issues related to the operation and maintenance of the Ashhurst Water Supply, but these are not covered by this WSP as such risks are the subject of health and safety in employment legislation, and site specific health and safety practices documented in operational protocols and health and safety manuals.

The document "A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies" (Ministry of Health 2005) has been used in preparing this plan.

The Ministry of Health guides listed below have been used to assist in identifying risks to the water supply. Additional risks have been identified through workshops and consultation with PNCC staff.

- Source and Abstraction
  - S1.1 Raw water: Surface and groundwaters
  - P1.3 Source abstraction: Groundwaters – Bores and Wells
- Treatment
  - P7.1 Disinfection: Chlorine Disinfection

  - P8.2 Aesthetic property adjustment: Iron/Manganese removal
  - P9.1 Fluoridation
  - P10 Pump operation (also applicable to distribution system)
  - P11 Drinking-water treatment plant construction and operation
- Storage and Distribution System
  - D1 Post-treatment storage
  - D2.1 Reticulation network: Construction Materials
  - D2.2 Reticulation network: System pressure
  - D2.3 Reticulation network: Operation
  - D2.4 Reticulation network: Backflow prevention
  - P2 Water Transmission (also applicable to distribution system)
- General Elements
  - G1 Staff training (draft)
  - G2 Monitoring (draft)

2 The Ashhurst Water Supply

2.1 Description

The Ashhurst township is located at the confluence of the Manawatū and Pohangina Rivers, approximately 10 km north-east of the Palmerston North City and has a population of approximately 2,800.

The water source comprises groundwater abstracted from a secure aquifer of good quality with low levels of hydrogen sulphide and ammonia. In addition to the main supply bore there is a test bore (unsecure) which could be used as an emergency backup supply. Chlorine is dosed at a relatively high level to provide a disinfectant residual to prevent the growth of the bacteria in the network. The water is also fluoridated.

The treated bore water is pumped to two elevated storage reservoirs located on Colyton Road which provide about three days storage at average demand. Water from the reservoirs is filtered through cartridge filters at a facility located at Oxford Street to remove iron and manganese deposits for aesthetic purposes prior to distribution in the remainder of the community. The water supply reticulation comprises 24 km of pipelines, supplying approximately 1075 service connections and is operated as a single pressure zone.

Figure 1 shows an overview of the Ashhurst water supply and a schematic is contained in Appendix A.

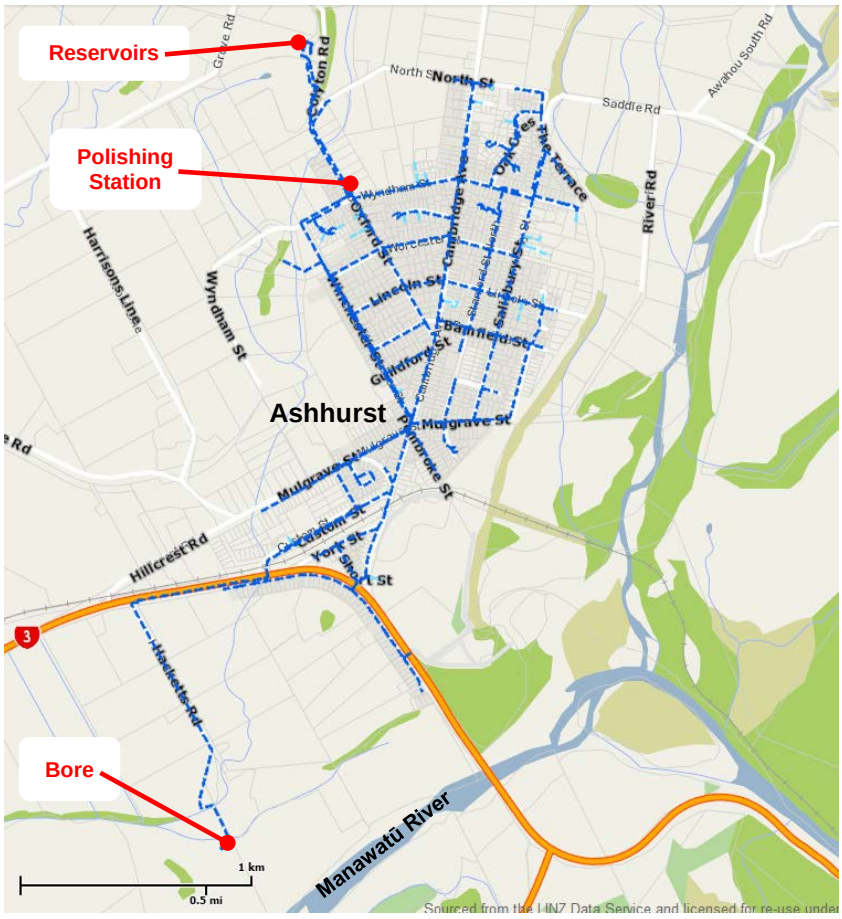


Figure 1: Overview of the Ashhurst Water Supply

2.2 Ownership

The land occupied by the bore is located at 68 Hacketts Road is owned by Mr E Jackson, Mr P Jackson and Mrs K Jackson and is designated for water supply purposes. Access easements are also in place. PNCC owns the land and buildings occupied by the two reservoirs on Colyton Road and the polishing plant on Oxford Street.

City Networks oversees the water supply operations and make key decisions about asset management. Daily operations and management is performed by the City Enterprises operations team in accordance with relevant Service Level Agreements. Contractors are engaged by City Enterprises from time to time for electrical and mechanical maintenance work.

2.3 Groundwater Source & Bore

The Ashhurst water supply is drawn from an artesian aquifer using a submersible pump south of Ashhurst on private farmland accessed from Hacketts Road. Table 1 outlines the capacity of the bore as well as construction and operation details.

