Tagabe River Catchment Management Plan 2017- 2030

Foreword

With great pleasure, I present to you the Tagabe River Catchment Management Plan 2017 – 2030 which has been prepared by the Department of Water Resources and the Department of Environmental Protection & Conservation and approved by the Tagabe River Management Committee (TRMC) and the Ministry of Lands & Natural Resources. It provides guidance and directions on the way the Tagabe water source will be managed.

This Management Plan will strengthen the role of the TRMC as the body that manages the water source. This Plan includes strategies and activities to address issues and barriers as well as opportunities that have been identified. In the future this Plan might place greater emphasis on compliance.

This Plan outlines and directs the stakeholders to carry out specific activities that are within their jurisdictions to help manage the Tagabe River water source efficiently. It is an integrated approach to ensure that the only water source that the entire citizens of Port Vila rely on is safeguarded.

While the implementation of this Plan extends for the next 13 years, the TRMC and its stakeholders must be proactive and innovative in contributing to the continuous development of the Tagabe water source.

I would like to thank the former Minister of Lands, Honourable Ralph Reganvanu, for ensuring that this Plan is developed.

It is my challenge to you to embrace the approaches which this Plan offers to know that through collaborations the management of the Tagabe river and its water source can be strengthened.

Hon. Alfred Maoh

Minister of Lands & Natural Resources

Acknowledgement

The Tagabe River Management Committee would like to thank the generous funding and assistance from the Global Environmental Facility International Waters Secretariat of the Pacific Community Ridge to Reef Program Vanuatu. The Tagabe River Management Committee would further like to acknowledge the Department of Forestry, Department of Environmental Protection and Conservation, Department of Water, Wan Smol Bag and all other respective Government Departments, NGOs, communities and partners for the continued assistance in the implementation of activities across the Tagabe River Catchment Area, and for their support and contributions towards the development of this plan. Many thanks to Amy Yang, waste management support officer (2016-2017) at the Department of Environmental Protection and Conservation and TRMC member, for writing, editing and design of the management plan, Director Erickson Sammy for his leadership, and Minister Ralph Regenvanu for his continuous support and drive in completion of this plan.

Acronyms

DARD	Department of Agriculture and Rural Development
DEPC	Department of Environmental Protection and Conservation
DoF	Department of Forestry
DoWR	Department of Water Resources
ELMA	Efate Land Management Area
MLNR	Ministry of Lands and Natural Resources
NGO	Non-Government Organisation
NWRAC	Natural Water Resources Advisory Committee
R2R	Ridge to Reef
TRCA	Tagabe River Catchment Area
TRMC	Tagabe River Management Committee
UNELCO	Union Electrique du Vanuatu Limited
WSB	Wan Smol Bag

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Executive Summary

The Tagabe River Catchment Area (TRCA) is currently the only source of potable water in Port Vila. The TRCA not only provides water for residents, but also businesses, agriculture, manufacturing and industries. The rapid urbanisation and increase in Port Vila's population, the drive to increase tourism, and proliferation of infrastructure that will increase the connectivity of Port Vila to international and domestic markets, will increase per capita use of fresh water and subsequently intensify pressures on Port Vila's water source. Climate change will additionally escalate the vulnerability of Port Vila and Vanuatu's ability to support existing and future TRCA users.

The Tagabe River Management Committee (TRMC) was established in 2003 and its first meeting was called to discuss protection of the TRCA in light of threats from rapid urbanisation of Port Vila and development in the upper catchment. TRMC members consists of representatives from government and Non-Government Organisations (NGO). The TRMC collaborates with stakeholders and communities to bring forth issues to the Natural Water Resources Advisory Committee.

The TRMC has undertaken various works to ensure the quality and security of the Port Vila water supply. These works have been implemented in the absence of long term objectives and vision for the TRCA. Furthermore, competing land use, land rights issues and natural disasters such as cyclones and flooding, as well as challenges from weak governance, poor environmental monitoring, gaps in knowledge and urbanisation have engendering a complex environment in which the TRMC must operate. As a result, activities have been extensively delayed or intermittent with no clear strategic outcomes. Given the significance of the TRCA and in absence of clear management objectives, this Management Plan was developed to improve the management of the TRCA, and hence safeguard the security of the water supply of Port Vila.

The vision of the Tagabe River Catchment Area Management Plan is a catchment which enables:

Sustainable access to sufficient and safe water for Tagabe River Water Catchment area users

To achieve this vision, the goal of this plan is:

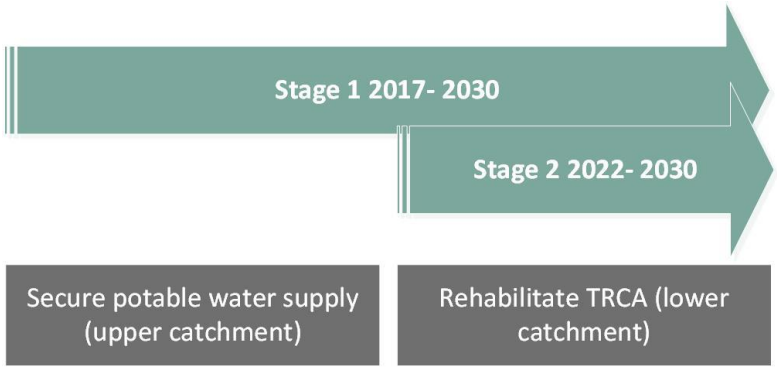
The management the Tagabe River Catchment Area based on enforceable legal frameworks, continuous monitoring and effective advocacy programs.

The objectives of this management plan (in no order) are to:

1. Improve and establish effective governance and enforceable legal framework/s to safe guard the TRCA
2. Improve and establish monitoring program for water quality and land use activities within the TRCA

3. Develop and implement advocacy and awareness programs for the protection of the TRCA to all national and local stakeholders
4. Rehabilitate the catchment area to secure the water supply of Port Vila
5. Implement environmentally sound management of solid and liquid waste through effective legislation and enforcement
6. Scientific research to identify capacity of current water supply and where needed, alternative water source/s for Port Vila
7. Mobilize financial resources to align with the needs of the TRCA
8. Improve TRMC capacity to effectively secure the Port Vila water supply and manage the TRCA

Taking into consideration challenges and activities implemented thus far, this plan will direct how the TRCA will be managed. This plan acknowledges the importance and need of connecting upstream and downstream activities to ensure the health of the whole catchment. This plan reflects a staged approach, with securing the Port Vila water supply the first priority, as reflected the Implementation Plan 2017- 2030.



To ensure that learnings, challenges and milestones are captured, this plan shall be regularly monitored with quarterly progress reviews at TRMC meetings. The annual TRMC reports shall report against the Implementation plan 2017- 2030, and include but not limited to:

- Activities implemented and milestones;
- Water quality monitoring results;
- Challenges and learnings;
- Financials;
- Changes to governance structure, if any;
- Number of TRMC meetings and attendance list; and
- Any substantial amendments to the Implementation Plan

1. Introduction

(Photo credit DoWR)

Vanuatu's main economic hub and greatest concentration of people and businesses is located in the capital city, Port Vila. Connecting Vanuatu to domestic and international markets, Port Vila is home to the major ports: Bauerfield International Airport, Star Wharf and Lapetasi Wharf (scheduled to be completed in late 2017). In 2014, the Port Vila Wharf received 85% of Vanuatu imported goods (Department of Customs and Inland Revenue 2015). In addition to the residents of Port Vila, people from neighbouring peri-urban and rural area also travel to Port Vila to conduct business transactions, purchase goods, work and attend school on a daily basis.

