

Prepared for To Tātou Vai

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Acronyms

AVG Automatic valveless gravity filter
NES National Environmental Services

OEMP Operational environmental management plan

PACI Poly Aluminium Chloride SOP Standard operating procedure

SS Suspended solids
ST Settling Tank
TTV To Tatou Vai

WTP Water Treatment Plant

<u>Units</u>

μg/L milligrams per liter

Kg Kilograms

E. Coli Escherichia coli (E. coli) bacteria normally live in the intestines of people and animals.

Most *E. coli* are harmless and actually are an important part of a healthy human intestinal tract. However, some *E. coli* are pathogenic, meaning they can cause illness, either diarrhea or illness outside of the intestinal tract. The types of *E. coli* that can cause diarrhea can be transmitted through contaminated water or food, or through contact with animals or persons. (https://www.cdc.gov/ecoli/general/index.html)

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Explanation

This supplementary plan is informed by the operational environment management plan main report. It provides for the management of environmental hazards and risks outside of the potential hazards and risks caused by the PACI. The plan covers the following:

- 1. Location of the Tūpapa Water Treatment Plant;
- 2. Areas where there are likely significant potential adverse environmental impacts;
- 3. How the Water Treatment Plant works;
- 4. Management of potential environmental hazards and risks; and
- 5. Summary of Recommendations and Monitoring Programme

1. Where is the Tūpapa Treatment Plant?



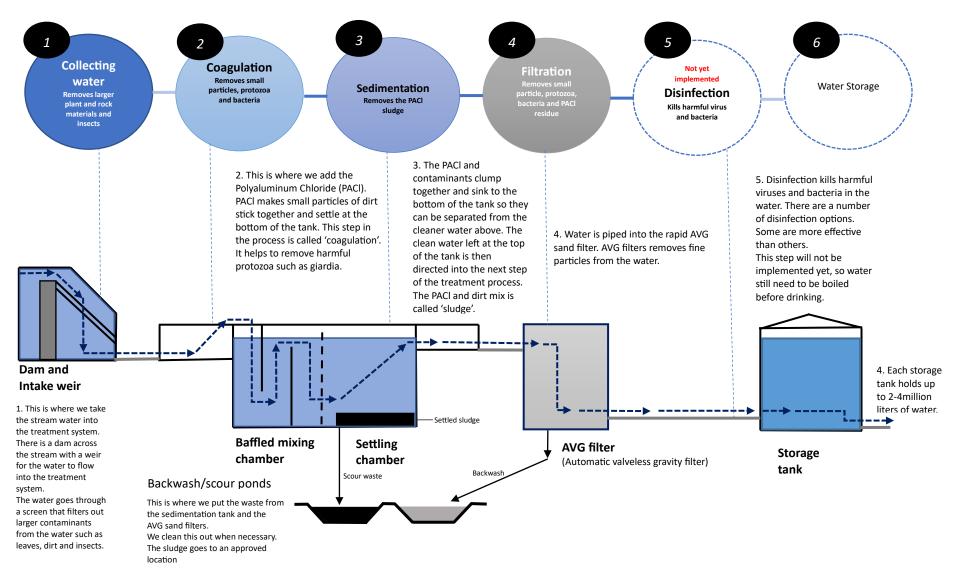
Figure 1 - Location of Rarotonga's Water Treatment Plants with Tūpapa in red

2. Tūpapa Water Treatment Plant – Areas where there are likely significant potential adverse environmental impacts.



3. How the WTP work?

Figure 3 - How the Tūpapa Water Treatment Plant work (Source: TTV sign boards at each WTP)



4. Management of Environmental Hazards and Risks

All hazards and risks are identified and using the risk assessment methodology attached in the Appendices Section as 6.1. The meaning of the color code: Red = Very High Risk, Brown = High Risk, Yellow = Medium Risk, Blue = Low Risk and Green = Very Low Risk.

