

Attachment A - Dargaville Water Safety Plan risk table

Stage	Event	No.	Cause	Likelihood	Consequence	Max Risk	Indicators	Preventive measures in place	Correction Actions	What to Check	Risk Managed	Likelihood	Consequence	Residual Risk	Acceptable	Certainty	Additional Measures	Resp
1. Catchment	Raw water quality too poor to treat	1.01	Unmanaged harvesting in catchment allows for erosion and elevated turbidity	Possible	Catastrophic	High	High NTU levels	Alarm levels set on the raw water turbidity Treated storage available Implementation of Resource Management Planning Rules Rural Land Use Policy addresses adverse effects of intensive farming/forestry on rural land. Treatment barriers effective against dirty water	Revert to secondary intake Invoke emergency water use restrictions for the town under the Water Bylaw. Refer to Contingency Plans	Turbidity is continuously monitored entering the water treatment plant. Weekly applications received from NRC for consents	Yes	Unlikely	Minor	Low	Y	Reliable	Work with Northland Forest Management to mitigate water quality issues during harvesting operations.	WWM PDE
	Microbiological contamination	1.02	Kaihu River @ Rotu: Surface contamination from farmland/agri lifestyles in the adjacent area	Almost Certain	Catastrophic	Extreme	High raw water E. coli results, Turbidity in raw water, Prolonged heavy rain, extreme weather events, Illness in community	Secondary intake. Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Land use consents. Subsequent treatment barriers effective against microbiological contamination	Revert to primary intake. Abstraction can be turned off and rely on treated water storage. Boil water notice can be issued. Incident response plan	Visual assessment of lake, raw water turbidity, effective disinfection barriers, source water monitoring results	Yes	Unlikely	Minor	Low	Y	Reliable	Consider five yearly protozoal catchment risk survey in line with DWSNZ 2008	WWM PDE
	Microbiological contamination	1.03	Kaihu River @ Rotu: Discharges from onsite wastewater systems, dairy effluent irrigation, farmed animals or septic tank systems, unconsented overflow	Likely	Catastrophic	Extreme	High raw water E. coli results, Turbidity in raw water, Illness in community, Regional Council SoE reporting	Secondary intake. Implementation of Resource Management Planning Rules i.e. Regional Policy Statement, NES for Sources of Human Drinking-water. Treatment barriers effective against microbiological contamination. Regional Water Plan and Clean Streams Accord encourage farmers to minimise contamination of water ways. Treatment barriers effective against microbiological contamination	Revert to primary intake. Abstraction can be turned off and rely on treated water storage. Boil water notice can be issued. District plan or Building Act abatement notices can be served	Compliance with consent conditions. Weekly applications received from NRC for consents Operator visual checks on raw water turbidity trends during plant visits two times a week	Yes	Unlikely	Minor	Low	Y	Reliable	Targeted catchment assessment	WWM PDE
	Chemical Contamination	1.04	Kaihu River @ Rotu: Surface runoff containing chemical contaminants from agricultural activities.	Possible	Major	High	Taste and or odour, information provided by Regional pollution hotline or public. Source water chemical screen indicates chemicals. Active weed control programme. Regional Council SoE reporting	Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Rural Land Use Policy to address the adverse effects of intensive farming and forestry on rural land. Subsequent treatment barriers employ coagulation, flocculation and sedimentation. Appropriate controls on pest management programmes.	Abstraction can be turned off and revert to treated water storage. District plan or Building Act abatement notices can be served. Incident response plan. Consumers advise water cannot be consumed.	Chemical suite, trends in raw water composition	Yes	Unlikely	Minor	Low	Y	Reliable	Consider assessment of raw water chemistry for allocation of Priority 2 chemicals.	WWM PDE
	Chemical Contamination	1.05	Kaihu River @ Rotu: Cyanobacteria growth in source water	Possible	Catastrophic	High	Taste and or odour, visual bloom observed	River status and condition reviewed before intake used. Subsequent treatment barriers	Abstraction can be turned off and revert to treated water storage	Regional Council SoE monitoring	Partially	Unlikely	Moderate	Medium	Y	Unsure	Consider more detailed algae risk assessment and if needed management protocol	WWM PDE