The Tagabe River Catchment Area (TRCA) is currently the only source of potable water in Port Vila. The TRCA not only provides water for residents, but also businesses, agriculture, manufacturing and industries. The rapid urbanisation and increase in Port Vila's population, the drive to increase tourism, and proliferation of infrastructure that will increase the connectivity of Port Vila to international and domestic markets, will increase per capita use of fresh water and subsequently

intensify pressures on Port Vila's water source. Climate change will additionally escalate the vulnerability of Port Vila and Vanuatu's ability to support existing and future TRCA users. Vanuatu is normally subject to high variability in rainfall. Climate change projections are expected to maintain this variability, frequency and intensity of rainfall projected to increase resulting in intermittent flooding, especially in the Port Vila peri-urban areas (McEvoy et al. 2016).

Since its conception in 2003, the Tagabe River Management Committee (TRMC) has undertaken various works to ensure the quality and security of the Port Vila water supply. PeaceCorp volunteers, have acted as technical advisors and has assisted the TRMC in developing and implementing activities across the catchment. These works have been implemented in the absence of long term objectives and vision for the TRCA. As a result, activities have been intermittent with no clear strategic outcomes. Given the significance of the TRCA and in absence of clear management objectives, the Tagabe River Management Plan was developed to improve the management of the TRCA, and hence safeguard the security of the water supply of Port Vila.

Integrated water resource management (IWRM) is a systems approach from a catchment perspective. IWRM provides a framework to understanding the interconnected political, financial, social, cultural and natural elements that make up a catchment. This plan has been developed using an IWRM approach, to address the challenges and issues of water management in Port Vila, and also to provide long term vision and strategic planning. It uses 'Ridge to Reef' (R2R) principles, emphasising the interconnections between the natural and social systems, from treetops, through watersheds to the sea; managing land and water from source to sea.

This plan aims to ensure that adequate water is available for all users and works towards achieving Sustainable Development Goals 6.3 (improvement of water quality by reducing pollution, eliminating and minimising release of hazardous chemicals and materials), 6.4 (increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater) and 6B (support and strengthen the participation of local communities in improving water and sanitation management). This plan aligns with the National Sustainable Development Plan 2030, ENV 4.2 (protect vulnerable forest, watershed, catchment and freshwater resources, including community sources), and addresses objective 4: available water resources and catchment known, managed and protected, and objective 5: all water quality monitored and maintained to meet agreed standards of the National Water Resource Strategy 2008-2018.

This plan will enable greater coordination between government agencies and lead organisations. Moreover, this plan will enable the TRMC the ability to direct donor projects and provide a greater local standing with regards to how water resources are managed in Vanuatu.

1.1. TRMC

The TRMC was established in 2003 and its first meeting was called to discuss protection of the TRCA in light of threats from rapid urbanisation of Port Vila and development in the upper catchment. TRMC members consists of representatives from government and Non-Government Organisations (NGO). The TRMC collaborates with stakeholders and communities to bring forth issues to the Natural Water Resources Advisory Committee (NWRAC) (Figure 1). The TRMC also advises the NWRAC. The TRMC is not an implementing agent, rather the TRMC coordinates activities within in the TRCA.

The NWRAC is Vanuatu's leading cross-sectorial body for water resources management. The NWRAC was established under Article 15 of the Water Resource Management Act No.9 of 2004 and is made up of members from government, NGOs and community representatives. The Director of the Department of Water Resources (DoWR) chairs the NWRAC with the Minster of the Ministry of Land and Natural Resources (MLNR) appointing up to 5 additional members; previous and current members are Department of Environmental Protection and Conservation (DEPC), DoWR, Ministry of Climate Change, Department of Agriculture and Rural Development (DARD), Department of Forestry (DoF), Vanuatu Association of Non-Government Organisations, Department of Public Health and Department of Local Authorities. NWRAC meetings are held when the Chairperson calls for meetings. The NWRAC must meet at least three (3) times a year. The role of the NWRAC is to:

a) Provide advice to the Director on matters relevant to the protection, management and use of water; and
b) Oversee the proper planning and development of urban and rural water supplies; and
c) Operate in such a way as to ensure co-ordination of water resource management activities; and
d) Do such other tasks as are agreed with the Director

n

Figure 1 Structure of the TRMC and relationship to the NWRAC

The housing of the TRMC has shifted throughout its inception, initially sitting within the MLNR, the TRMC secretary was moved to Shefa Province in 2006. In absence of appointed staff to implement TRMC activities, consecutive Peace Corp volunteers has assisted the TRMC by providing technical assistance and/or acting as the secretary. As of 2017, the DoWR chairs the TRMC with the Global Environmental Facility International Waters Secretariat of the Pacific Community Ridge to Reef Program Vanuatu Project Manager acting as the secretary. There is no current governance structure for the TRMC. As the DoWR houses the TRMC, the DoWR acts as the chairman. The TRMC does not have a vision, goal statement nor set schedule of meetings.

Initial TRMC operations was funded by the MLNR. Additionally, an account was established with the National Bank where funds raised through fundraising activities was deposited. However, MLNR ceased supporting activities in 2010 and all works stopped. With the backing of the Honourable Minister Ralph Regenvanu, the Council of Minister's Decision 119 of 2013 approved the amendment of Article 29 of the concession agreement with Union Electrique du Vanuatu Limited (UNELCO), enabling the use of funds allocated under Article 29 to implement activities within the TRCA. Prior to this amendment, there was no formal allocation of funds for the TRMC. With this secured budget, the TRMC has since been able to implement a series of actions. Funds are managed by UNELCO with all activities paid by UNELCO's accounts.

2. Tagabe River Watershed Catchment Area

The TRCA provides Port Vila with its potable water. Due to the need for secure water quality and reliable water supply, water supply sources are commonly located in remote areas and hence can require extensive costly infrastructure and treatment to pump water from the source to users. Port Vila is extremely fortunate to have a water source that is very close to town area with minimal treatment requirements (Depledge 1994).

2.1. Catchment description

2.1.1. Hydrogeology

Port Vila geology consist of faulted blocks, generally made of reef limestone, overlying volcaniclastic deposits of the Efate Pumice Formation. The Tagabe plains are comprised of soil derived mostly from dacitic[1] and andesitic[2] tuffs of sandy stratified deposits. Alongside the Mele and La Colle Catchments, the TRCA sits within the alluvium[3] plain. Reef limestone formations has been found downthrown 65 meters below ground level. The majority of reef limestone is composed of recrystallised and structureless coral algae reef complexes with a variety of skeletal debris of frameworks of lime-secreting organisms (Depledge 1994).