Table 1: Hacketts Road Bore Characteristics

Component	Designed & Current Capacity	Description	Operation	Year Built
Hacketts Road Bore No. 1	165 m^3/hr	83m deep bore of 300mm diameter bore	6-10 hr/day	1991

The bore has sufficient depth to prevent surface water contamination and meet requirements for secure groundwater under the DWSNZ. The bore water quality is of consistently high quality. Disinfection is not necessary for the bore water, however, chlorine is dosed at a relatively high level to provide a disinfectant residual to prevent the growth of the bacteria in the network. Fluoride is added for dental health purposes. A fluoride day tank has been installed to address the risk of excessive fluoride dosing occurring in line with the risk mitigation recommended in the Code of Practice for Fluoridation of Drinking Water Supplies in New Zealand (Water New Zealand – 2014).

There are no storage facilities on site at the bore and so water is pumped directly to the two reservoirs located north-east of Ashhurst using two boosting pumps on a standby/duty arrangement through a 5km long PVC 300mm diameter rising main. This rising main was installed in 1992. Historic reasons for loss of supply have included power cuts and pipe breaks in the rising main to the reservoir.

2.4 Reservoirs

Water is pumped from the bore to two reservoirs located at Colyton Road which can be operated independently, in parallel, in series or bypassed. Table 2 outlines the size and details of the reservoirs including the year of construction.

Table 2: Details of Colyton Road Reservoirs

Reservoir	Details	Year Built
Colyton Road Reservoir No. 1	1,900 m^3 circular pre-cast double tee construction concrete reservoir.	1991
Colyton Road Reservoir No. 2	This is a 1,000 m^3 circular steel reservoir.	2015

Historical issues have included severe concrete corrosion of the previous concrete reservoir, which was replaced in 2015. During the new reservoir construction additional valves were installed to enable independent operation of the reservoirs. The new reservoir was designed to be functioning post-earthquake and also has the auto shutdown valve triggered by the big ground movement to retain water.

2.5 Polishing Station

A single 200mm diameter Asbestos Concrete falling main delivers water from the reservoirs via the polishing station on Oxford Street prior to reticulation to the township. 5 Micron Polypropylene cartridges are used to filter iron and manganese deposits for aesthetic reasons.

2.6 Reticulation

The Ashhurst water supply is operated as a single pressure zone. There are approximately 24 km of mains consisting almost entirely of asbestos cement (AC) pipes which were laid in the early 1970s. To date, the AC pipes have had a very low failure rate compared to pipes of similar age in Palmerston North, probably because of the deeper groundwater levels not impacting on the pipe bedding and the more stable pressure regime during the day.

2.7 Operations, Monitoring and Control

City Networks oversee the water supply operations and make key decisions about asset management. Daily operations and management is performed by City Enterprises operations team, assisted by outside contractors for electrical maintenance work, in accordance with relevant Service Level Agreements.

In order to comply with the DWSNZ PNCC contracts Central Environmental Laboratories (CEL) to sample, analyse and report on both raw and treated water quality monitoring undertaken in the water supply system.

PNCC has a telemetry system linked to the Ashhurst bore and reservoirs which transmits operational data in real time as well as provided advice of any alarms.

3 WSP Preparation & Methodology

The purpose of a WSP is to assist the Water Authority to identify and manage risks to the water supply that may have an impact on public health. WSPs encourage the use of a risk-management approach to identify situations that may lead to the contamination of the water supply as well as the actions necessary to protect the public.

Information provided by the Ministry of Health was used as a guide in preparing the WSP. The Ministry of Health recommends the following steps are undertaken when preparing a WSP:

- Develop a flow diagram of the supply that includes all elements that must be considered as part of the WSP;
- Identify barriers to contamination present in the supply;
- Identify events that may introduce contamination or health hazards into the water supply, and then consider causes, preventative measures and corrective actions for each event.

The WSP has been prepared in collaboration with PNCC staff and using available information from the 2010 WSP and other Council documents. Key documents relevant to this WSP are:

- Water Supply Asset Management Plan 2014;
- Water Supply Bylaw and Bylaw Administration Manual/Backflow Prevention Policy 2015;
- Water Supply Development Plan 2015.

Further input was provided by PNCC staff into the monitoring and maintenance plans and improvement schedule.

4 Barriers to Contamination

Table 3 describes the barriers to contamination present for the Ashhurst Water Supply.

Table 3: Barriers to Contamination

Source	Barrier	Barrier Description
Hacketts Road Bore	Stop contamination of raw water	• Existing planning rules regarding land use. • Meet DWSNZ secure groundwater classification. • Well is fenced off. • Wellhead is constructed to avoid contamination and is protected from flooding by stop banks.
	Remove particles from the water	• The groundwater turbidity is typically less than 0.2 NTU. E. coli monitoring of raw has shown concentrations consistently less than 1 MPN/100mL.
	Kill germs in the water	• Disinfection (chlorine).
	Prevent recontamination after treatment	• Water is delivered through pressurised pipes • PNCC has a backflow prevention policy. • Backflow prevention device installation and maintenance programme. • Chlorine/chloramine residual maintained in reticulation. • Trained staff and contractors. • Alarms system.

5 Risk Information Tables

The risk information tables set out possible events for the Ashhurst water supply that may create public health risks.

The risk information tables include:

- The level of risk based on the likelihood and consequence of the event;
- The causes of each risk event;
- Preventive measures currently in place to avoid consequences of the risk event;
- Checks to determine whether the preventive measures are working;
- Corrective actions required where current preventive measures are insufficient to avoid consequences of the risk event.

Appendix 2 of *"A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies"* provides scale descriptions for five categories of likelihood and five categories of consequences which are then used in a matrix for estimating risk. These scale descriptions and the resulting risk matrix has been used for the purposes of this WSP and is repeated below. The level of risk was assessed by PNCC's engineering and operations teams.