	Loss of supply	1.06	Low flows in source water through drought	Unlikely	Major	Medium	Water levels and flow rates, weather conditions	Consent conditions . Visual checks. Regional Council monitoring programme provides for early detection.	Initiate water demand and conservation management. Follow Drought Management Plan and implement supplementary supplies	Catchment rainfall, steam and river levels Operator checks on long term forecast	Partially	Rare	Moderate	Low	Y	Unsure	Review Drought Management Plant	WWM PDE
2. Abstraction	Loss of supply	2.01	Raw water pipeline failure	Unlikely	Catastrophic	High	Loss of flow and pressure to plant Raw main consumers report loss of water Bridge collapse	Most breaks can be repaired quickly by maintenance Treated water storage Emergency intake at Ahikiwi Bridge crossings (22) under roading management	Carry out emergency work to reinstate/repair the intake. Invoke emergency water use restrictions for the town under the Water Bylaw. Use reservoir storage in the short term if sufficient.	Monitor plant intake flow rates continuously by Magflow meter.	Yes	Unlikely	Moderate	Medium	Y	Reliable	Perform in-depth condition assessment of the raw water transfer line	WWM PDE
	Loss of supply	2.02	Intake Vandalism/Sabotage	Unlikely	Major	Medium	Volume and flow to plants. Visible damage, threats, reported suspicious activity	Intakes are located in isolated areas . Treated water storage. Legal Deterrents. Intake structures designed to withstand some damage	Repairs, consumer advisory to conserve water	Review intakes security if interference or vandalism becomes more common	Yes	Rare	Moderate	Low	Y	Confident	Review intake sites security generally and improve it if vandalism becomes an issue	WWM PDE
	Loss of water	2.03	Pump failure @ Rotu intake	Possible	Major	High	Loss of water or pressure in reticulation Frequent low reservoir level	Asset management Certified maintenance staff. Redundancy in plants and intakes Alarms. Secondary intake for supply	Incident management plan. Demand restrictions imposed	Reservoir level	Yes	Unlikely	Minor	Low	Y	Confident		WWM PDE
	Micro & chem contamination	2.04	Provision of raw water to consumers on raw pipeline	Almost Certain	Major	Extreme	Consumer complaints, illness	Consumers advised water is untreated. Connections included backflow devices	Reminders provided	Number of connections Backflow devices	Yes	Possible	Minor	Medium	Y	Reliable		WWM PDE
	Particles/Protozoa not captured / removed	3.01	Floc not formed due to poor coagulant mixing	Likely	Major	High	No or poor floc formation. High turbidity in water leaving the clarifier or filter .	Dosing points are at sites of maximum mixing energy. Plant flow maintained at optimal rate NTU meters trigger alarm and shut down plant Coagulant dose controlled by streaming current meter Subsequent filtration stage also removes particles	Adjust plant flow. Run water to waste and rely on storage when turbidity is particularly high Refer to Elevated Turbidity Source Water contingency plan Zeroing of the streaming current meter	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident	Install SCADA telemetry system as well as alarms so the plants data can be viewed remotely Review ways of controlling wastage of water and chemical during the sedimentation process	OEWS WO&M
	Particles/Protozoa not captured / removed	3.02	Floc not formed due to alum or poly dose pump failure.	Likely	Major	High	No or poor floc formation. High turbidity in water leaving the clarifier or filter .	Operator at plant daily Turbidity is monitored online in water leaving the filters Dosing pumps are well maintained and calibrated Subsequent filtration stage removes particles	Adjust plant flow.	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident	Auto-changeover duty/standby for all dose pumps at the plants	OEWS WO&M

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											Yes	Unlikely	Minor	Low	Y			
3. Dargaville Treatment - Coagulation, Clarification, Sedimentation, Filtration	Particles/ Protozoa not captured / removed	3.03	Floc not formed due to inappropriate dose rate of coagulant chemicals.	