

About public water supply disinfection

Why do we need to disinfect our public water supply?

Rarotonga's water intakes do not currently provide safe drinking water.

This is because stream water contains harmful micro-organisms including bacteria and viruses that can make people sick. Disinfection is a process that kills these micro-organisms and ensures the water supply is safe to drink.

Disinfection is a public good, because a safe water supply promotes healthy communities.

Regular water safety tests completed by MoH's Public Health division have shown that community water stations are not reliable sources of safe drinking water

The Public Health division of the Ministry of Health has become increasingly concerned with the poor water safety surveillance test results in 2018.

Over the past five years, most community and school water stations have produced variable results especially after heavy rain with a select few continuing to fail to meet the required microbiological standards for acceptable drinking water.

This has required health officers place temporary red stickers on those stations until remedial action is taken.

The bacteria found in our water is proven to cause health problems

Poor test results occur when unsafe levels of e-coli (Escherichia Coli) bacteria are found in our water. There is a strong link between the presence of e-coli bacteria in water and a number of illnesses. These include gastrointestinal illness, and infections of the upper respiratory tract, ears, eyes, nasal cavity and skin.

We are likely to already be experiencing water-related health problems, but not realising they're caused by our water supply

Infections and illness from water can be mild, and it can be difficult to pinpoint water as the cause, even for more severe cases. However, a number of studies have proven that untreated stream water does cause health issues.

We need to disinfect our water supply to ensure reliable access to safe drinking water

Rarotonga's drinking water will not be safe until it is disinfected to remove harmful micro-organisms. This means disinfecting both the pipes carrying the water and the water itself. There are a number of ways to disinfect the water, however a small amount of residual chlorine is needed to treat the pipes it travels in.

To be effective, we need to disinfect both the water as it enters the network, and the pipes used to transport it to the tap.

Pipe disinfection can only be achieved using small doses of chlorine.

The '4 step' water treatment process

Disinfection is just one part of the four-step water treatment process Te Mato Vai is installing. Multiple steps are needed to get water clean and safe for drinking, bathing and food preparation - each step plays an important role.

Currently Rarotonga uses only the first step, and the system is not working as well as it should.

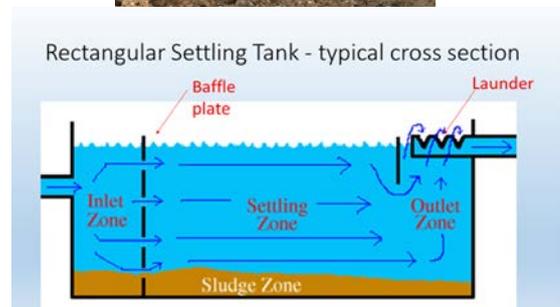
1. Sedimentation (settling)

This process uses gravity to remove solids (dirt, leaves etc) from the water
The solids settle on the bottom of the tank as sludge



2. Coagulation/flocculation

Flocculation is a slow mixing process which helps particles of dirt etc. clump together and settle faster at the bottom of the tank.
This step, together with filtration, removes harmful protozoa



3. Filtration

Rapid gravity filters use sand to further filter the water. Waste is removed from the top of the tank, and the filtered water is collected from the bottom
This step, together with coagulation/flocculation, removes harmful protozoa



4. Disinfection

There are a number of disinfection options
Disinfection kills other harmful organisms such as viruses and bacteria
Different methods are more/less effective at removing these

The three types of harmful organisms found in the water that can cause different illnesses

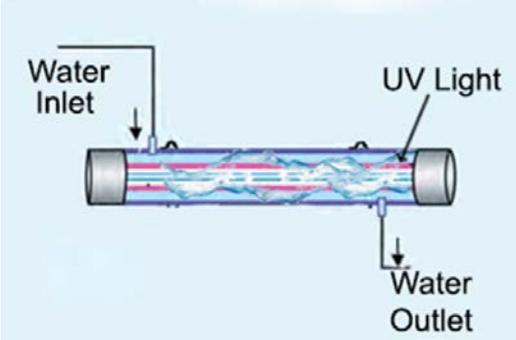


What are the disinfection options?