[1] Volcanic rock
[2] A fine-grained tan or grey volcanic rock consisting of plagioclase feldspar, especially andesine, amphibole, and pyroxene
[3] Alluvium consists of silt, sand, clay, and gravel and often contains a good deal of organic matter (https://www.britannica.com/science/alluvium)

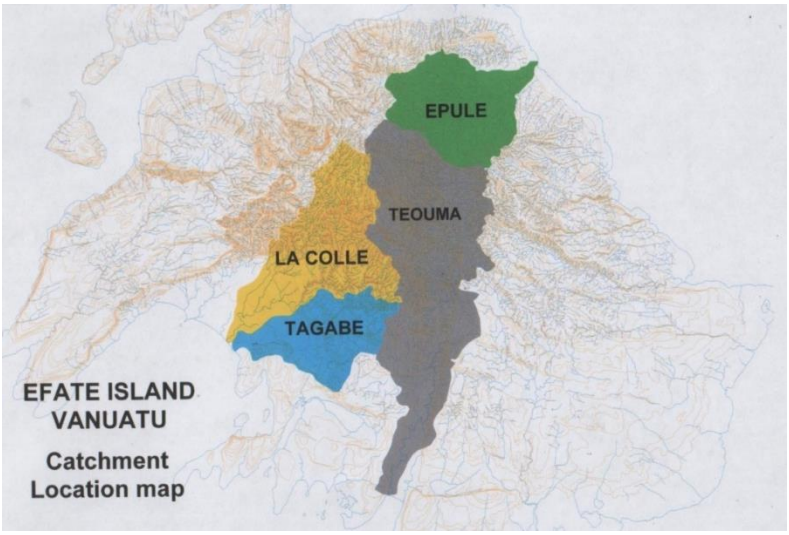
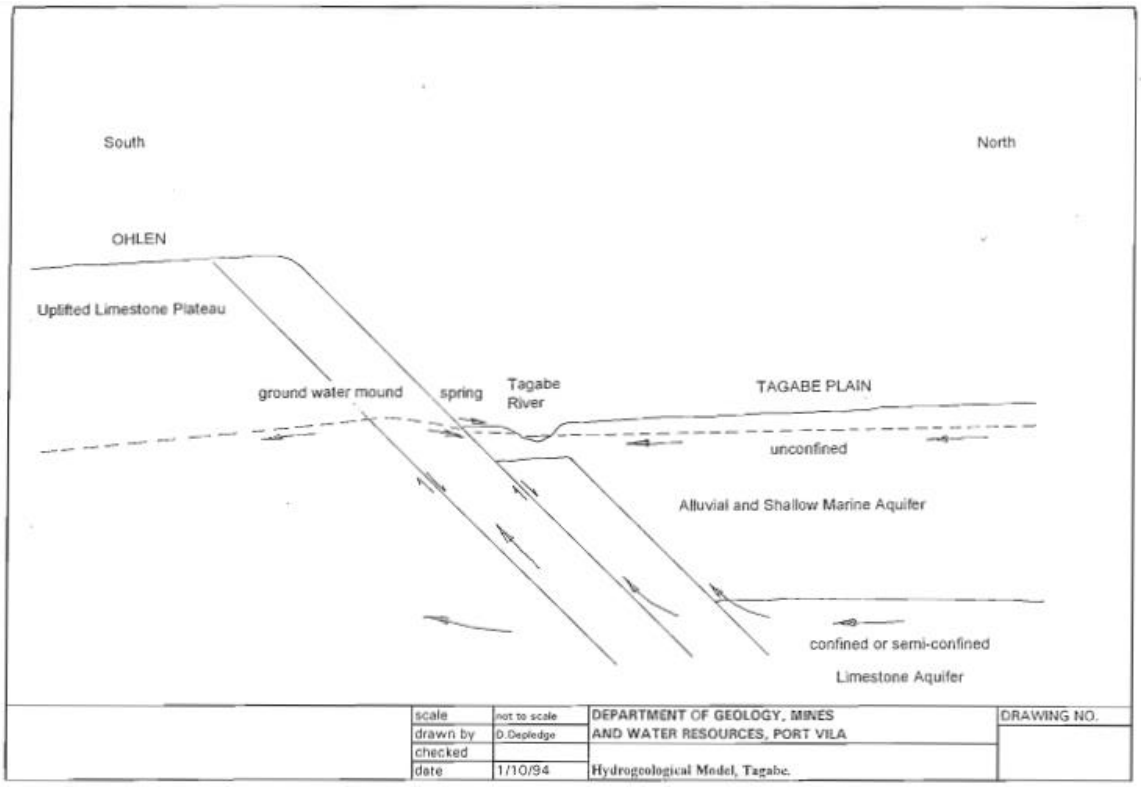


Figure 1 Tagabe River Water Catchment Area (TRMC)

2.1.2. Hydrology

With an area of 29.76 km^2 (DoWR personal communications 2017), the TRCA is fed by springs at the base of an escarpment north of Port Vila. The river flows in a westerly direction, discharging into the Mele Bay in the Black sands area. The TRCA has a mean annual flow of 450 l/s. The aquifer is derived from net rainfall (rainfall minus evapotranspiration), falling and entering the catchment to the northeast of Port Vila. Ground water feeds into the river through a series of springs, seepages along the base of the escarpment (Depledge 1994). As such, the aquifer will be highly vulnerable to



prolonged drought seasons. The fault escarpment acts as a control on the flow of direction and rate of the Tagabe River. (Depledge 1994)

Currently, there have been no complete hydrological assessment of the TRCA. Preliminary assessment indicated that the river flows in a south-westerly direction with ground water discharge area at the base of the escarpment adjacent the Tabage well field. There is hydrological continuity between the limestone aquifer, alluvial aquifer and the river (Depledge 1994).

Depledge (1994) calculated the average recharge rate of between 500mm/a ("reconnaissance" method) and 515 mm/a (correlation between spring flow with groundwater recharge) with almost all discharge into the river through springs and seepage and a possible 20% through surface runoff.

2.1.3. Water network

Under the 1993 concession agreement between the Vanuatu Government with UNELCO, *Contract for the management and operation of the water supply service in Port Vila,* UNELCO is reponsible for the management and operation of the Port Vila water supply within the concession area, inclusive of the finance and construction of water networks. If the contract is not renewed, at the expiry of the contract and subject to a notice of three (3) years, the Vanuatu Government shall take over as the operator of the water network.

There are seven (7) bore holes that pumps water from the TRCA water table, with a total pumping capacity of 24,800 m^3/day or 213m^3/hour (based on a 20-hour pump cycle) and daily pumping rate of 14,000 m^3. The total volume pumped for 2016 was 5,470,549 m^3. Three (3) pumps are located at Joint Court with four (4) at Ohlen. There are seven (7) water reservoirs: two (2) at Joint Court, three (3) at Ohlen, one (1) at the Wharf and one (1) at the Reserve Bank (UNELCO 2016).

The water distribution network continues to gradually increase since the concession agreement with UNELCO from 71,865 meters in 1994 (Depledge 1994) to 229,332 meters in 2016 (UNELCO 2016). The total number of households connected to the water distribution networks also continues to increase from 3,200 in 1993, 5,840 in 2007, 8,188 in 2016, with a projected 3% annual increase or 10,500 connections by 2025 (J. Lengsau personal communication 30th June 2017).

2.1.4 Biodiversity

Approximately 75 percent of Vanuatu is characterised by evergreen rainforest. On lowland leeward slopes, there are extensive areas of savannahs and open woodland. Lowland windward sloped are much richer in evergreen forest with a canopy, understory and shrub layer below (Bregulla 1991). Prior to colonisation, the TRCA was characterised by lowland forested area. Since colonisation and the sub-division of land, the lowland forest has been cleared for grazing, remnants of larger trees remaining (FAO 2000).