Likely	Major	High	No or poor floc High turbidity in water leaving the clarifier or filters. Chemicals exceeding MAVs in final water	Operator at plant daily. Poly pump stroke is manually adjusted but flow paced Pumps are routinely calibrated Turbidity is monitored online and alarmed in water leaving the filters Very small poly dose used because intake water turbidity is very low Subsequent filtration stage removes particles	Adjust plant flow. Increase capacity in other plants	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.04	Clarifier fails to remove particles due to sudden change of raw water turbidity	Possible	Major	High	Poor floc formation or no floc blanket Filters clog up quickly High turbidity in water leaving filters	Filter headloss monitored and alarmed Turbidity is monitored online in water leaving clarifier and the filters Subsequent filtration stage removes particles	Adjust plant flow. Adjust coagulant dose	Sediment blanket Online Turbidity Catchment weather	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.05	Floc not formed due to coagulant chemicals supply exhausted.	Possible	Major	High	No floc formed Filters clog up quickly High turbidity in water leaving filters. Co-ag day tank empty	Operators at plant daily and monitor chemical storage Chemicals are held in bulk at treatment plant Sufficient polyelectrolyte onsite for a minimum 20 days at maximum demand	Arrange urgent delivery	Delivery schedules. Bulk tank levels	Yes	Unlikely	Minor	Low	Y	Confident	Investigate plant flows to limit excess water being run to waste from clarifier and associated unnecessary use of coagulant	OEWS WO&M
	Particles/ Protozoa not captured / removed	3.06	Poor floc formation due to raw water pH incorrect for optimal coagulation	Possible	Moderate	Medium	Poor floc formation. Excessive floc carryover to the filters High turbidity in water leaving the clarifier	Raw water pH rarely changes Turbidity is monitored online in water leaving the filters Operator vigilance and training. Treated water storage Subsequent filtration stage removes particles	Shut off the supply if a serious pH problem is suspected Calibrate the pH meter as per manufacturers' instructions.	online pH	Yes	Unlikely	Minor	Low	Y	Confident	Install system to allow for continuous monitored data to be used for compliance Review calibration procedures for all monitoring equipment.	OEWS WO&M
	Particles/ Protozoa not captured / removed	3.07	Inability to backwash effectively due to power outage	Possible	Major	High	High turbidity in water leaving the filter. Other power dependent equipment goes offline	Turbidimeters on each filter indicate filter performance Back up power supply, mobile generators	Initiate emergency power, initiate water conservation measures	Backwash procedure	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.08	Backwash pump failure	Possible	Major	High	Backwash cycle doesn't happen Increased post filter turbidity	Regular maintenance of backwash pumps	Repair/Replace	Pumps monitored for noise and vibration	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.09	Failure of backwash air scour	Possible	Major	High	Visual inspection of backwash process identifies backwash blower failure	Maintenance includes backwash air scour Air blower can be repaired or replaced with off-the-shelf item Subsequent UV stage inactivates oocysts	Repair/Replace		Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.10	Caking or mudballing of the filter media.	Possible	Major	High	Visual inspection shows caking or mud-balling. Irregular pattern of filter media fluidisation during backwash cycle Elevated filtered water turbidity	Air scour and backwashing process fluidises filter media during backwash cycle Visual inspection undertaken of backwash cycle Turbidimeters on each filter indicate filter performance Filters are soaked in caustic each year to minimise cracking due to the polyelectrolyte binding the sand grains Subsequent UV stage inactivates oocysts	Run water to waste and rely on storage when turbidity is particularly high	Visual assessment during back wash	Yes	Unlikely	Minor	Low	Y	Confident	Establish backwashing procedure	OEWS WO&M

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Dargaville Treatment Plant - UV	Inadequate disinfection	4.01	UV intensity insufficient due to build-up of deposits on sleeve	Likely	Catastrophic	Extreme	E. coli detected in water leaving the plant or illness in the community. Visible build-up of deposits on sleeve and sensor lens	UV intensity is continuously monitored and alarmed. Dual reactors in place as contingency Routine cleaning and maintenance schedule for lamp sleeves and UV sensor. Regular replacement of UV lamp. UVI reference sensor checked regularly and calibrated annually UV intensity is alarmed and shuts production down	Clean UV sleeves, Undertake cleaning and maintenance Change lamps Incident Response plan – Microbiological contamination Increase chlorine dosing in reservoir Shut off reactor not performing	UV Intensity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	4.02	Flow rate through UV unit too rapid for effective treatment	Likely	Catastrophic	