5.1 Likelihood Scale

Table 4: Likelihood Scale

Likelihood Ranking	Description
Rare	May occur only in exceptional circumstances (once in 1000 years)
Unlikely	Could occur (once in 100 years)
Possible	Might occur at some time (once in 10 years)
Likely	Will probably occur (once in 1 or 2 years)
Almost certain	Is expected to occur in most circumstances

Table from: A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies, MoH, 2005

5.2 Consequence Scale

The consequence scale contained in Table 5 has been developed for this WSP to provide more specific and measurable consequences.

Table 5: Consequence Scale

Consequence ranking	Description
Insignificant	• Insignificant impact • Little disruption to normal operation • Small increase in operation costs

Consequence ranking	Description
Minor	• Short disruption of service (<1 hour) to part of a zone • Limited restrictions on outdoor water use to reduce demand • Aesthetic water quality event for some consumers • No reported illness • Some manageable operation disruption • Some increase in operating costs.
Moderate	• Disruption of service (<4 hours) to one or more zone • Restrictions on outdoor water use to reduce demand • Water quality event that requires flushing to clear • Boil water notice for up to 3 days • No reported illness • Significant modification to normal operation but manageable • Operation costs increased • Increased monitoring
Major	• Disruption of service (>4 hours) to two or more zones • Prolonged boil water notice • Probable illnesses • Adverse publicity and loss of trust of consumers • Systems significantly compromised and abnormal operation if at all • High level of monitoring required
Catastrophic	• Disruption of complete supply for one or more day • Several instances of illness in the community or instance of death • Prolonged boil water notice • Significant negative national press and long term loss of trust of consumers • Complete failure of systems

5.3 Level of Risk

Table 6: Risk Framework

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

Table from: A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies, MoH, 2005

6 Summary of Level of Risk

The risk assessment for the Extreme, High, Moderate and Low risk events from the risk information tables contained in Section 5 are summarised in the Table 7 to Table 10 below.

6.1 Source & Abstraction

Table 7: Groundwater Source and Abstraction Risks

			Risk Assessment of Existing		
Ref	**Event**	**Cause**	**Likelihood**	**Consequence**	**Residual Risk**
SA1	Not enough source water available for abstraction.	• Drought.	Rare	Major	High
SA2	Contamination of bore during construction.	• Cross-contamination by drilling equipment. • Residual substances used in drilling releasing health significant determinands (e.g. barium from barite).	Unlikely	Moderate	Moderate
SA3	Contaminated water getting into the bore from shallower depths.	• Poor joints, cracks, or corrosion in the bore casing. • Drawdown bringing contaminants from shallower regions of the aquifer.	Unlikely	Moderate	Moderate
SA4	Contaminated water getting into the bore from the surface.	• Water inundates the bore head. • Inappropriate bore head design, or poor construction. • Bore head not properly sealed. • Bore head or casing damaged. • Contamination sources (e.g. stock) too close to the bore head. • Back siphoning.	Unlikely	Major	High
SA5	Contamination of the aquifer.	• Contamination sources too close to the bore head, or bore too shallow. • Aquifer is not secure. • Close by "testing bore" contaminates the aquafer	Unlikely	Major	High
SA6	Too little water can be drawn from the bore to meet demand.	• Damage to the pump or bore head. • Catastrophic failure (e.g. flood, slips or earthquake related damage). • Pump failure. • Vandalism/sabotage. • Screens clogged. • Deterioration in bore condition/structure.	Possible	Moderate	High
SA7	Demand exceed consent limitation	• Unforeseen growth/demand increase • Major leakage as a result of pipe burst • Local groundwater source over allocated	Unlikely	Minor	Low

6.2 Treatment

Table 8: Treatment Risks

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Disinfection – Chlorination					
T1	Not enough free available chlorine.	• Dosing malfunction. • Dose controller's sensor incorrectly calibrated. • Dose controller's set-point incorrect or incorrect dose calculation. • High chlorine demand coupled with poor dose control. • Power failure. • Chlorine supply exhausted. • Chlorine supply adequate, but insufficient chlorine reaching dosing point. • FAC monitoring samples taken incorrectly or incorrectly recorded. • Method of FAC measurement incorrect, incorrectly calibrated, or analysis reagents have deteriorated. • pH too high (resulting in a lower percentage of the FAC existing in its more powerful disinfection form).	Possible	Minor	Moderate
T2	Too much free available chlorine.	• Dosing malfunction. • Dose controller incorrectly calibrated. • Dose controller's set-point incorrect, or incorrect dose calculation. • Low chlorine demand coupled with poor dose control.	Possible	Insignificant	Low
T3	Excessive formation of chlorination by-products.	• Natural organic matter present in the water being chlorinated.	Possible	Minor	Moderate

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Fluoridation					
T4	Fluoride concentration greater than required for dental protection.	• Fluoride dosing solution (or day tanks) delivered at the wrong concentration, or using the wrong fluoride chemical. • Dosing system malfunction. • Dose rate set incorrectly. • Controller's fluoride sensor out of calibration or malfunctioning (if dose controlled by feedback from in-line probe). • Monitoring samples not taken, or results incorrectly recorded. • Monitoring method incorrectly calibrated, performed incorrectly, or analysis reagents deteriorated. • Excessive dose as a result of any of the above faults.	Unlikely	Moderate	Moderate
Pump Operation (Bores & Boosters Only)					
T5	Changes in pressure, or water hammer (pressure surges), suck contaminants into the water.	• Bore/booster pump failure due to mechanical failure or overload. • No water because of pump failure due to power failure. • No water because of pump failure due to flooding or other damage.	Possible	Moderate	High
T6	Incorrect chemical dosing leads to poor treatment.	• Process pumps do not add the correct dose of chemical.	Unlikely	Moderate	Moderate
Plant Construction and Operation					
T7	Treatment plant cannot produce enough water.	• Explosion/fire. • Earthquake. • Vandalism. • Landslide / flooding.	Rare	Major	High
T8	Introduction of contaminating material into filter station.	• Damage to the seal (cartridge or filter housing). • Cartridge is incorrectly seated • Contamination of filter housing when changing the cartridge.	Possible	Minor	Moderate

