Prepared for To Tātou Vai

By Tiu Te Matangi Ltd

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Acronyms

AVG	Automatic valveless gravity filter
NES	National Environmental Services
OEMP	Operational environmental management plan
PACl	Poly Aluminium Chloride
SOP	Standard operating procedure
SS	Suspended solids
ST	Settling Tank
TTV	To Tatou Vai
WTP	Water Treatment Plant

Units

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 PACl. The plan covers the following:

1. Location of the Avanā 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 Avanā Water Treatment Plant?

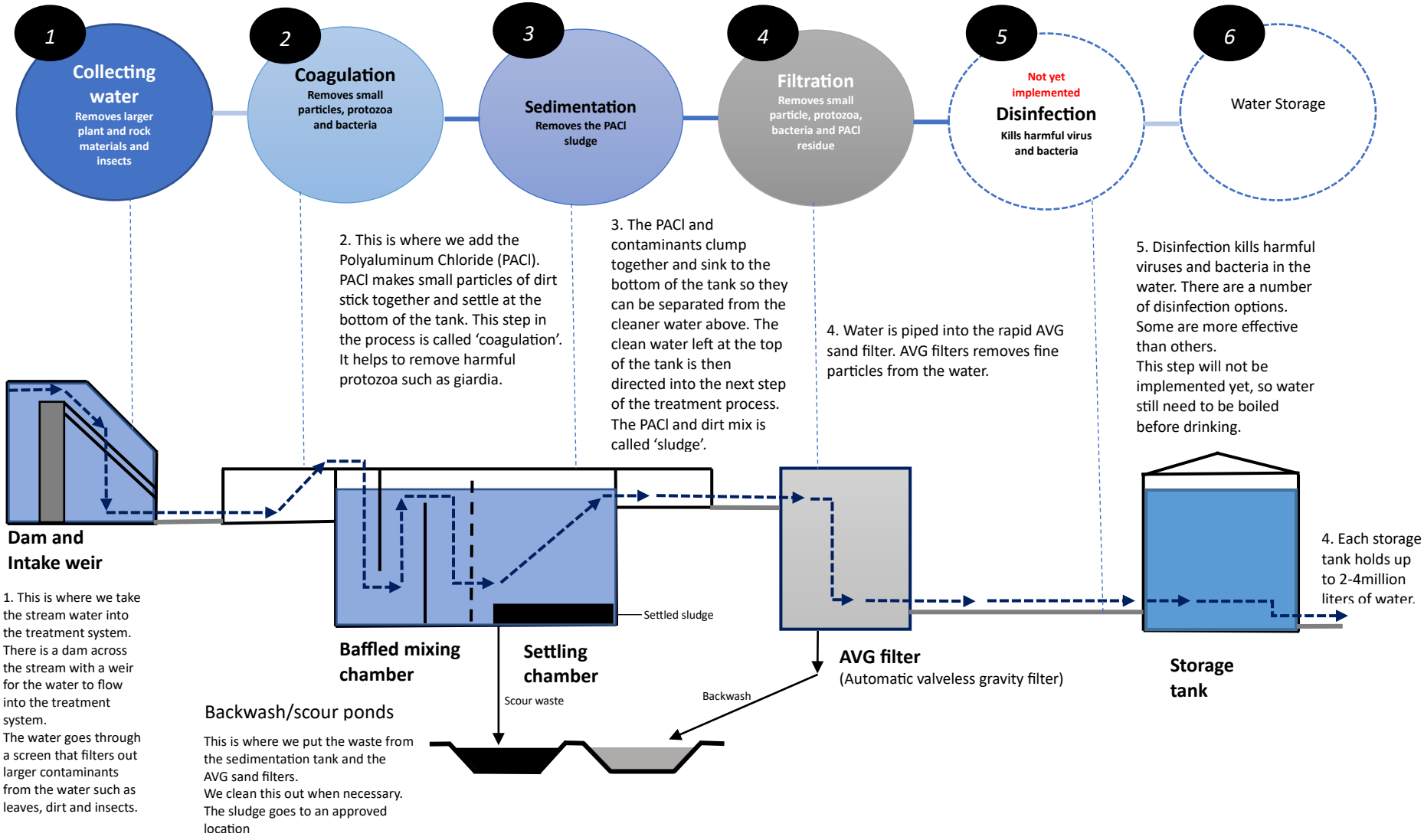
Figure 1 - Location of Rarotonga's Water Treatment Plants with Avanā in red

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

Figure 2- Avanā Water Treatment Plant where there is risk of PACl getting into the environment and where there is potential risk to the plant from the environment.