Extreme	Flow rate through plant greater than UV unit maximum	Routine maintenance and calibration checks on flow rate controller	Slow plant flow rate to that which is optimal for UV units Recalculate dose rates and change flow settings	Flow rates Maintenance records of flow rate controller Flow controller calibrations	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	4.03	Excessive turbidity/colour in water decreasing the effectiveness of the UV treatment (UVT too low)	Likely	Catastrophic	Extreme	High turbidity levels detected in raw water E. coli detected in water or illness in the community	Water has received clarification and filtration. Setpoints within validation conditions and are controlled by the supplier Alarms	Backwash sand filters Ensure coagulation dosing system operating correctly.	NTU, UVT Filter maintenance schedule	Yes	Unlikely	Minor	Low	Y	Confident	Develop a system of internal checking of important procedures such as calibration	OEWS WO&M
	Inadequate disinfection	4.04	Power failure resulting in UV unit being unable to work	Likely	Major	High	Alarms	Alarm to indicate power failure Regular maintenance of UV power supply Generator connections installed Treated storage	Replace faulty equipment Conservation measures until power is restored and arrange for another supply of water	Power supply maintenance schedule Maintenance log and schedule for equipment	Yes	Unlikely	Moderate	Medium	Y	Confident	Investigate agreement for priority allocation of generators	OEWS WO&M
5. Dargaville Treatment -Chlorination	Inadequate disinfection	5.01	Inadequate contact time	Unlikely	Major	Medium	Calculation of retention time determines contact time is inadequate E. Coli or coliforms detected despite adequate FAC residual concentration	Minimum contact time provided by reservoirs and bulk main Chlorine dose point is set to 1.3 mg/L leaving plant.	Low chlorine contingency	Contact time, Microbiological quality, Flow rates, online FAC	Yes	Rare	Minor	Low	Y	Reliable	Auto shut down of plant on low Cl alarm	OEWS WO&M
	Inadequate disinfection	5.02	Gas chlorine supply exhausted	Possible	Catastrophic	High	FAC is less than 0.2 mg/L or E. coli (or elevated coliforms) detected in water in the distribution system. Illness in community.	FAC is continuously monitored on-line with alarms to operators and date telemetered Gas chlorine tanks installed in an automated duty/standby arrangement. Sufficient gas bottles are on hand at the plant all times and replacements are easily obtained 920kg duty cylinder supplies approximately 6 months three 70kg standby cylinders at the water treatment plant.	Replace chlorine gas bottle manually	Post treatment FAC Cylinders onsite/turnover	Yes	Rare	Moderate	Low	Y	Reliable	Improve method for knowing how much Cl is left in cylinders	OEWS WO&M
	Inadequate disinfection	5.03	Dosing system failure	Likely	Catastrophic	Extreme	FAC is less than 0.2mg/L or E. coli detected in water in the distribution system.	Operator visits the plant daily to check operation of chlorination system FAC is semi continuously monitored at the treatment plant and in the reticulation twice weekly Operator checks at least two times a week and more often to check the chlorine dosing equipment Annual check and servicing of the chlorine dosing equipment with overhaul every two years.	Repair and return to service Contractor staff competency audits Repair any equipment faults, with plant shutdown and reservoir storage used to cover repair period Low chlorine contingency Re-train staff as necessary in correct procedures	Operation of chlorine dosing pump FAC alarms, on-line data FAC records stored on SCADA Record all events of chlorination problems Record chlorinator maintenance	Yes	Unlikely	Moderate	Medium	Y	Reliable	Carry out training needs assessments annually Review the positioning of the chlorine analyser to see if Bacteria Compliance Criteria 2a can be used	OEWS WO&M
	Inadequate disinfection	5.04	Automated chlorine dose rate incorrect	Likely	Catastrophic	Extreme	FAC is less than 0.2 mg/L or higher or E. coli detected in water leaving the WTP	Chlorine dose rate is flow paced Operator visits the plant at least daily to check operation of chlorination system FAC is continuously monitored on-line with alarms to operators and date telemetered	If FAC sampling indicates incorrect FAC level, adjust dose rate as required	FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident	Update Operations and Maintenance manuals to reflect actual FAC target values per practice.	OEWS WO&M