6.3 Storage & Distribution

Table 9: Storage & Distribution Risks

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Post-treatment Storage / Colyton Reservoirs					
SD1	Not enough water in post-treatment storage to meet demand.	• Insufficient water treatment capacity, or malfunction of the bore pumps. • Inadequate post-treatment storage capacity. • Inability to transmit water from source to post-treatment storage. • Transmission pipe burst. • Leakage from the storage facility.	Possible	Moderate	High
SD2	Chlorine contact time too short.	• Short-circuiting.	Unlikely	Insignificant	Low
SD3	Introduction of contaminating material into service reservoir.	• Access by animals/birds. • Rising main pipe burst. • Unauthorised access/vandalism/sabotage. • Leaching/corrosion from construction materials. • Entry of roof drainage. • Entry of contaminated groundwater for in-ground tanks. • Chemical contamination from incorrect chemical dosing. • Backflow from drains.	Unlikely	Minor	Low
SD4	Development or re-suspension of sediment within tank or reservoir.	• Sediment/slime accumulation and release.	Likely	Insignificant	Moderate
Reticulation Network - Construction Materials (also Applicable to Treatment Processes)					
SD5	Entry of or dissolution of chemicals from construction materials.	• Unsuitable materials in use. • Inadequate design standards. • Inadequate monitoring of new developments and construction. • Poor quality materials. • Inadequate flushing of new materials. • Inadequate maintenance or replacement of worn materials. • Materials insufficiently resistant to dissolution by the water and the surrounding environment. • Inadequate or inaccurate activity asset data. • Inadequate maintenance and repair programme.	Likely	Minor	High

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Reticulation Network - Construction Materials (Continued)					
SD6	Failure of the distribution system through failed construction materials.	• Deterioration of distribution system, leading to ingress of micro-organisms. • Biofilm development sustaining pathogens. • Inadequate or inaccurate activity asset data. • Inadequate maintenance and repair programme.	Unlikely	Minor	Low
SD7	No water available.	• Material failure.	Possible	Moderate	High
Reticulation Network - System Pressure					
SD8	Introduction of contamination by pressure fluctuations.	• High instantaneous demand. • Pipe failure or accidental penetration. • Unpredicted event such as a major fire. • Failure of booster pumps when reservoirs bypassed.	Possible	Moderate	High
SD9	Re-suspension of sediment or biofilm within the mains by pressure.	• Sediment or biofilm allowed to develop. • Significant fluctuations in reticulation pressure. • Flow reversal.	Likely	Insignificant	Moderate
Reticulation Network – Operation					
SD10	Introduction of contaminating material into the distribution system.	• Affected area not correctly isolated. • Standard hygiene practices not adopted. • Inadequate staff training. • Inadequate flushing and disinfection practices during repairs or commissioning of new mains. • Unsatisfactory location of water reticulation pipes. • Inappropriate materials used. • Breaks, leaks, incidental damage to water mains. • Unsuitable temporary bypass and/or supply bypass. Cross connections. • Contamination during sampling. • System pressure drop.	Possible	Moderate	High
SD11	Re-suspension of contaminants in sediments in the distribution system.	• System pressure drop. • Water velocity too high.	Possible	Minor	Moderate

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Reticulation Network – Operation (Continued)					
SD12	Development of sediment or biofilm.	• Poor chemical water quality leaving the treatment plant e.g. post-treatment precipitation of floc, iron, manganese. • Poor microbiological water quality leaving the treatment plant and in the distribution system. • Water flows too low resulting in: decay of chlorine, microbiological colonisation of surfaces. • Poor repair practices allowing colonisation. • Inadequate cleaning programme.	Likely	Insignificant	Moderate
SD13	Failure to maintain sufficient water pressure.	• Insufficient water available from the source, treatment plant or post treatment reservoir. • Failure of booster pumps when reservoirs bypassed. • Leaks in the reticulation network.	Rare	Minor	Low
Reticulation Network - Backflow Prevention					
SD14	Water pressure in the distribution system lower than pressure in supplied premises.	• A pressure drop in the reticulated system as a result of pump failure, pipe burst. • An elevated pressure in the premise(s) supplied as compared to the reticulated system.	Possible	Minor	Moderate
SD15	No, inadequate, faulty, or incorrectly installed backflow prevention device.	• The backflow prevention device is not actually connected or is connected improperly. No backflow prevention device installed because of insufficient knowledge of activities on the premises. An illegal cross connection to the reticulated system. • The backflow prevention device may have failed safe, but may then have been removed to maintain the water flow and not been replaced. • Failure of backflow prevention device. • Unauthorised drawing of water from fire hydrants. • Vandalism or accidental damage.	Possible	Minor	Moderate

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Water Transmission					
SD16	Contamination gets into the rising main/falling mains.	• Rising main/Falling mains break. • Air release valves entrain contaminated water or air. • Leaks. • Incidental damage (e.g. floods, slips, vehicle related incidents). • Poor repairs of breaks and/or leaks, • Incidental damage and penetration of trunk mains.	Likely	Moderate	High
SD17	Sediment containing contaminants stirred up.	• Sediment or biofilm allowed to develop. • Velocity too high.	Possible	Minor	Moderate