Dominant tree species that can be found in the TRCA are the *Samanea saman* and *Macaranga dioca*, along with other timber and non- timber tree species. Some big *Syzygium malaccens* (Nakaviva) trees are also found growing along the edge of the river (Samuel & Dovo 2017).

Due to the isolation and geological age of Vanuatu, there are relatively fewer species of flora and fauna, and fewer endemic species when compared to neighbouring states such as Fiji and New Caledonia. It has been difficult for species to reach Vanuatu with little time for evolution (Bregulla 1991). In Vanuatu, there are 158 species of orchids, 21 species of palms, 121 species of birds, 30 species of reptiles, and 12 species flying foxes and bats (Vanuatu Government 2016). With few comprehensive biodiversity studies conducted in Vanuatu, it is expected that some species remain undiscovered (Bregulla 1991). Endemic terrestrial animals that have been documented in Efate are

the vulnerable white flying fox (*Pteropus anetianus*), Vanuatu flycatcher (*Neolalage banksiana*), Vanuatu white eye (*Zosterops flavifrons*), and the Vanuatu Mountain Honey eater (*Phylidonyris notabilis*) (Bregulla 1991).

Rivers and streams in Vanuatu can be divided into six zones: spring zone (over 800m), higher course (450-800 m; steep) middle course (150-450m; less 10% slope), upper lower course (50-150m) and lower course (less than 50m). Distribution of freshwater species will be dependent on these zones (Vanuatu Government 2016). Dominate freshwater species are fish, gastropods and crustaceans. Common endemic freshwater fish commonly found in Efate are the Jungle perch (*Khulia rupestris*), (*Khulia munda*), Thread silver biddy (*Gerres filamentosus*), Threadless blenny (*Meiacanthus anema*), Throatspine gudgeon (*Belobranchus belobranchus*), and Gobies (*Eleotris fusca, Eleotris fusca, Hypseleotris guentheri, Ophieleotris aporos* new var*, Ophieleotris porocephala*) (Amos 2007).

Fresh water eels can also be found in the river systems. The Giant long-finned eel (*Anguilla marmorata*) is commonly found in throughout Vanuatu while the *Lamnostona polythalmus* is rare and only found in Efate and Epi Island (Amos 2007).

2.1.5. Land use

The TRCA can be divided into two (2) sections: upper catchment and lower catchment. Upper catchment is typically comprised of livestock farming and agriculture, with relatively small area of high-dense settlements (inclusive of subdivision of Ohlen and Freshwota 5 which sits within the fringes of Port Vila Municipal). The international and domestic airport can be found within MWPZ 2 and 3. A quarry is also located in MWPZ 3.

Enterprises are more commonly located downstream: Tusker factory, Planet 107, poultry farm, petrol service station and power generation substation (Tawney 2006). Informal and high-density settlements are also more likely to be found downstream. Lower downstream is furthermore characterised with high traffic volumes as commuters travel from homes to Port Vila town, to North Efate and to and from the airport.

2.2 Activities

The first TRMC meeting was held in 2003 to address increasing concerns of the water supply security of Port Vila. Milestones and the range of activties that has been implmented can be seen in Figure 3.

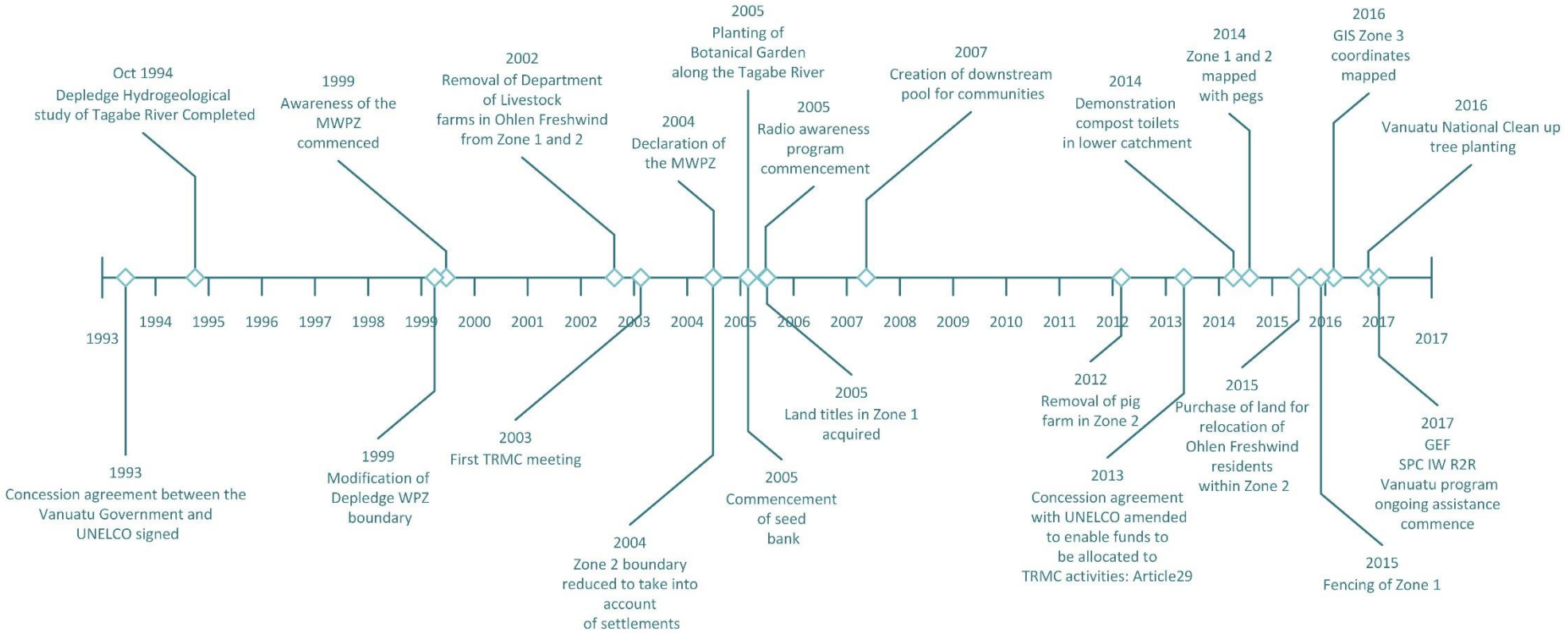


Figure 3 Milestones and activities implemented in the TRCA

2.2.1. Matnakara Water Protection Zones

Water protection zones are designated areas in which regulations are implemented to ensure that water quality is protected from pollutants. Subsection 26(1) of the Water Resources Management Act No. 9 of 2002 enables the DoWR Director to declare an area to be a water protection zone. First identified in the 90s by German consulting firm, Hydroplan, the Matnakara Water Protection Zones (MWPZ) cover an area of 25.7 km^2. The MWPZ details land use restrictions relative to their proximity to the pump station and bore holes (Tawney 2006).