Hazards and Risks (What they are and level of risk)	Potential Impacts	Mitigation Strategy	Monitoring Parameter	Monitoring Programme	Responsibility	Staff and equipment Requirement	Oversight
The result of long-term accumulation of organic material behind the weir during low water flow IC = Minor P = Low	Increased dissolved organic carbon behind the weir at the Intake - can contribution to increased dissolved organic carbon in the water which can influence the solubility level of aluminum in the water.	Short term + keep the area behind immediately behind the weir at the intake free of accumulated organic debris + Check twice weekly	- Accumulation of organic debris behind the weir especially during low water flow.	+ Keep an eye out for accumulation especially during times of low water flow. + Increase rotting smell of vegetation in the water. + Check twice weekly	+ Operator (s)	+ Operator (s) + 4 the more the better.	+ Supervisor
Increased E. Coli at Source. IC = Moderate P = High	- E. Coli from insects, geckos, skinks, bats, chickens, rats and dogs E. Coli stored on leaf detritus that is broken down and released into the water when it floods Adverse impact on the water quality Increase sludge in settling pond.	Short term + Keep intake free of accumulated organic detritus. + Check twice weekly Long term + Ongoing water testing + Awareness activities through the Tourism sector.	- E. Coli level	+ Continue with water testing programme. + Manage use of trek trail across the island.	+ Operator (s) + TTV laboratory staff + Tourism sector and Public Health.	+ Operator (s) + TTV laboratory	+ Supervisor
Increase suspended solids IC = Moderate P = Medium	- Adverse impact on the water quality increase sludge in settling pond.	+ Keep vegetation along lower slopes short. + Eliminate invasive species, e.g., pīpī-vai, rau-māniota and kākā. + Regular inspection of inner stream for overgrowth.	- Suspended solid level	+ Continue with water testing programme	+ Operator (s) + TTV laboratory staff	+ Operator (s) + 4 the more the better.	+ Supervisor
Removal of debris from behind weir. IC = Moderate	- Erosion in the catchment area May increase slips in the catchment area.	Short term + Develop SOP for controlled release of materials downstream.	- SOP - Debris deposits and	+ Daily check + After major rainfall.	+ Operator (s) + Supervisor	+ Removal from behind the weir by contractor, T&M Heather.	+ Manager + Supervisor

Hazards and Risks (What they are and level of risk)	Potential Impacts	Mitigation Strategy	Monitoring Parameter	Monitoring Programme	Responsibility	Staff and equipment Requirement	Oversight
P = Medium	- Increase sediment entering WTP.	+ Controlled release of material downstream. Long term + Request for NES approval for controlled release of material downstream. + Investigate and construct silt trap options further inland of the intake and weir to minimize erosion.	volume of deposits When debris level is critical and after major rainfall Volume of material released.			+ Supervisor to be present.	
Falling trees. IC = Major P = Medium	- Encroachment onto plant increases risk of falling trees onto the Plant Increase risk of leaves falling into the ST	Short term + Trim trees + Keep trees low + Remove fallen leaves and branches from the ST Long term + Remove trees that are likely to cause risks to the plant whether it be fallen leaves, broken branches or falling trees.	- Threatening Vegetation Invasive species such as pīpī-vai, rau- māniota, albecia, tree hibiscus and creepers like kākā.	+ Daily check + Dedicated monthly check for vegetation overgrowth or vegetation threatening the plant or parts of the plant.	+ Supervisor (s)	+ Contractor option is preferred.	+ Manager + Supervisor
Land slips are predominant on this site. IC = Major P = Medium	 - Access along the access road is impaired. - Risk to health and safety of operators especially during times of heavy rain and the wet season. 	Long term + Maintain RV radio communication on vehicles making sure they are operational at all times. + Maintain a good relationship with contractor, i.e., Call and pay later to dig and move debris and trees from the road, and pay on time.	- slips - Heavy rainfall.	+ Visual Inspection Especially during the wet season and times with high rainfall and windy conditions.	+ No supervision needed, at this time + Supervisor will be dealing with other priorities to keep the WTP on line.	+ Clearing of access way by contractor, T&M Heather. + Supervisor to be present.	+ Manager + Supervisor
Sludge pond is inappropriately located due to limited land for WTP. IC = Major	- Sludge pond located near the mountain, and surface water from the mountain goes directly into the sludge pond during times of high rainfall.	Short term + Keep an eye on the weather and manage the sludge pond accordingly. Long term	Weather, rainfall.	+ Visual inspection during wet season.	Operator (s) Engineering Division Operators	Operator (s), Engage contractor to do emergency work when required.	Manager and Supervisor.

Hazards and Risks (What they are and level of risk)	Potential Impacts	Mitigation Strategy	Monitoring Parameter	Monitoring Programme	Responsibility	Staff and equipment Requirement	Oversight
P = High	- Cause sludge to get into the stream and drainage.	+ Seek the advice of the engineering division for drainage options. + Use vetiver grass to protect the slope and improve drainage.					

5. Summary of Recommendations and Monitoring Programme

The following are recommended actions to improve the operation and effective management of this WTP.

Increase E. Coli, like all WTPs, the threat from human presence can be managed through stringent laws to prevents additional risk to the system from people using the walking trek.

It is important to investigate further ways to reduce the workload involved in the removing of debris from behind the weir. Removing the debris will also help prevent the longer accumulation of organic materials behind the weir.