6.4 General

Table 10: General Risks

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Staff Training					
GN1	Introduction of microbiological contaminants into the water supply, or the inadequate inactivation, or removal, of microbiological contaminants.	• Inadequate training in terms of breadth or depth or both.	Unlikely	Moderate	Moderate
GN2	Introduction of chemical contaminants (incorrect application of treatment chemicals), or the inadequate removal of chemical contaminants.	• Inadequate training in terms of breadth or depth or both. • Major chemicals all have unique feed manifolds - can only couple to the unique outlet from the chemical delivery truck.	Unlikely	Moderate	Moderate

Ref	Event	Cause	Risk Assessment of Existing		
			Likelihood	Consequence	Residual Risk
Monitoring					
GN3	Incorrect water quality data used for supply management.	• Inappropriate or incorrect sampling. • Inadequate or incorrect test equipment or incorrectly calibrated test equipment. • Inadequate reagents. • Inappropriate method or incorrect calibration. • Inadequate or incorrect monitoring records. • Failure of staff to follow the analytical method and other related quality assurance procedures. • Use of a non-Ministry of Health approved laboratory.	Unlikely	Moderate	Moderate

7 Improvement Schedule

The following list of improvements for the Ashhurst Water Supply has been developed from the preceding risk information tables with reference to Council's Water Asset Management Plan 2014 adopted by the Long Term Plan. Improvements are subject to Council funding availability. Regular monitoring and maintenance actions have not been included in this table but are outlined in Section 8. Improvements are prioritised from high to low according to the existing risk level, and from low to high on cost.

Table 11: Improvement Schedule

Ref	Improvement Needed	Reason for Improvement	Event Ref	Ex. Level of Risk	Priority	Cost Estimate	Target Date to Complete	Person Responsible	Benefit
1	Bore renewal programme.	Renew the bore and use the existing bore as a backup water source	SA6 SA7	High	High	$400k	2018-2021	Water Asset Engineer (Dora Luo)	A second bore to provide alternative water source.
2	Replacement of rising main from Ashhurst bore to Colyton Road reservoirs.	Replace the 300mm PVC pipe which is susceptible to pipe burst.	SD1 SD3 SD6 SD7 SD8 SD10 SD13 SD16	High	High	$855k	2018 - 2021	Water Asset Engineer (Dora Luo)	Less chance of contamination; Less chance of reservoir low water level.
3	Ashhurst new Water Treatment plant	Install water treatment to address the discoloured water issue and reduce risk of THM formation.	T3 Aesthetic-tic			$940k	2019-2021	W**ater** Asset Engineer (Dora Luo)	Improve water quality.
4	Monitoring raw water TOC	Monitoring the potential of forming Chlorination by-product which has health risk	T3	Low	Medium	$500 p.a.	2017	Water Asset Engineer (Dora Luo)	Better understand water quality to inform future treatment upgrades.
5	Water toby renewal.	To replace water tobies with manifolds with backflow functionality.	SD15	Moderate	Medium	$10k	2029	Water Asset Engineer (Dora Luo)	Reduce the risk of backflow.

Ref	Improvement Needed	Reason for Improvement	Event Ref	Ex. Level of Risk	Priority	Cost Estimate	Target Date to Complete	Person Responsible	Benefit
6	Testing Bore security improvements- headworks, concrete casing & apron, fencing works	Risk of contamination of aquafer	SA4 SA5	High	High	$12k	May 2017	Water Asset Engineer (Dora Luo)	Reduce risk of contamination
7	Testing Bore security improvement – Install backflow facility on the testing bore head	Risk of contamination of aquafer	SA4 SA5	High	High	$8k	2018	Water Asset Engineer (Dora Luo)	Reduce risk of contamination
8	Testing Bore security improvement – 5 yearly bore head security Survey	Risk of contamination of aquafer	SA4 SA5	High	High	$600	2022 2027	Water Asset Engineer (Dora Luo)	Reduce risk of contamination
9	Survey surrounding bores with the potential to contaminate the aquifer	Risk of contamination of aquifer from other bores	SA5	High	High	$8k	2017	Water Asset Engineer (Dora Luo)	Reduce risk of contaminating the aquifer
10	Upgrade of chlorine Monitoring system	To improve control & reliability of chlorine dose	T1 T2 T3	Moderate	Medium	$4k	2017	Water Asset Engineer (Dora Luo)	More consistent FAC
11	Upgrade the HFA dosing pump	To improve the Fluoride dosing reliability	T4	Moderate	Medium	$2k	2017	Water Asset Engineer (Dora Luo)	More accurate Fluoride dosing

8 Related Plans, Monitoring & Maintenance

8.1 Council Policy and Plans

This WSP will be considered in the updating of the Water Asset Management Plan, the Risk Management Plan and the preparation of Council's Annual Plans and Long Term Plan.

8.2 Regular Monitoring

Table 12 below contains a summary checks that are carried out on the Palmerston North water supply, how often they need to be made and who is responsible for them.