As the only current fresh water source of Port Vila, the aim of the MWPZ is to protect the quality and quantity of the Tagabe River whilst enabling a sustainable and multi-purpose management system. The MWPZ is divided into three (3) zones (Figure 4): Zone 1 Tabu area (Figure 5), Zone 2 Recharge Area (Figure 6) and Zone 3 Water Catchment Area (Figure 7). The MWPZ delineates specific activities for each zone, restriction increasing from Zone 3 to Zone 1 (Attachment 2: Matnakara Water Protection Zone).

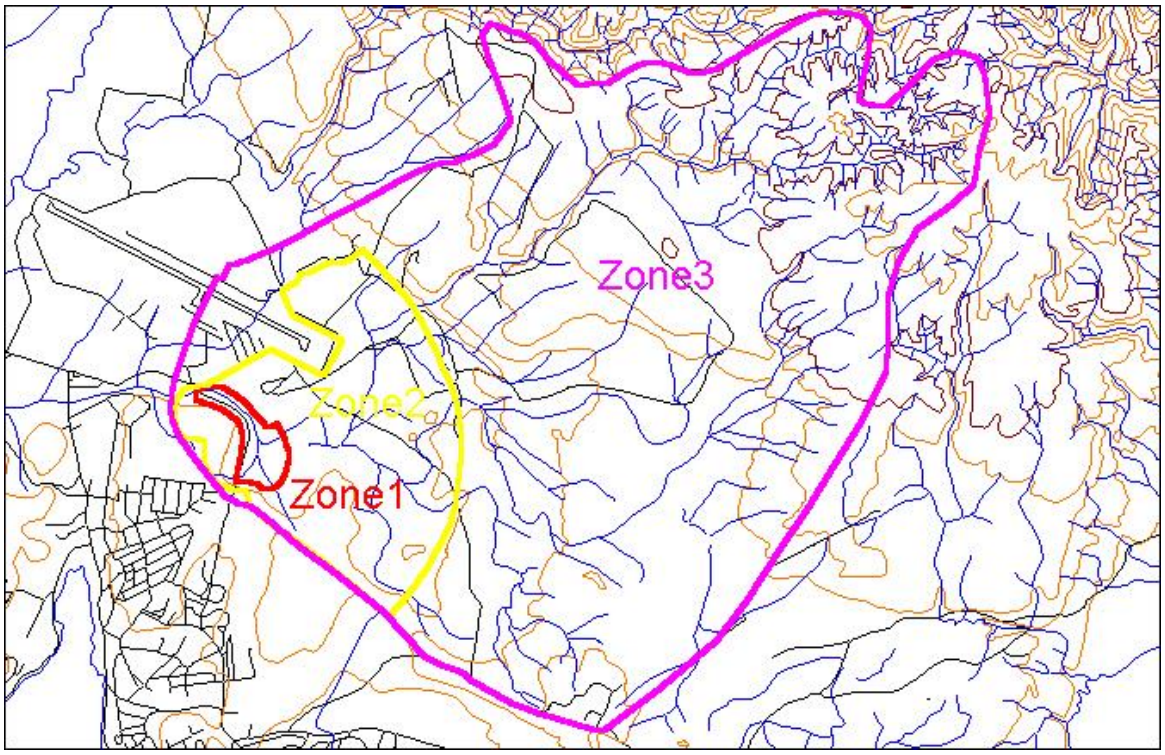


Figure 4 The Matnakara Water Protection Zone and divisions into sub-zones (Gazette No 73 of 2017)

Figure 5 Matnakara water protection zone 1 (DoWR, 2017)

Figure 6 Matnakara water protection zone 2 (DoWR, 2017)

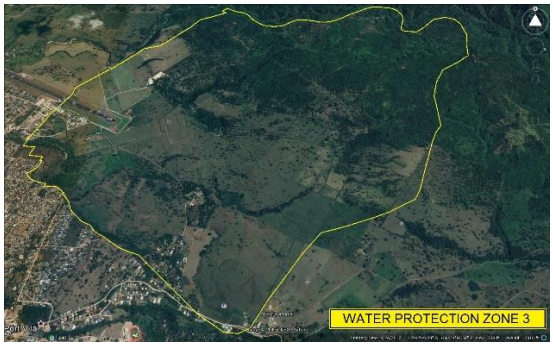


Figure 7 Matnakara water protection zone 3 (DoWR, 2017)

2.2.2. Water Quality Monitoring

Water quality monitoring provides an understanding of water quality in streams, rivers and lakes, an understanding of how water quality varies across locality, if these conditions change over time, and whether these changes are due to natural phenomena or human activities (WMO 2013).

Three types of test can be conducted: physical test, chemical test and bacteriological test. Physical test record colour, turbidity, total solids, odour and taste. Chemical test can and not limited to; comprise of pH, hardiness, Biochemical Oxygen Demand (amount of oxygen needed by micro-organisms for stabilized organic decomposition) and presence of select chemical parameters. Bacteriological analysis tests for harmful organisms (Sciortino & Ravikumar 1999).

As part of the DoWR monitoring program, bore holes samples are taken on a weekly basis. Though DoWR is expected to conduct weekly monitoring, monitoring has been intermittent and dependent

upon on availability of staff, truck and fuel. As a result, there are a series of gaps in the data due to lack of resources to collect the data and/or lack of personal to enter data collected.

Under article 11 of the *Contract for the management and operation of the water supply service in Port Vila*,

> *"Water supply shall at all times have the qualities required by the standards in force in Vanuatu and, as far as possible, to the standards set by the World Health Organisation"*

UNELCO undertakes regular water monitoring of the Port Vila drinking water to ensure that water is suitable for drinking. Inclusive of automatic monitoring of bore holes water levels, water sampling sites are located both inside and outside of the TRCA. Weekly samples by UNELCO are taken across various locations in accordance to a set schedule; location are not limited to Port Vila urban areas and extend to the Wharf, Black sands, Malapoa and Mele (J.Lengsau personal communication 30th June 2017)

Schedule and parameters of 2017 water quality monitoring program for the DoWR and UNELCO can be observed in the Table 1, parameter and results of the annual test detailed in Attachment 3: Annual water quality monitoring parameters. May 2017 water quality analysis demonstrating that the water is potable (Table 2 and Table 3).

Table 1 Parameters and frequency of water quality monitoring in Port Vila

Agent	Water type	Parameters	Frequency
DoWR	Ground water	Height	Weekly
	Ground water	Conductivity	Weekly
	Ground water	Temperature	Weekly
UNELCO	Surface and ground water	Total Coliforms	Weekly
	Surface and ground water	Faecal Coliforms	Weekly
	Surface and ground water	Faecal streptococci	Weekly
	Surface and ground water	Bacterial counts at 37°C	Weekly
	Surface and ground water	Bacterial counts at 22°C	Weekly
	Surface and ground water	Total Residual Chlorine	Weekly
	Surface and ground water	Total free chlorine	Weekly
	Surface and ground water	pH	Weekly
	Surface and ground water	Conductivity	Weekly
	Surface and ground water	Turbidity	Weekly
	Ground water	Total Coliforms	6 monthly
	Ground water	Faecal Coliforms	6 monthly
	Ground water	Faecal streptococci	6 monthly
	Ground water	pH	6 monthly
	Ground water	Ammonium	6 monthly
	Ground water	DBO	6 monthly
	Ground water	Nitrate	6 monthly
	Ground water	Nitrite	6 monthly
	Ground water	Turbidly	6 monthly
	Tank and ground water	Turbidity	Annual
	Tank and ground water	Physico-chemical	Annual
	Tank and ground water	Unwanted metals	Annual
	Tank and ground water	Toxic metals	Annual

