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 Tōtokoʻitu 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 Tōtokoʻitu Water Treatment Plan?

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

1. Tōtokoʻitu Water Treatment Plan – Areas where there are likely significant potential adverse environmental impacts

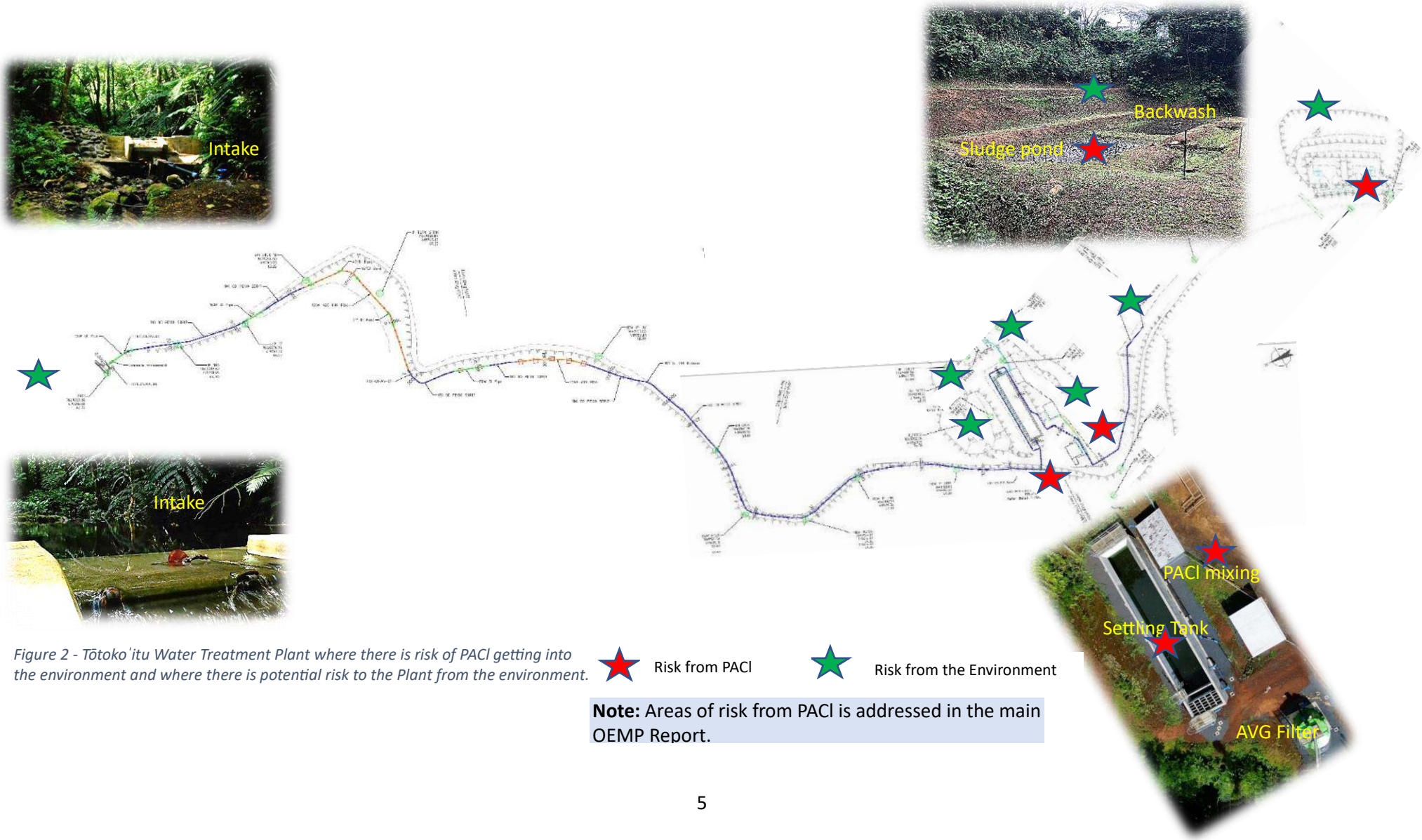


Figure 2 - Tōtokoʻitu Water Treatment Plant where there is risk of PACl getting into the environment and where there is potential risk to the Plant from the environment.