Table 12: Monitoring Summary

Ref	Check	Details	How often	Responsibility
1	Bacterial compliance (*E. coli* indicator) in bores/reticulation and FAC, pH, turbidity at treatment plant.	Take samples from the bore and reticulation as per DWSNZ requirements.	1 sample per quarter with not more than 135 days between samples and the sampling covers 3 different days of the week	PNCC Treatment Plant Operators
2	Fluoride (P2).	Take samples from bore	Weekly	CEL
3	Bore Radiological compliance.	Radiological tests.	10 yearly (next due 2026)	Water Asset Engineer (Dora Luo)
4	Bore water age (residence time).	Tests required for bore water security assessment.	Every 5 years (next due August 2018)	Water Asset Engineer (Dora Luo)
5	Water abstraction flow, pump outlet pressure, pump running hours, FAC and turbidity	Continuously monitor critical water supply alarms and respond accordingly.	Continuous	Water Asset Engineer (Dora Luo) /PNCC Treatment Plant Operators
6	On-line monitoring instrument calibration.	Re-calibrate turbidity, pH probes using calibration buffers.	Weekly	PNCC Treatment Plant Operators
7	Chemical storage levels.	Check chlorine, FAC levels and re-order if necessary.	Weekly	PNCC Treatment Plant Operators
8	Water bulk flow out of reservoirs and reservoir level	Pressure and flow in reticulation (alarm if abnormal).	Continuous	Water Asset Engineer (Dora Luo) /PNCC Treatment Plant Operators
9	Backflow devices.	IQP test and record on asset management system.	Annual	Water Asset Engineer (Dora Luo)

8.3 Maintenance Schedules

Table 13 below summarises key maintenance activities for the Palmerston North water supply and who is responsible for them. Refer also to Operation and Maintenance manuals.

Table 13: Maintenance Activities

Ref	Schedule	Frequency	Responsibility
1	Inspect well head condition and security.	5 yearly next due 2019	Water Asset Engineer (Dora Luo)
2	Inspect bore pumps and dosing equipment.	Monthly	Treatment Plant Manager (Mike Monaghan)
3	Service dosing equipment	Annually	Treatment Plant Manager (Mike Monaghan)
4	Annual inspection of power source, connections and electrical equipment.	Annually	Treatment Plant Manager (Mike Monaghan)
5	Exercising of valves and hydrants.	Every 4 years	Civil Works Supervisor (Terry Skinner)
6	Calibrate flow meters on water takes.	5 yearly	Treatment Plant Manager (Mike Monaghan)
7	External condition of reservoirs/WTP.	Annually	Treatment Plant Manager (Mike Monaghan)
8	Reservoir cleaning and internal condition inspection	Every 2 years	Treatment Plant Manager (Mike Monaghan)
9	Ashhurst reticulation sequential flushing	Annually	Water Asset Engineer (Dora Luo) Civil Works Supervisor (Terry Skinner)
10	Flushing programme for dead end mains and problem areas.	2 monthly/monthly	Civil Works Supervisor (Terry Skinner)
11	Rising main swabbing to remove deposits.	6 monthly	Civil Works Supervisor (Terry Skinner)
12	Backflow preventer inspection and re-certification.	6/12 monthly	Water Asset Engineer (Dora Luo)

9 Contingency Plans

Table 14 to Table 18 below contain Contingency Plans for all risk events. These contingency plans are based on those given in the Ministry of Health guidelines.

Table 14: Events that Affect the Groundwater Source

Event – Large amounts of contamination enter the groundwater or well	
Indicators:	• Report of chemical spill in an area where chemicals may get into the groundwater you use. • Your consumers complain of discoloured, or bad tasting or smelling water coming from their taps. • High levels of germs or chemicals are found in samples from routine sampling test • Many people in the community complain of illness which may be linked to water quality.
Required actions:	• Stop drawing water from the well, and alert emergency services if it is a chemical spill. • Tell the MOH about what has happened and discuss. Warn consumers not to draw water until further notice. • Organise water tanks and distribute bottled water for essential use. • Identify what is causing the contamination, and decide whether the problem is likely be short term or last for a long time. • If problem is short-term: – Drain and flush the affected part of the reticulation network and Disinfect the reticulation network with high levels of chlorine if high levels of germs were in the water. – Sample for the chemical of concern or germs to find out when the water can be used again. Inform the customers when the supply is safe to use, but need to flush their taps until good quality water is again flowing. • If problem is likely to be long-lasting: – Look for a new source of water or consider more treatment – Record cause of the system failure and the correction actions have been taken – Modify water safety plan if necessary.
Responsibility:	• Water Asset Engineer.
Event – Earthquake and landslides	
Indicators:	• An earthquake may cause damage to the source, treatment plant or reticulation network. The water supply may be shut down as a result. • Destroyed well-head, chlorination shed or reservoir. • Geysers of water from breaks in the reticulation network pipes.
Required actions:	• Contact the Ministry of Civil Defence in the event of an earthquake emergency. • Monitoring telemetry system if it is still working to and define and major leaks through mess balance • Inspect well-head, chlorination system, reservoirs, and the reticulation network. • Sample bore water in ensure it is safe to drink • If any part of the supply is damaged so that water cannot be distributed or the quality is unacceptable, organise water tanks and distribute bottled water for essential use. • Notify MOH about the situation. • Record cause of the system failure and the correction actions that have been taken. • Modify water safety plan if necessary.
Responsibility:	• Water Asset Engineer.

Event – Flooding	
Indicators:	• Excessive rain fall and high water level in Pohangina River and Manawatu River • Breach on stopbank • The Bore site and pump station area is inundated
Required actions:	• Contact the Ministry of Civil Defence • Notify MOH about the situation • Monitoring telemetry system if it is still working • Sample water in reservoir if is safe to drink • Bore water sampling to check if it is safe to drink • Sand bag the bore site and pumping to keep the area dry if possible • Boiling water notice or water restriction notice when necessary • Post flood bore head, pump, facility inspection • Post flood bore water sampling and bore flush when required • Record cause of the system failure and the correction actions that have been taken • Modify water safety plan if necessary.
Responsibility:	• Water Asset Engineer.
Event – Water shortage	
Indicators:	• Low groundwater table. • Water usage much higher than usual. • Drop in water pressure.
Required actions:	• Consider restricting water use. • If water shortages occur frequently, consider increasing bore pumping capacity. • Plan for additional or alternative source. • Record incident and action taken. • Modify Water Safety Plan if necessary.
Responsibility:	• Water Asset Engineer.