Agent	Water type	Parameters	Frequency
	Tank and ground water	Pesticides	Annual

Table 2 Weekly water analysis results, May 2017 (UNELCO, 2017)

Analysis	Result per location			Unit
	Airport	Pump station	Bore Hole 2	
Total Coliforms	0	0	0	U/100 ml
Faecal Coliforms	0	0	0	U/100 ml
Fecal streptococci	0	0	0	U/100 ml
Bacterial counts at 37°C	3	0	4	U/1 ml
Bacterial counts at 22°C	8	4	18	U/1 ml
Total Residual Chlorine	0.21	0.19	na	mg/L
Total free chlorine	0.14	0.16	na	mg/L
pH	6.91	6.84	6.99	
Conductivity	487	488	491	µS/cm
Turbidity	0.31	0.28	0.09	NTU

Table 3 Water analysis results of the TRCA (UNELCO, 2017)

Analysis	Result per location				Unit
	The Spring	Food tech centre/ End of Zone 1	Tagabe Bridge	Black sands Bridge	
Total Coliforms	3	89	124	200	U/100 ml
Faecal Coliforms	1	51	70	200	U/100 ml
Faecal streptococci	0	2	6	24	U/100 ml
pH	6.94	7.12	7.4	7.48	
Ammonium	0	0.01	0.07	0.13	mg/L
BOD	0	1	6	19	Ng/l O dem
Nitrate	0.04	0.11	0.42	2.1	mg/L
Nitrite	0	0	0.02	0.07	mg/L
Turbidly	0.39	3.2	25.7	20.2	NTU

2.2.3. Botanical garden and reforestation

In 2005, the Ohlen Mataso community was contracted to clear the area allocated for the Botanical garden (Viranamangga 2005). The objectives of the botanical garden were to (Tawney 2006):

- Provide an area for botanical and horticultural research;
- Plant botanical collections of appropriate flora to rehabilitate the riparian area along the Tagabe River;
- Educate residents and visitors on the role of plants in social welfare and the environment; and
- Demonstrate and share knowledge of landscape architecture methods.

Initial plans for the Botanical garden is as shown in Figure 8. Seedlings were collected from outer islands. Endemic, endangered and species of traditional significance such as *Alectryon sp.*, *Bischofia javanica*, *Dillenia biflora*, *Oxeva sp., Phaleria pentecostalis* and *Gnetum gnemon* have been planted

in the botanical garden. Despite the development of plan, planting did not follow this plan. Due to cost of weeding, cover crops was also planted to suppress weeds.

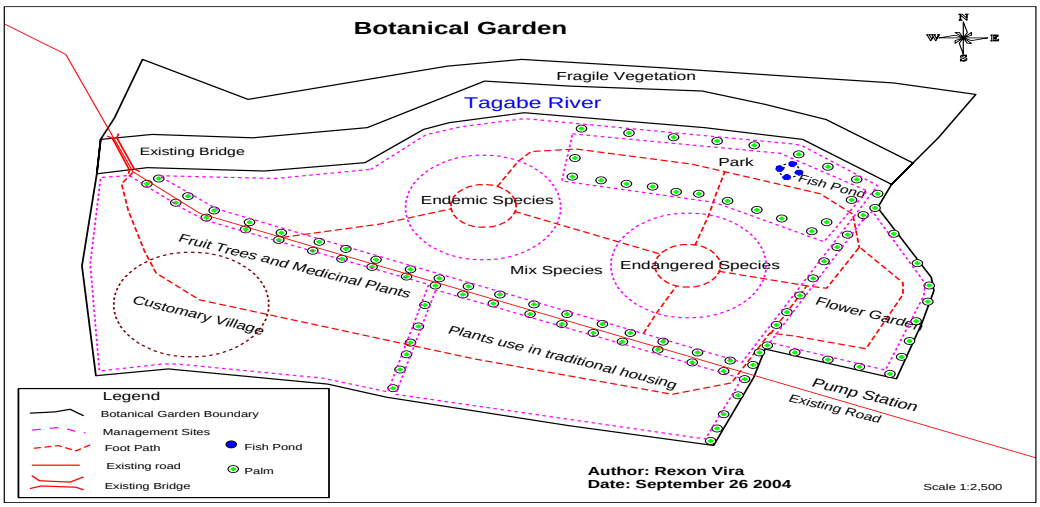


Figure 8 Initial conceptual plan for TRCA botanical garden (Viranamangga 2005)

Collection of cuttings and seedlings, plantings and maintenance of the botanical garden are dependent upon the availability of funds and resources. Intermittent maintenance was conducted to remove weeds. However, continuous removal of trees within the botanical garden for fuel and building materials by neighbouring residents deterred the Department of Forestry from replacing lost vegetation. As such, when funds ceased, works in the botanical garden also stopped; the botanical garden growing wild.

Since 2006, the TRCA has been identified as a critical component as one of Vanuatu's terrestrial reforestation and conservation effort by the TRMC. As such, forest conservation and reforestation of the TRCA is a high priority for the Department of Forestry. The Department of Forestry has carried out various works within the TRCA to implement reforestation and conservation activities including the creation of a Botanical Garden within MWPZ 1 and planting of trees, see Table 4 for the total trees planted as part of the reforestation program of the TRCA. Approximately one hectare of trees has been planted thus far (J. Samuel personal communication 14th July 2017).

Table 4 Total trees planted in the TRCA MWPZ 1 (Samuel & Dovo 2017)

Classification	Common Name	Scientific Name	No. plants planted
Timber	Whitewood	*Endospermun medullosum*	12
Timber	Mahogany	*Swietenia micropyhlla*	80
Timber	Sandalwood	*Sandallum austro caledonicum*	4
Timber	Nangai	*Canarium indicum*	6
Fruit	Nakavika	*Syzygium Malaceancea*	6
Endemic		*Mimusops elengi*	25
Endemic		*Dyospyros samoansis*	13
Endemic		*Arytera sp*	12
Endemic		*Ficus Wasa*	4
Total			162

As part of the reforestation program, a national seed bank was established in the TRCA. The first planting of seedlings occurred in 2004, 27 different types of seedlings was planted. The seed bank area was divided into two sites: site 1- planting of trees of economic, social and cultural value, and site 2- 'wet feet plant' for revegetation of the riparian area (Tawney 2006). With trees grown and community's use of the national seed bank area for garden spaces, the national seed bank is currently not in use. Potential to resurrect the seed bank is possible as many of the endemic plants remain, making cuttings or seed collection for planting possible.