6. Dargaville Storage	Inadequate disinfection	5.05	Chlorine demand exceeds chlorine dose due to high raw water turbidity	Possible	Catastrophic	High	High turbidity in water. Chlorine dose rate needs to be high to maintain an adequate residual FAC is less than 0.2 mg/L or E. coli detected in water leaving the WTP	Source water has turbidity monitored and alarms Operator visits the plant at least daily to check operation of chlorination system FAC is continuously monitored on-line with alarms to operators and date telemetered	Increase chlorine dose level	Turbidity of water at treatment plant FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident	Review measures for protecting reservoirs from foreign matter	OEWS WO&M
	Over Chlorination	5.06	Dosing system failure.	Possible	Moderate	Medium	FAC level exceeds 1.6 mg/L. Odour and taste complaints	Operator visits the plant daily to check operation of chlorination system FAC is continuously monitored on-line with alarms	Advise consumers if high chlorine FAC is delivered to the distribution zone	Operation of chlorine dosing pump FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident	Review contact Tanks for damage and lid security	OEWS WO&M
	Over Chlorination	5.07	Chlorine dose rate incorrect	Possible	Moderate	Medium	FAC is more than 1.6 mg/L in water leaving the WTP Odour and taste complaints	Chlorine dose rate is flow paced Operator visits the plant daily FAC is continuously monitored on-line with alarms to operators and date telemetered	Advise consumers if high chlorine FAC is delivered to the distribution zone	Operation of chlorine dosing pump FAC in reticulation system downstream of treatment plant	Yes	Unlikely	Minor	Low	Y	Confident	Review O&M cleaning procedures for reservoir and distribution system	OEWS WO&M
	Microbiological contamination	6.01	Leakage through reservoir roof or other parts of structure or access by birds or vermin.	Likely	Moderate	High	Visual evidence of leakage E. coli in water leaving reservoirs	Reservoir is covered and all entry hatches are locked against unauthorised access Regular inspection of reservoirs is carried out. Asset condition assessment	Repair any reservoir leaks or bird and vermin access points without delay. Take out of service. Install replacement liners where feasible	Leakage from reservoir Access points for birds and vermin Evidence of birds or vermin inside reservoir	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M

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	Micro and chem contamination	6.02	Vandalism or unauthorised entry to the storage reservoir	Possible	Moderate	Medium	E. coli in water leaving reservoir Reports from the public Evidence of damage or tampering with reservoir	Reservoir is a large concrete structure with all entry hatches locked against unauthorised access Reservoir is located on land with restricted access. Operator checks site daily.	Inspect reservoir in response to reports of suspicious activity Report any damage or interference to Council immediately. Refer to Contingency Plan - Contamination Reservoir Water.	Access hatches	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
7. Reticulation	Micro and chem contamination	6.03	Sediment accumulation within reservoir	Likely	Moderate	High	Visible suspended matter in water in distribution system Visible sludge in bottom of reservoir Complaints from consumers	High chlorine residual provides protection against contaminants Regular inspection of reservoir is carried out and cleaning undertaken if required	Isolate and clean reservoir as required Adjust chlorine dose if FAC is less than 0.2mg/l ex reservoir in any sample	Check accumulation of sediment in reservoir every 5 years Turbidity	Yes	Unlikely	Minor	Low	Y	Confident	Pumping- upgrade to duty and standby arrangement for pumping. Hold spares allowing for repair/replace <24hrs	OEWS WO&M
	Loss of supply	6.04	Failure of reservoirs	Unlikely	Catastrophic	High	Complaints from consumers about loss of supply or pressure Obvious signs of leakage or failure at reservoir site	Asset condition assessments. Reservoirs are constructed of concrete and steel.	Isolate damaged or failing reservoir and supply directly from treatment plant or use other reservoirs	Structural integrity of reservoir Condition reports	Yes	Rare	Moderate	Low	Y	Confident	Review/Develop written proactive maintenance programmes for the distribution system	OEWS WO&M