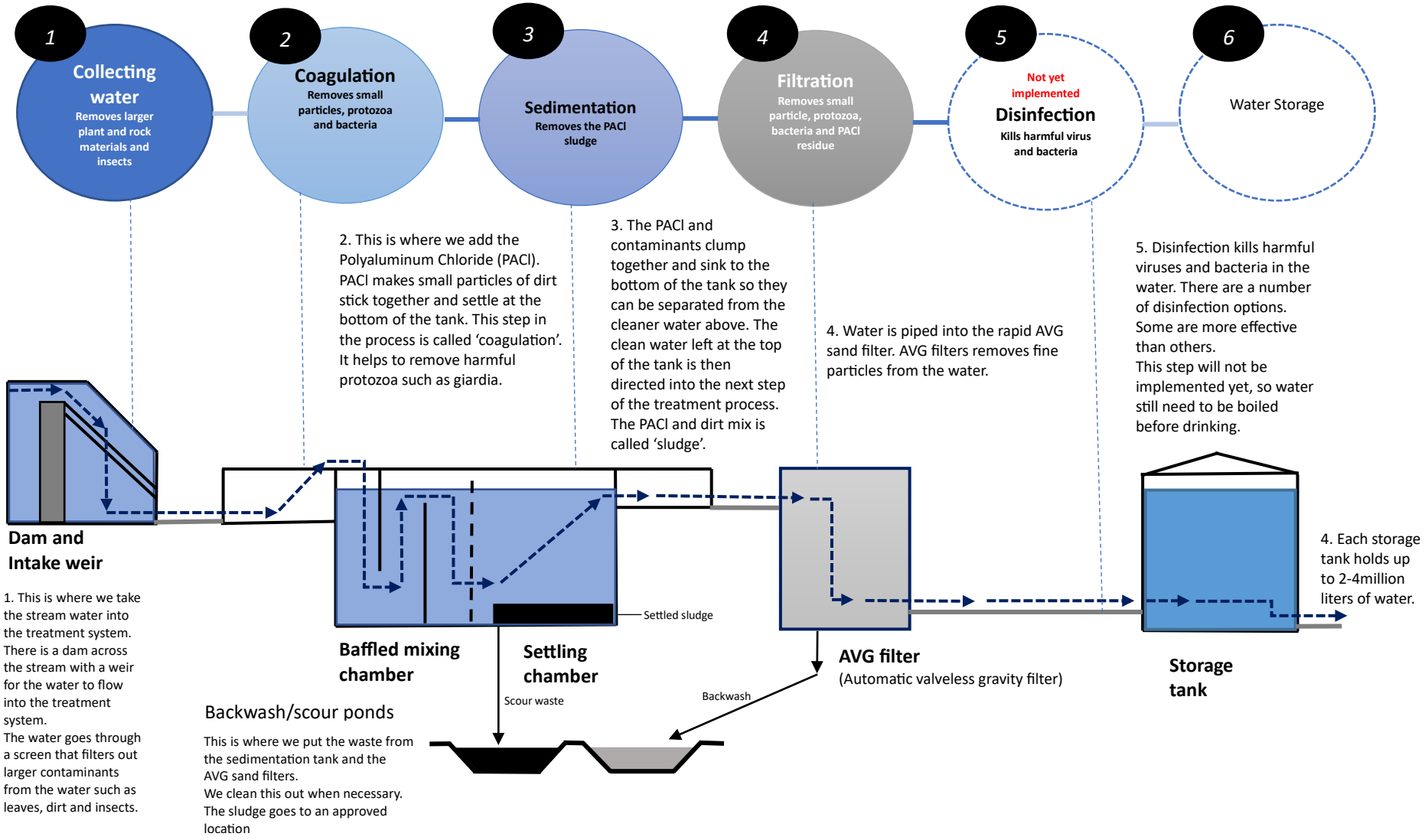
Risk from PACl

Risk from the Environment

Note: Areas of risk from PACl is addressed in the main OEMP Report.

2. How the WTP work?

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



3. 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 accumulate debris behind intake. IC = Moderate P = Medium	- Erosion in the catchment area. - May increase slips in the catchment area. - Increase sediment entering WTP.	**Short term** + Develop SOP for controlled release of materials downstream. + Controlled release of material downstream.	- SOP - Debris deposits and volume of deposits. - When debris level is critical	+ Daily check + After major rainfall.	+ Supervisor (s)	Operator (s) x4 with wheel barrow and shovel	+ 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**
		+ Team of 4 Operators (the more the better) with wheel barrow and shovel trek 500 meters to the intake to remove accumulated debris. **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 after major rainfall. - Volume of material released.				
Removal of debris from behind weir. IC = Moderate P = Medium	- Erosion in the catchment area. - May increase slips in the catchment area. - Increase sediment entering WTP.	**Short term** + Develop SOP for controlled release of materials downstream. + Controlled release of material downstream. and the old water gallery. + Can use debris for roading			Operator (s) x2 and Supervisor	Operator (s) Removal is done manually by at least 4 operators.	Manager and Supervisor
Sludge pond is inappropriately located due to limited land for WTP. IC = Major P = High	- Sludge pond located near the mountain, and surface water from the mountain goes directly into the sludge pond during times of high rainfall. - Cause sludge to get into the stream and drainage.	**Short term** + Keep an eye on the weather and manage the sludge pond accordingly. **Long term** + Seek the advice of the engineering division for drainage options. + Use vetiver grass to protect the slope and improve drainage.	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.
Falling trees. IC = Major P = High	- Encroachment onto plant increases risk of falling trees onto the Plant.	**Short term** + Trim trees + Keep trees low	- Threatening Vegetation. - Invasive species such as	+ Daily check + Dedicated monthly check for vegetation	+ Supervisor (s)	+ Contractor option is preferred.	+ 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**
	- Increase risk of leaves falling into the ST	+ 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, broke branches or falling trees.	pīpī-vai, rau-māniota, albecia, tree hibiscus and creepers like kākā.	overgrowth or vegetation threatening the plant or parts of the plant.			

4. Summary of Recommendations and Monitoring Programme

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

Hazards and Risks (What they are and level of risk)	**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 accumulate debris behind intake.	+ Develop SOP for controlled release of materials downstream. + Controlled release of material downstream. + Team of 4 Operators (the more the better) with wheel barrow and shovel trek 500 meters to the intake to remove accumulated debris. + 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	+ Daily check + After major rainfall.
Removal of debris from behind weir.	+ Develop SOP for controlled release of materials downstream. + Request for NES approval for controlled release of material downstream.	+ Revised SOP + Measure volume of deposits.

Hazards and Risks (What they are and level of risk)	**Recommendations**	**Monitoring Programme**
	+ Investigate and construct silt trap options further inland of the intake and weir to minimize erosion.	+ Remove debris when debris level is critical and after heavy rain in Tōtokoʻitu. + Measure volume of material released. + Daily check
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
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.

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)