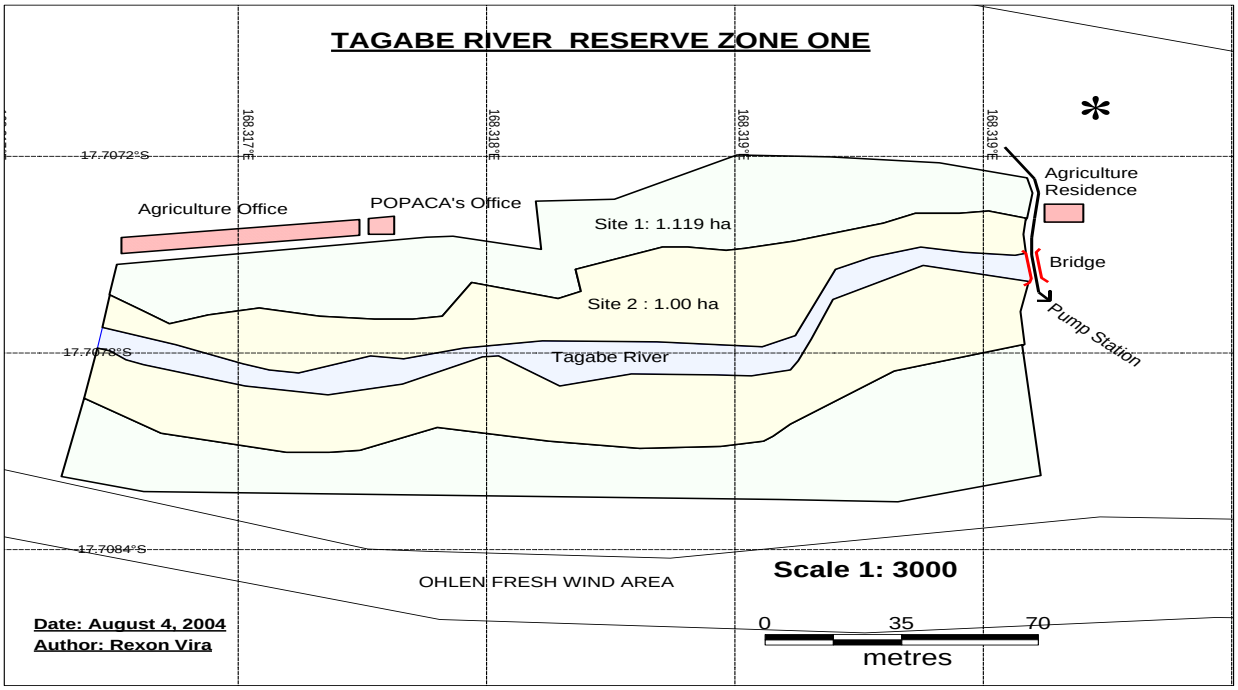


Figure 9 Map of seed bank (Viranamangga 2005)

2.2.4. Community Awareness and Programs

Community awareness of the significance of the Tagabe River and need for the MWPZ commenced in 1999 with a series of radio segments and community workshops. Since 1999, intermittent community campaigns have been launched by the TRMC. These campaigns have been primarily focused in the upper catchment.

Wan smol bag (WSB) is a non-government organisation located in the lower catchment. WSB runs numerous programs targeted at the community: youth development and empowerment, girls and women's rights, education, nutrition, arts and theatre, and environmental conservation. Since 2002, WSB has been collecting solid waste from communities residing from Tagabe Bridge to Black sands. Every Tuesday, approximately 300 to 400 rubbish bags are collected. Prior to the waste collection service provided by WSB, there was minimal waste collection as households (majority residing in informal settlements) cannot meet waste collection fees. Consequently, waste was dumped into the river or nearby vacant lots, polluting the river and leading to illnesses such as skin infections. Since the waste collection service, cases of skin infections have lessened. River clean ups supported by WSB has assisted in removing rubbish, however, rubbish dumping in the river and vacant areas still remains an issue.

In addition to waste collection services, WSB has worked with communities to revegetate river banks from Black sands Palma to Black sand bride; planting Natavoa, White wood and Mahogany trees in the 90s. More recently, in 2015, grass was planted from Tagabe Bridge to Sulphur Bay along the riparian area. To reinforce waste and conservation messages, workshops were conducted along downstream communities to reinforce the importance of the Tagabe River and how to use the river in an environmentally safe manner. Workshops were supported with the 'River Play'.

Informal settlements do not have access to water, and relied on bush toilets. Bush toilets were commonly located close to water wells or the river and contaminated water sources. In 2015, a series of compost toilets has been installed by WSB in Black sands Palma, Willie Roma, Black sands Bridge (Chief Silas), MCI and Lali community. Communities have been encouraged to use compost toilets, however in larger communities such as Black sands Bridge, use of bush toilets are still prevalent.

3. Legislative and Planning Framework

The TRCA intersects with multiple national priorities and government strategies. As such, various legislative and policies are subsequently indirectly relevant to the management of the TRCA. The relevant legislations and policies, and their pertinence to the TRCA is explored in Table 5.

Table 5 Legislation and Policies relevant to the management of the Tagabe River Catchment Area

Legislation/Policy	Implementing Agency	Application to TRCA
National Sustainable Development Plan	Various government agencies	ENV 4.2: Protect vulnerable forest, watershed, catchment and freshwater resources, including community sources
Water Resources Management Act No.9 of 2002	DoWR	Outlines the parameters of use all waters in Vanuatu, inclusive of protection and management tools.
Water Supply Act [CAP 24]	DoWR	Regulation of public water utilities, including costs of connection and supply of water by pipe, and maintenance and protection of the water supply
Water Supply Apparatus Act [CAP 87]	Department of Public Works	Sewage and drainage works inclusive of water mains (any pipe or pipes of whatever material used for the distribution of public water supplies)
Vanuatu National Water Strategy 2008-2018	DoWR	Provides guiding principles for the management of Vanuatu's water resources. There are 7 objectives, of significance to this plan is objective 4: Available water resources and catchment known, managed and protected, and objective 5: all water quality monitored and maintained to meet agreed standards.

Legislation/Policy	Implementing Agency	Application to TRCA
Environment Management and Conservation Act No.12 of 2002	DEPC	Preliminary Environmental Assessment and/or Environment Impact Assessment is required for all projects, proposals or development activities that are likely to impact the environment.
Vanuatu National Drinking Water Standards 2016	DoWR	Provides minimum drinking water standards for institutions and communities, inclusive of recommended collection guidelines.
Pollution Control Act No.10 of 2013	DEPC	Specification of pollutants, ability to issue abatement notices when management of pollutants are in breach of standards, and the ability to create pollution permitting system.
Waste Management Act No. 24 of 2014	DEPC	Designated responsible agents for solid waste management, roles and responsibilities. Shefa Province is the designated offer within the Shefa planning area and Port Vila Municipal within the Port Vila municipal boundary.
National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020	DEPC	Improved management of waste using environmentally sound technologies, inclusive of reduction of waste going to landfill and increase in resource recovery.
Vanuatu National Environment Policy and Implementation Plan 2016-2030	DEPC	4.1, PO 2.3: protect vulnerable forest, watersheds, catchments and freshwater resources, including community water sources. 5.1, PO 3.1: reduce waste and pollution through effective waste management and pollution control.
Forestry Act No.26 of 2001	DoF	Part 6 forest protected areas and Part 7 Reforestation Fund*
Vanuatu Forest Policy 2013-2023	DoF	Policy 11: Undertake compensatory planting- watersheds and soils. The protection rehabilitation of catchment areas to secure water supplies.
Lands lease Act [CAP163]	Department of Lands	Part 7 Leases: conditions of lease and subleases agreements.
Public Health Act 2006	Department of Public Health	Part 7 Provision and protection of water supply: details the supply of water and protection measures when water-sources are intentionally defiled* Part 8 Sanitation and waste disposal: states conditions of sanitation devices*