	Loss of supply	6.05	Insufficient storage for peak demand	Possible	Catastrophic	High	Loss of water or pressure in reticulation Frequent low reservoir level Records of consumer complaints (e.g. regarding low pressures or loss of supply)	Multiple reservoirs Reservoirs are just adequate for the average demands on them	Emergency water restrictions Introduce conservation and efficiency measures	Reservoir level Plant flows daily and monthly from the Magflow meter	Yes	Unlikely	Minor	Low	Y	Confident	Audit commercial high risk premises and rural properties annually for back-flow testing	OEWS WO&M
	Loss of water	7.01	Pump failure	Possible	Major	High	Loss of water or pressure in reticulation Frequent low reservoir level	Asset management, certified maintenance staff. Redundancy in plants and intakes. Alarms	Incident management plan. Demand restrictions imposed	Reservoir level	Yes	Unlikely	Moderate	Medium	Y	Confident	Improve audit and tracking process of SoPs. Ensure auditing of development manual requirements and contract requirements are undertaken Audit/review hygienic repair procedures by Broadspectrum under the O&M service contract.	OEWS WO&M
	Micro/Chem contamination	7.02	Inadequate controls on maintenance and construction work	Likely	Major	High	Complaints from consumers about taste or odour. E. coli present in reticulation system	Maintenance and replacement work is undertaken by trained qualified and experienced contractors. Contractors are trained in emergency chlorination procedures for repair works – when identified, contaminated water is scoured from the mains and replaced with chlorinated water O&M Contract requires immediate attention to any pipe failures.	Implement a boil water notice as outlined in the contingency plan if the quality of the water supplied cannot be assured	Sanitation procedures and sanitation practices of contractors.	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Micro/Chem contamination	7.03	Backflow from consumer connections.	Likely	Moderate	High	Contaminants identified in the reticulation system. Taste or odour complaints from consumers.	Council policy (in Bylaw) on backflow prevention requires existing at-risk commercial consumers to have back flow Preventers installed Pressure in the reticulation is generally maintained at 400 kPa	Implement a boil water notice as outlined in the contingency plan Isolate the affected part If possible.	Land-use and building use changes Check reticulation pressures under very high demand situations	Yes	Unlikely	Minor	Low	Y	Confident	Consider new dual main or increased storage for Baylys Beach	OEWS WO&M
	Inadequate Supply of Water	7.04	Poor quality workmanship or inappropriate materials used for reticulation pipes and fittings	Likely	Moderate	High	Contaminants identified in the reticulation system. Taste and odour complaints from consumers	Water supply bylaw. Materials used in reticulation to meet standard specifications. SoPs, and best practice reticulation approach taken to reticulation installation/repairs. Asset management and pipe replacement programme. GIS management of network and materials	Redo work that has been poorly undertaken. Replace any materials that do not meet minimum specifications. Undertake pipe repairs as required in the O&M contract and record on Councils database. O&M contract requires prompt attention to leaks and bursts Enforce contractor performance conditions for hygienic pipe repairs under the O&M contract Refer to Contaminated Distribution System Contingency Plan	Quality of work undertaken. Types of material used Plumbosolvent water leaching heavy metals out of private pipes and fittings	Yes	Unlikely	Minor	Low	Y	Confident	Ensure WSP is understood by Council Staff and Operations and Maintenance Contractor's staff Ensure WSP and schedule of improvements are reviewed and updated after major works have been completed to reflect changing circumstances and requirements. Create O&M Manual for the Dargaville Water Supply, Develop a quality assurance system for monitoring and instrument calibration Staff training in quality assurance. Start using approved methods for monitoring. Train staff	OEWS WO&M
	Sediment/biofilm formation	7.05	Silt build up or biofilm within reticulation pipes	Likely	Minor	Medium	Reduced flows in reticulation. Complaints from consumer about quality of water. Low FAC readings in network	Flushing undertaken in response to complaints. Regular dead end mains flushing Reticulation turbidity taken manually once per week	Undertake flushing as required	Dirty water complaints	Yes	Unlikely	Minor	Low	Y	Confident	Audit/review of monitoring activities and issue of non-compliances to the contractor where performance against the contract is inadequate. Clearly label and identify plant components and functions and update the O&M Manuals.	OEWS WO&M