3. How the WTP work?

Figure 3 - How the Avanã 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) x2 and Supervisor	Operator (s) Removal is done manually by at least 4 operators.	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 = 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. + Seek permission from NES to remove debris further inland from the weir and the old water gallery. + Can use debris for roading	volume of deposits. - When debris level is critical and after major rainfall. - Volume of material released.				
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

Hazards and Risks (What they are and level of risk)	**Potential Impacts**	**Mitigation Strategy**	**Monitoring Parameter**	**Monitoring Programme**	**Responsibility**	**Staff and equipment Requirement**	**Oversight**
Access road washouts during times of heavy rainfall. IC = Major P = High	+ Access problems during heavy rainfall, e.g., road washouts. + Operators are unable to check the WTP.	**Short term** + Maintain RV radio communication on vehicles making sure they are operational at all times. **Long term** + 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.	- Extreme Weather and heavy rainfall	+ Visual Inspection, especially during wet season and times of high rainfall and windy conditions.	+ Operator (s)	+ Operator (s) x2 + Restoration is carried out by contractor, T&M Heather. Supervisor to be present.	+ Manager + Supervisor
Poor drying conditions at sludge pond. IC = Moderate P = Medium	- Sludge pond and backwash ponds are shaded slowing down the drying of sludge.	**Short term** + Sludge moved to Papua for drying using sewage sucker truck. (Truck tanks are cleaned first). **Long term** + Plan to investigate using backwash to go straight to taro growing swamps further downstream.	- Level of sludge pond.	+ Observation of backwash pond level. + If level increases Contractor is contacted.	+ Supervisor	+ JW Estall Contractor (Sucker truck) and Supervisor	+ Manager + Supervisor
Trees over sludge pond IC = Moderate P = Medium	- Sludge pond and backwash ponds are shaded slowing down the drying of sludge.	**Short term** + Sludge moved to Papua for drying using sewage sucker truck. (Truck tanks are cleaned first). + Pump from backwash to sludge pond. Happen in Avatiu, Matavera and Tupapa.	- Level of sludge pond	+ Observation of backwash pond level. + If level increases Contractor is contacted.	+ Supervisor	+ JW Estall Contractor (Sucker truck) and Supervisor	+ Manager + Supervisor

5. Summary of Recommendations and Monitoring Programme

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

Hazards and Risks	Recommendations	Monitoring Programme
Increased E. Coli at Source.	+ Keep intake free of accumulated organic detritus. + Check twice weekly + Ongoing water testing + Awareness activities through the Tourism sector.	+ Continue with water testing programme. + Manage use of trek trail across the island.
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. + Controlled release of material 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. + Seek permission from NES to remove debris further inland from the weir and the old water gallery. + Can use debris for roading	+ Daily check + After major rainfall.
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.
Access road washouts during times of heavy rainfall.	+ Maintain RV radio communication on vehicles making sure they are operational at all times. **Long term** + 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 wet season and times of high rainfall and windy conditions.

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Trees over sludge pond	+ Sludge moved to Papua for drying using sewage sucker truck. (Truck tanks are cleaned first). + Pump from backwash to sludge pond. Happen in Avatiu, Matavera and Tupapa.	+ Observation of backwash pond level. + If level increases Contractor is contacted.

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

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
Consequences of Impact	Minor	Very Low	Very Low	Low	Low
	Moderate	Low	Low	Medium	Medium
	Major	Medium	Medium	High	High
	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/m^3)	Intake (NTU)	ST (NTU)	Post AVG (NTU)	Reservoir (NTU)	Flow Rate (L/Sec)	Reservoir (KPA)	Comments

Note: PACl storage tank (how full it is in %), PACl 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 PACl (in mg/L), Intake (NTU), Sediment tank (Float valve arm at the NTU), Post AVG (NTU), RES (NTU)
Flow rate (L/sec)