Table 15: Events that Affect Treatment

Event – FAC concentration is lower than minimum acceptable level	
Indicators:	• A detectable chlorine residual cannot be obtained in the water leaving the treatment plant (high chlorine demand due to poor destratification). • In 100 mL samples of water leaving the treatment plant, E. coli or coliforms are continually detectable, or E. coli is present at elevated levels (more than 10 per 100 mL). • Widespread levels of illness in the community.
Required actions:	• Follow the actions given in Figure 4.1 of the DWSNZ:2005. • Identify the reason for the failure and rectify. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Civil Works Supervisor and Treatment Plant Manager

Event – FAC concentration is very much higher than maximum acceptable value	
Indicators:	• A major spillage or overdose of chlorine into the water. • Inability to obtain pink colour from DPD chlorine indicator despite high chlorine dose rates. (NB: This indicates chlorine levels well in excess of the MAV – very high chlorine levels bleach the pink colour that normally develops in the presence of chlorine.) • Water develops a strongly chlorinous odour. • Widespread levels of taste and odour complaints, or illness, in the community.
Required actions:	• Close down the plant. Provide another source of potable water until water of acceptable quality can again be supplied. • Inform the MOH of the situation. • Identify the reason for the chlorine overdose and rectify. • Dump the reservoir water, or add chemicals to neutralise the chlorine if more appropriate (neutralisation may be required before any water is dumped, anyway). • Flush the distribution system, if excessive levels of chlorine are also present in the distribution system, and monitor water quality until chlorine concentrations are again back to normal operating levels. • Warn consumers to thoroughly flush their taps before drawing water for use (if they are likely to have been affected). • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Civil Works Supervisor and Treatment Plant Manager
Event – Fluoride concentration is higher than maximum acceptable value	
Indicators:	• Elevated fluoride concentrations evident from monitoring samples. • Marked drop in pH (if the fluoride compound is acidic). • Knowledge of a chemical spillage or overdose that may have led to a high fluoride concentration being produced in the water.
Required actions:	• Notify the MOH and shut down the plant if necessary. Provide another source of potable water until water of acceptable quality can again be supplied. • Identify the cause of the problem and rectify. • Dump the reservoir water if this is necessary and possible; flush the distribution system. • Warn consumers to flush their taps thoroughly before resuming the supply of water. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Civil Works Supervisor and Treatment Plant Manager

Table 16: Events that Affect Stored Water at Colyton Road Reservoir

Event – Breach of the post-treatment storage tank/reservoir	
Indicators:	• Visual inspection shows evidence of structural deterioration or a leak. • Water levels cannot be maintained despite water being pumped into storage at an adequate rate.
Required actions:	• Identify the location of the leak, and repair. • Bypass the tank/reservoir and take water directly from the treatment plant. • If the normal water source does not meet the needs of the community or treatment plant capacity (i.e. the quantity is too low at that time of year), implement water use restrictions investigate and obtain alternative source(s) of water; • Repair the storage tank/reservoir if a leak is the cause of the shortage. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Civil Works Supervisor and Treatment Plant Manager
Event – High levels of chemical contaminants in the stored water	
Indicators:	• Knowledge of a major chemical spill, or chemical overdose (e.g, chlorine), into the reservoir; vandalism. • Change in the appearance, smell or taste of the water. • Widespread levels of illness in the community. • Chlorine residual not restored.
Required actions:	• Close down the reservoir, and if necessary the supply. Provide another source of potable water until water of acceptable quality can again be supplied. • Inform the MOH of the situation. • Identify the source of contamination and take steps to avoid recontamination. • Dump the reservoir water. Consultation with the Regional Council will probably be required with regard to disposal of the flushed water. • Flush the reticulation system and monitor water quality until determinand concentrations are again less than 50% of the MAV. • Warn consumers to thoroughly flush their taps before drawing water for use. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Civil Works Supervisor and Treatment Plant Manager

Table 17: Events that Affect the Distribution Network

Event – Contamination enters the distribution system	
Indicators:	• Inability to maintain a chlorine residual when one can normally be maintained. • In 100 ml samples of water from the reservoir, E. coli is continually detectable or is present at elevated levels (more than 10 per 100 mL). • Widespread complaints of taste and odour from consumers. • Widespread levels of illness in the community. • Turbidity fluctuations and levels greater than that in water leaving the treatment plant.
Required actions:	• Follow the actions given in Figure 4.2 of the DWSNZ:2005. • Identify the reason for the failure and rectify. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan if necessary.
Responsibility:	• Water Asset Engineer.

Event – No water because of failure of materials	
Indicators	• Consumer complaints. • Burst or leaking pipes. • High unaccounted for water use.
Required Actions:	• Identify the location of the leak and repair. • Confirm that hygienic procedures for repairs have been followed. • Monitor chlorine residuals and increase residual to make sure that more than 0.2 mg/L FAC reaches all parts of the distribution system. • Identify the reason for the failure and rectify. • Record the reason for the failure and the steps taken to rectify. • Review of water main renewal priorities • Modify Water Safety Plan if necessary.
Responsibility	• Civil Works Supervisor and Treatment Plant Manager
Event – Backflow into the distribution system occurs	
Indicators:	• Complaints of discoloured, tasting or smelling water coming from taps. • Backflow incident reported by industry. • Reports of illness in parts of the community. • Inability to maintain disinfectant residual in parts of the distribution system. • E. coli or coliforms found in the distribution system
Required actions:	• Notify the MOH, and in consultation warn consumers in the affected area not to draw water until further notice. If necessary, provide another source of potable water until water of acceptable quality can again be supplied. • Identify the source of the backflow incident, and isolate until a backflow prevention device can be fitted, or the one already installed can be made operational. • Drain and flush the affected part of the distribution system, considering the need to flush with elevated chlorine concentrations if the incident may have involved microbiological contaminants. (Consultation with the Regional Council will probably be required with regard to disposal of the flushed water.) • Monitor an appropriate determinand in the affected area to determine the successive of the contingency measures, and notify consumers, when the supply is safe to use, that they will need to flush their taps until good quality water an again be drawn. • Record cause of system failure and steps taken to correct. • Modify Water Safety Plan and Backflow Prevention Policy if necessary.
Responsibility:	• Water Asset Engineer.