	Loss of supply	7.06	Treated water main to Baylys beach fails	Possible	Moderate	Medium	Loss of water or pressure in reticulation Records of consumer complaints (e.g. regarding low pressures or loss of supply)	Best practice reticulation approach taken to reticulation installation/repairs. Asset management and pipe replacement programme. GIS management of network and materials	Introduce conservation and efficiency measures Provide emergency water (tankered)	Reservoir level Plant flows daily and monthly from the Magflow meter	Yes	Unlikely	Moderate	Medium	Y	Confident	Establish a compliant sampling schedule which confirms with the new DWSNZ 2005 (revised 2018)	OEWS WO&M

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8. Other	Operator error/mismanagement	8.01	Inadequate training, professional development and up-skilling of operators	Likely	Major	High	Staff not provided with adequate ongoing training. Poor operation of plant. Plant compliance failure. Loss of supply. Vacancies. Staff feedback. WSP not properly understood and followed by staff. Failure of staff to follow KDC QA procedures	Experienced staff employed. Staff attend appropriate professional conferences and other professional development opportunities. Operators have or are completing the National Cert or Dip in Drinking Water Treatment. Appropriately experienced and qualified engineering personnel. Regular staff training for new staff in particular. Regular refresher and induction training for new staff. Contractor performance measures include completeness of required documentation and recording. Up to date QA and O&M manuals. Include key staff in the WSP process and provide training before and during implementation. Operator training and refresher courses Comprehensive O&M Manual for the supply	Review documentation. Provide in-house training where abilities are in deficit. Standard Operating Procedures are available for staff. Amend the contract if service levels are inappropriate and/ or Council audit reveals weaknesses Corrective action may still be possible for tardy test results if the problem is ongoing. Amend the WSP to include any new supply elements Refer to Contaminated Distribution System Contingency Plan	Documentation. Operator abilities, knowledge and training qualifications Training attendances	Yes	Unlikely	Moderate	Medium	Y	Confident	Data - review SCADA management	OEWS WO&M
	Operator error/mismanagement	8.02	Inadequate supply planning and management	Likely	Major	High	Lowering levels of service. Consents not renewed. Capital costs uncontrolled. Failing infrastructure strategy. 3rd party audits e.g. OAG. Reduction in funding	Relevant statutory obligations ie LGA, RMA, Council policies. Infrastructure planning team. Regular monthly audit of contractor performance under the O&M contract to ensure the required 'Levels of Service' are met. Contractor reports three monthly on service provided against the O&M contract. Condition assessment of mains in the AMP/GIS database identifies life expectancy of pipes Reticulation system is built to a modern standard	Apply contingencies for changes in legislation or other key planning considerations	New Legislation, regulations or Standards. Residential and industrial growth/connections Regular WSP reviews	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Sampling Failure	8.03	Inadequate sampling programme or sample collection error.	Almost Certain	Moderate	High	DWSNZ compliance failure e.g. due to days of week, days between samples, insufficient samples, information gaps, positive results or sampling error.	Sampling programme prepared and checked against standards. Sampling is IANZ accredited and an MoH accredited laboratory is used Alert notices for non-compliant test results (transgressions) are required Working relationship with lab where incorrect or erroneous results can be managed	Review sampling programme Carry out E.coli follow -up sampling following all transgressions Log any incidents and corrective actions taken in the incidents register and in DWO	Sampling programme against DWSNZ. Monthly reports to Council on water quality monitoring activities by the contractor and recorded on DWO Council audit 2-3% of all work carried by the contractor. Test results	Yes	Unlikely	Minor	Low	Y	Confident	Review compliance documentation and record keeping	OEWS WO&M