Landslips is a major concern at this site, so to deal with this matter effectively, TTV need to maintain a good relationship with the contractors so that access and other difficulties that could impair the operation of this WTP can be managed in as short a time frame as possible.

Improvement of drainage around the sludge ponds is also a concern that need to be addressed and the problem improved.

The following are recommended strategies for each area identified as medium to high risk.

Hazards and	Recommendations	Monitoring Programme		
Risks				
Increased E.	+ Keep intake free of accumulated organic detritus.	+ Continue with water testing programme.		
Coli at Source.	+ Check twice weekly	+ Manage use of trek trail across the island.		
	+ Ongoing water testing			
	+ Awareness activities through the Tourism sector			

Hazards and Risks	Recommendations	Monitoring Programme
Increase suspended solids	 + Keep vegetation along lower slopes short. + Eliminate invasive species, e.g., pīpī-vai, rau-māniota and kākā. + Regular inspection of inner stream for overgrowth. 	+ Continue with water testing programme
Removal of debris from behind weir.	+ Develop SOP for controlled release of materials downstream. + Request for NES approval for controlled release of material downstream. + Investigate and construct silt trap options further inland of the intake and weir to minimize erosion.	+ Revised SOP + Measure volume of deposits. + Remove debris when debris level is critical and after heavy rain in Tūpapa. + Measure volume of material released. + Daily check
Falling trees.	+ Trim trees + Keep trees low + Remove fallen leaves and branches from the ST + Remove trees that are likely to cause risks to the plant whether it be fallen leaves, broken branches or falling trees.	+ Daily check + Dedicated monthly check for vegetation overgrowth or vegetation threatening the plant or parts of the plant.
Land slips are predominant on this site.	+ Maintain RV radio communication on vehicles making sure they are operational at all times. + Maintain a good relationship with contractor, i.e., Call and pay later to dig and move debris and trees from the road, and pay on time.	+ Visual Inspection Especially during the wet season and times with high rainfall and windy conditions.
Sludge pond is inappropriately located due to limited land for WTP.	+ Keep an eye on the weather and manage the sludge pond accordingly. + Seek the advice of the engineering division for drainage options. + Use vetiver grass to protect the slope and improve drainage.	+ Visual inspection during wet season

6. Appendices

6.1 Risk Assessment Methodology Used

The assessment of risks involved for each hazard is provided below in Tables 1 and 2.

Table 1 Level of risk impact and probability

Risk Criteria	Definition of Rating	Score
	A: Extent – The area over which the impact will be experienced	Local = 1; Island = 2; and
		National = 3
	B: Intensity – The magnitude of the impact, i.e., whether the impact will	Low = 1; Medium = 2; and High
Impact (I)	result in minor, moderate, major or catastrophic environmental, social and	= 3
	economic (including human health) changes	
	C: Duration – The time frame over which the impact will be experienced	Short Term – 1; Mid Term – 2;
	and its reversibility.	and Long Term – 3
In	npact Consequences (Combined Score): Minor 3 – 4; Moderate 5 – 6; Major 7	′ – 8; Massive 9 – 10.
Probability	Improbable - Unlikely to occur during project lifetime	1
(P) –	Possible - May occur during project lifetime 20%-60% chance of occurring	2
Likelihood	Probable - Likely to occur during the project lifetime >60-90% chance of	3
of the	occurring	
impact	Highly probable - Highly likely to occur, or likely to occur more than once	4
occurring	during project lifetime	

Table 2 Matrix showing overall significance of the impact as a combination of the consequences and probability rating

		Probability of Occurrence						
		Improbable	Possible	Probable	Highly Probable			
of	Minor	Very Low	Very Low	Low	Low			
Consequences of Impact	Moderate	Low	Low	Medium	Medium			
lmsequ	Major	Medium	Medium	High	High			
Co	Catastrophic	High	High	Very High	Very High			

6.2 To Tatou Vai (TTV) Water Treatment Plant (WTP) Operator's Daily Check List (Source: TTV Treatment Division)

Date WTP	Sludge Level (%)	Bulk Tank (%)	Dose Rate (mg/L or g/m³)	Intake (NTU)	ST (NTU)	Post AVG (NTU)	Reservoir (NTU)	Flow Rate (L/Sec)	Reservoir (KPA)	Comments

Note: PACI storage tank (how full it is in %), PACI header tank (Float valve and arm), the sludge level in the settling tank (from bottom of tank to mid-way level in %), adjusting the dosing level of PACI (in mg/L), Intake (NTU), Sediment tank (Float valve arm at the NTU), Post AVG (NTU), RES (NTU) Flow rate (L/sec)