Table 18: Events Related to Operators and Monitoring

Event – Operator Error	
Indicators:	• Incidents as a result of operation error.
Required actions:	• Refreshment training.
Responsibility:	• Civil Works Supervisor and Senior Treatment Plant Supervisor.
Event – Poor quality assurance and/or quality control for monitoring	
Indicators:	• Too many errors detected during audits or surveillance. • Too many process control failures. • Too many outliers shown by inter-lab quality control studies. • Repeated unexplained compliance test failures (FAC/E. coli).
Required actions:	• Full audit of quality procedures. • Identify and resolve deficiencies in equipment/methods/staff training. • Identify all analysis records that may have been adversely affected. • Inform the Medical Officer of Health (MOH) if compliance tests may have been affected. • Once the cause of the poor performance has been identified, correct it. • Record the reason for the failure and the steps taken to rectify. • Modify the water safety plan if necessary.
Responsibility:	• Water Asset Engineer.

9.1 Post Event Debrief

A post event debrief should be carried out following any of the risk events identified in this Section.

The debrief should include a review of the following:

- Whether the indicators are clear enough to reflect the event;
- Whether the judgements and decisions around actions were timely and correct;
- Whether the corrective actions were effective;
- Gap identification and any improvements required.

The findings from the debrief should be used to update the WSP.

10 Water Safety Plan Performance Assessment

The Water Safety Plan should be reviewed and updated annually or any significate changes/event occurred and comprehensively reviewed and updated every five years to ensure the plan is current. The Water Asset Engineer is responsible for the review process. The review process will involve:

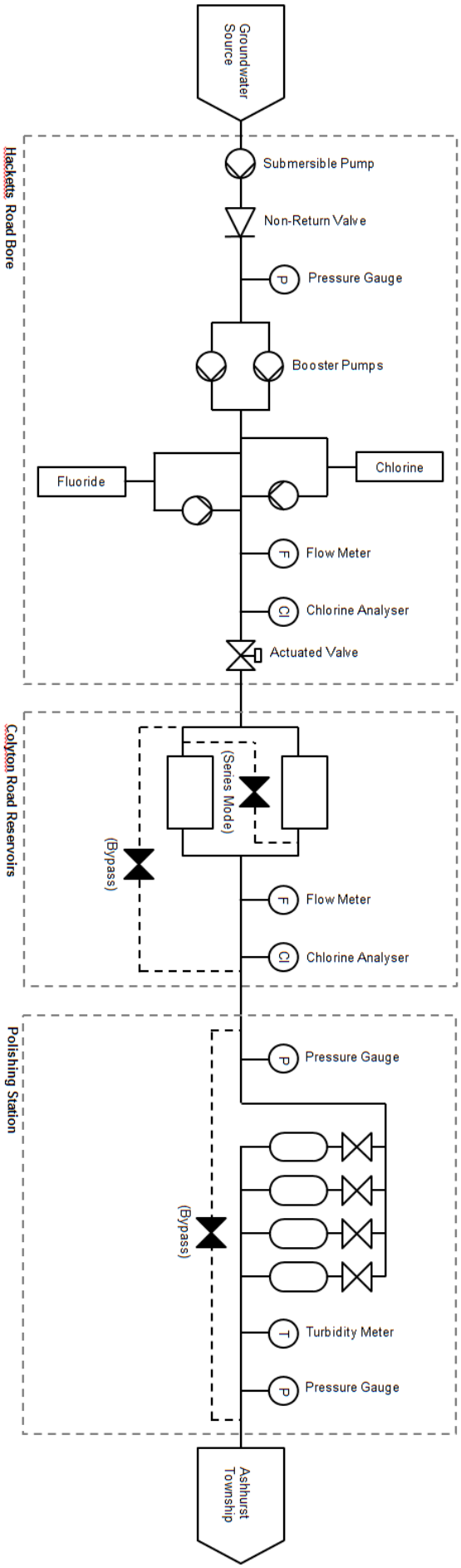
- Checking that roles and responsibilities are still valid.
- Reviewing the operation of the water supply by:
  - Checking compliance with the Drinking Water Standards for New Zealand;
  - Reviewing incident records and lessons learned from any incidents;
  - Checking whether any problems have been found during routine checks and maintenance.
- Reviewing progress with implementing improvements and updating the schedule with new improvements identified as a result of incidents occurring.
- Addressing new or altered risks arising from modification, additions or changes made to the supply.
- Reviewing monitoring and maintenance responsibilities.
- Checking personnel changes and that new staff are aware of the Water Safety Plan.

The first comprehensive review will be on 2021.

11 Water Safety Plan Progress Reporting

The implementation of this Water Safety Plan should be monitored and reported against measures in it on annual basis. The report will be submitted to the Drinking Water Assessor.

Appendix A. Ashhurst Water Supply Schematic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Submersible Pump
Non-Return Valve
P
Pressure Gauge
Booster Pumps
Fluoride
Chlorine
F
Flow Meter
Ω
Chlorine Analyser
Actuated Valve
Colyton Road Reservoirs
(Series Mode)
(Bypass)
F
Flow Meter
Ω
Chlorine Analyser
Polishing Station
P
Pressure Gauge
(Bypass)
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Turbidity Meter
P
Pressure Gauge
Ashhurst Township

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