	Unidentified Operational Failure	8.04	Insufficient monitoring and alarming of key operational data	Almost Certain	Major	Extreme	Contamination identified in supply. Operational near miss identified. Inadequate information collected to provide confidence in supply operation	Continuous on-line alarmed monitoring for pH and turbidity at the treatment plant. Operators validate treatment plant equipment weekly and calibrate equipment as required	Undertake manual grab sampling if required. Initiate incident management plan.	Trends and alarms of Cl2, UVT, pH and turbidity continuous monitoring	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Failure due to Inadequate Maintenance	8.05	Supply equipment fails due to inadequate asset information and inadequate maintenance planning	Likely	Moderate	High	Unexpected plant equipment failure.	Council and contractor have a good understanding of water supply assets allowing maintenance to be planned and undertaken	Attend to failure as a priority Plan to renew or improve assets as required	Condition and forward planning for asset renewal	Yes	Unlikely	Moderate	Medium	Y	Confident	Renew water take consent for Waipapataniwha Stream	OEWS WO&M
	Failing to meet DWSNZ	8.06	Treatment processes of the water supply are not sufficient to comply with the requirements of the DWSNZ	Almost Certain	Major	Extreme	Insufficient treatment processes at the treatment plant to comply with the DWSNZ. DWA reports	Continuous on-line alarmed monitoring for pH and turbidity at the treatment plant. Chlorination. E.coli and FAC monitoring	Implement boil water notice if safety of supply cannot be guaranteed	DWSNZ compliance data	Yes	Unlikely	Moderate	Medium	Y	Confident	Monitor plant security and increase security if minor incidents occur that might escalate	OEWS WO&M
	Failure to Provide Safe Water	8.07	Inadequate data collection, reporting and control systems	Likely	Moderate	High	Information about how the supply is operating is not available. Manual collection and recording of data. IT failure. Inadequate or outdated QA and O&M manuals.	Continuous on-line alarmed monitoring for pH and turbidity at the treatment plant	Undertake manual grab sampling if required	Trends and alarms of Cl2, UVT, pH and turbidity continuous monitoring	Yes	Possible	Moderate	Medium	Y	Confident	As per 8.01 and 8.03	OEWS WO&M
	Loss of supply	8.08	Resource consent limits reached or exceeded or no current consent	Unlikely	Major	Medium	Consent conditions Information from Regional Council	Priority consent Existing use rights Consented at Rotu	Daily abstraction rates are always within the water take limits. Emergency provisions of RMA would be exercised to allow water to be used.	Regional Council Policy	Partially	Possible	Insignificant	Low	Y	Confident		OEWS WO&M
	Microbiological or chemical contamination	8.09	Vandalism to plant equipment	Possible	Major	High	Obvious signs of damage to treatment or storage equipment Reduced/no flow to treatment plant or distribution system	Controls and treatment plant are in robust concrete block buildings. Supply equipment is visited and checked regularly. Legal deterrents, ie prosecution. Operator completes daily inspections which includes a general security check . Operator visit the plant daily No history of significant damage as yet	Implement boil water notice if safety of supply cannot be guaranteed. Activate incident management plan. Engage Contingency Plan measures if there is evidence of deliberate contamination of the supply	Condition of treatment buildings and equipment	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M

Stage	Event	No.	Cause	Likelihood	Consequence	Max Risk	Indicators	Preventive measures in place	Correction Actions	What to Check	Risk Managed	Likelihood	Consequence	Residual Risk	Acceptable	Certainty	Additional Measures	Resp
	Total Plant Failure	8.10	Catastrophic natural disaster or failure including earthquake and flooding	Rare	Catastrophic	Medium	Major natural disaster occurs. Intense sustained weather. River bank slip, flooding. Total plant failure is evident. Warnings from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police.	Prior warning from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police. Robust secure plant structures and buildings. Business continuity plan in place and exercised. Emergency response plan. Regional Emergency Plan exists and requires local authority emergency plans to be drawn up An Emergency Plan for less serious incidents is included in the O&M Contract	Execute the actions in the O&M Contract for minor emergencies Repair any damage as soon as possible Emergency Water Response and Action Plan not implemented for the supply	Prior warnings issued by Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police	Partially	Rare	Major	Medium	Y	Reliable	Complete the Emergency Response and Action Management Plan as to align with the Regional Emergency Plan	OEWS WO&M