The Te Mato Vai project management unit has assessed the most commonly used water supply disinfection options – these are UV, ozone and chemical (chlorine) systems. Factors considered include safety, complexity, reliability, capital cost, and ongoing operational and maintenance costs.

Based on this assessment, the PMU recommends chlorination as the safest, most cost-effective and reliable disinfection system for Rarotonga.

The following table explains why we are recommending chlorination as the most suitable option.

Disinfection options	Means	Comments
<p>Ultra Violet radiation (UV)</p>	<p>UV rays penetrate harmful pathogens in the water and inactivates bacteria, viruses, and some cysts (protozoa), by attacking their genetic core (DNA).</p>  	<p>Relies on power, UV lamps need cleaning/replacing and UVT to be monitored. Does not kill viruses (Giardia lamblia cysts or Cryptosporidium oocysts). No disinfectant residual effect beyond the point of treatment.</p> <p>A treatment system would be required at each intake site. Initial capital cost would also be high because it would require a permanent power supply to be installed at each the intake site. Requires specialist skills to maintain the system, which can be unsafe when not properly managed.</p> <p>The power supply costs would be in addition to an estimated installation cost of \$800k-\$1.2m. Annual operating costs are also high (estimated \$154k) as are the costs of ongoing maintenance.</p> <p>Chlorine would still be required to disinfect the pipe system and to ensure the water flowing through distribution network remains potable.</p>
<p>Ozone Gas Ozonation</p>	<p>Destroys microorganisms and degrades organic pollutants through the infusion of ozone, a gas produced by subjecting oxygen molecules to high electrical voltage.</p>	<p>Effective on all pathogens. Has high energy demand. O₃ inhalation is accompanied by dangerous side-effects.</p> <p>A treatment system would be required at each intake site. Initial capital cost would also be high because it would require a permanent power supply to be installed at each the intake site. Ozone systems are typically only used for niche applications where high-level specialist technical maintenance and</p>



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		<p>operational skill is readily available.</p> <p>The power supply costs would be in addition to an estimated installation cost of \$1.4m. This system has very high operating and maintenance costs.</p> <p>Chlorine would still need to be added to disinfect the pipes to ensure the network remains safe.</p>
<p>Chemical Chlorine - Chlorination</p>	<p>Chemical disinfection using liquid chlorine or chlorine-containing solutions for the oxidation and disinfection of the water source.</p> 	<p>Effective at killing bacteria and viruses, retains a residual if breakpoint chlorination reached/exceeded. Does not kill all protozoa (oocysts)</p> <p>A safe and proven method, used in many countries around the world, including Australia and New Zealand. Simple to install and manage effectively, it does not require high levels of technical equipment or skill to operate effectively. This option is cost-effective, as it requires minimal new infrastructure. The estimated installation cost is \$600-800k and annual operating costs would be about \$100k.</p> <p>The 'Envirolyte' system is a chlorine dosing system that uses salt to generate chlorine for dosing.</p>
<p>Chemical Chlorine - Anolyte</p>	<p>A chemical dosing system, using a chlorine based product derived from salt to generate chlorine for dosing.</p> <p>It is this fact that enables this system to work, as it's the chlorine that kills harmful bacteria and viruses in the water.</p>	<p>This would involve creating the chlorine liquid at a special plant, then transporting to the intake sites.</p> <p>Have not yet received a technical proposal including costings</p>

Frequently asked questions

Q: What does ‘potable’ mean?

A: ‘Potable water’ means water that’s been demonstrated to be safe for drinking, and meets established drinking water standards. Potable water is also safe to use for food preparation, personal bathing etc.

Q: What standards are you using to judge whether water is safe or not?

A: The Cook Islands Ministry of Health has recently prepared a Drinking Water Standard which is based on World Health Organisation (WHO) Guidelines for drinking water quality. It is similar to the standards used in other Pacific countries including Tahiti and Fiji.

Q: Why should we disinfect when we’ve been drinking our water without a problem for years?

A: While we don’t currently monitor for illnesses that may be caused by our water supply, the Ministry of Health has become increasingly concerned with the poor results of their regular water safety surveillance tests. Water that is not potable could cause a waterborne disease outbreak.

Q: Why don’t we use in-home UV treatment instead?

A: Whatever disinfection method Government decides on, it will need to be applied at the water intake sites rather than individual households. This is because it’s important the system is centrally operated and maintained to ensure it is safe and reliable. Only disinfection, both of the water as it enters the network and the pipes, can achieve a safe and reliable public water supply. Pipe disinfection can only be achieved using small doses of chlorine.

Q: Why don’t we just boil our water instead?

A: While boiling water can make water safe to drink, only disinfection can achieve a safe and reliable public water supply. There are a number of reasons for this, including the fact that waterborne diseases can occur not only from drinking contaminated water, but also from other uses including bathing, brushing teeth, and washing salad vegetables.

Q: Why don’t we just keep using the community water stations?

A: Whatever disinfection method Government decides on, it will need to be applied at the water intake sites rather than at the water stations. This is because it’s important the system is centrally operated and maintained to ensure it is safe and reliable. Unfortunately the community water stations have not been reliable.

Q: I’ve been drinking our water for years and I’ve never been ill – is it really unsafe?

A: Not every person infected with a pathogen from contaminated water falls ill, but young children, the elderly, visitors and those who are unwell are more vulnerable. This is because they either have a lowered resistance to disease or have not been exposed to water-borne pathogens and have never built up any resistance.

The chances of developing an illness after drinking contaminated water depends on a number of things, including the type of micro-organism, the amount of the micro-organism consumed, and the resistance of the infected person. (FAQs are continued on the following page)

Q: Will the Government introduce tariffs to pay for disinfection?

A: The Government has confirmed it is planning to introduce a water tariff to help fund essential infrastructure and encourage responsible water use.

Questions about chlorination

Q: Why should we trust the PMU's advice on this?

A: The PMU engineers responsible for reviewing and assessing disinfection options for Rarotonga have over 40 years' experience on similar projects in the Pacific, New Zealand and further afield. We are confident they are suitably qualified to provide the Cook Islands Government and public with advice on the most suitable option.

Q: Doesn't chlorine make the water taste terrible?

A: Chlorine may give water a distinctive taste and smell, but some people will be more sensitive to this than others. If you don't like the taste, it's very easy to remove the chlorine from your drinking water. You can leave drinking water to sit in an open jug in the fridge overnight to evaporate the chlorine, or use a charcoal filter to remove the chlorine at the kitchen tap.

Q: How much chlorine would you put in the water?

A: We would need to add two litres of chlorine solution to every 10 million litres of water. This is based on the World Health Organisation recommendation to maintain a minimum chlorine concentration of 0.2 milligrams per litre and maximum of 0.5 milligrams per litre, at the point when it reaches the tap.

Q: If the water is chlorinated, can we still use it on our gardens and food crops?

A: Yes, it will be perfectly safe to use on your gardens and crops.

Q: If the water is chlorinated, will it affect the marine environment?

A: No, it will be perfectly safe for our marine environment. Chlorine is a naturally occurring substance in the ocean, and the amount of chlorine used to treat water is very small.

Q: What if I am allergic to chlorine?

A: Chlorine allergy is extremely rare. If you do have an allergy, it is easy to remove the chlorine, either through evaporation or a charcoal filter. Charcoal filters can be fitted to the household water supply or just to one tap. Another option is to collect and use tank water, but this would be at your own risk.

Q: How much do charcoal filters cost?

A: There is a range of price points of charcoal filters depending on their specifications. Prices range from about \$65 for a counter-top filter to \$300+ for a filter that attaches to your mains supply for the whole house.

Q: Will the Government subsidise charcoal filters?

A: No, because filters are not needed to remove chlorine. It's easy to remove chlorine from water by letting it evaporate.