Legislation/Policy	Implementing Agency	Application to TRCA
Utilities Regulatory Authority Act No. 11 of 2007	Utilities Regulatory Authority	Regulation of utilities, inclusive of safety and reliability standards, and maximum pricing of services.
Vanuatu Strategic Tourism Action Plan 2014-2018	Department of Tourism	Details the direction of Vanuatu's tourism development
Pesticide Control Act No.11 of 1993	DARD	Conditions of use of Pesticides: permits, storage, sale and importation
Vanuatu national livestock policy 2015-2030	Department of Livestock	Thematic area 1: development of small-scale livestock farming, thematic area 2: commercialisation of livestock farming and thematic area 7: sufficient potable water for livestock
Physical planning Act [CAP 193]	Internal Affairs	Declaration of Physical Planning Area and specification development classes
Land reform Act [CAP123]	MLNR	Stipulates rights of custom land owners
Building Act No.36 of 2013	Internal Affairs	Part 2 Building Code: standards for construction of both permanent and temporary buildings.
Vanuatu national fisheries sector policy 2016 to 2031	Department of Fisheries	Strategic objective 2 Fishery investment and economic growth: growth in aquaculture and thusly the potential for aquaculture development in the TRCA.
Vanuatu agriculture sector policy 2015-2030	DARD	Policy 4.1.3: zoning of agricultural land and 5.3.2: exemption of all taxes and duties on agricultural inputs such as pesticides

*Under review (2017)

4. Management Challenges

The TRCA is a working catchment. It services a wide range of users from the residents of Port Vila to manufacturing and industry. Compounded with competing land use, land rights issues and natural disasters such as cyclones and flooding, the TRMC has faced several issues in managing the TRCA. These issues may be broadly classified into three (3) categories: Governance, Environment and People. Challenges are not isolated to individual categories and are often interrelated or overlapping; engendering a complex environment in which the TRMC must operate (Figure 10)

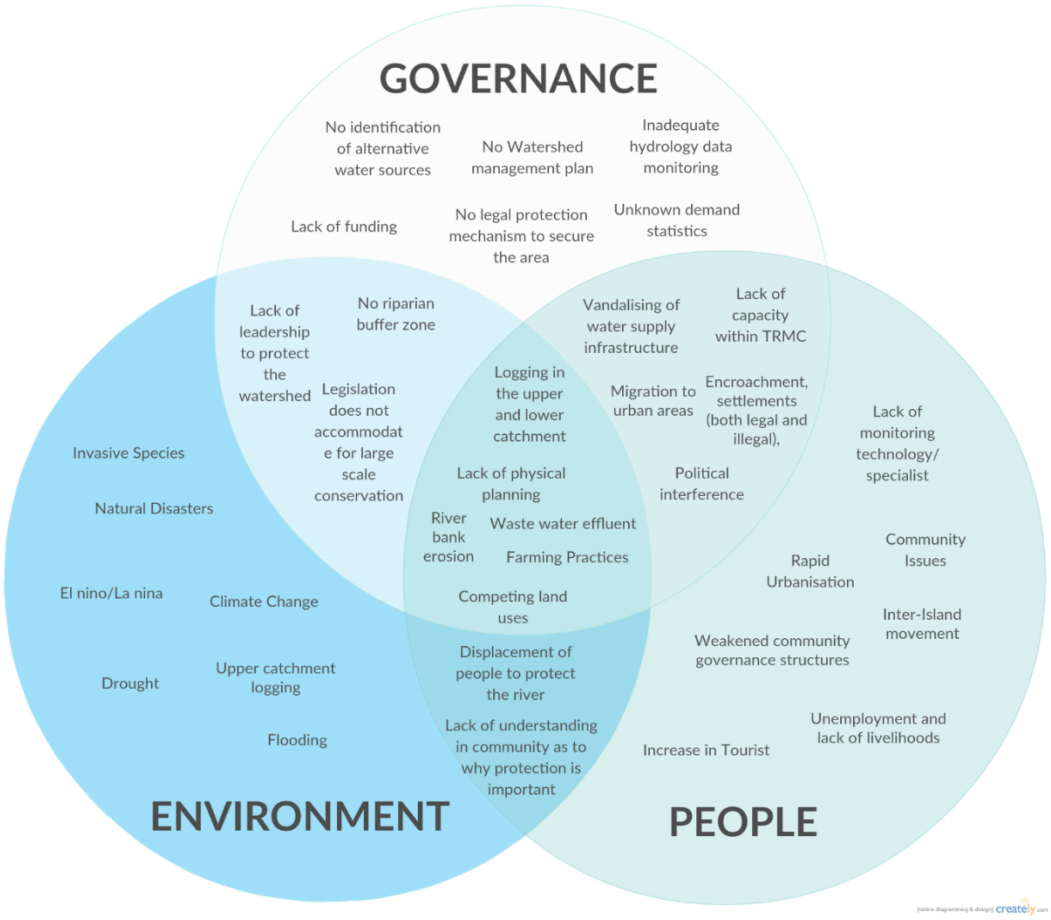


Figure 10 Venn diagram of management issues within the TRCA

4.1 Governance

4.1.1. Legislation and enforcement

Governance is defined as actions or manners in how a state, organisation or entity is managed. In the absence of clear legislative protection for the catchment and historical de-prioritisation of water on the national agenda, water regulatory frameworks have been weak. Governance challenges are further highlighted in the lack of robust environmental flow monitoring, weak legislative framework to prevent works and activities, and subsequently the absence of preventative measures such as fines.

Compounding this de-prioritisation, a lack of coordination, communication and access to information between government agencies and subsequently, absence of allocated government funding to combat these issues has delayed or in some cases, halted works along the TRCA. When funding from MLNR ceased in 2010, land acquisition efforts were halted and thus enabled informal settlements to be established and land to be subdivided in Zone 2.

1.1.2. Vandalism

To protect the pump station and bore holes within MWPZ Zone 1, a fence was installed along the perimeter. The fence also prevents neighbouring residents and communities from short-cutting across the MWPZ to access the Tagabe area. Notice boards have additionally been placed along the MWPZ Zone 1 to alter communities that it is prohibited to enter the zone.

Signage in TRCA Zone 1 (UNELCO, 2017)

Since its installation, fences have had holes cut into them to allow communities to short cut across the MWPZ, or enter the Zone 1 to trees cut down for firewood or building materials, and to access fruits trees in the botanical garden. UNELCO regularly repairs fences, however repairs have been costly and unsustainable. Guards patrol the area; their boundary is limited to MWPZ 1.

Fencing along Zone 1 (UNELCO, 2017)

1.1.3. Lack of capacity of the TRMC

The chair and coordination of the TRMC has shifted between MLNR, Shefa Province and now sits within the DoWR. Due to limited resources and funds, in respects to existing work loads of each TRMC member and the absence of designated coordinators, there has been a lax in implementation of activities and an imbalance of responsibilities within the TRMC. When coordination was successful, activities were hampered by a lack of resources: limited technical capacity and small funds to carry out works, competing use of department resources, and no personnel to implement

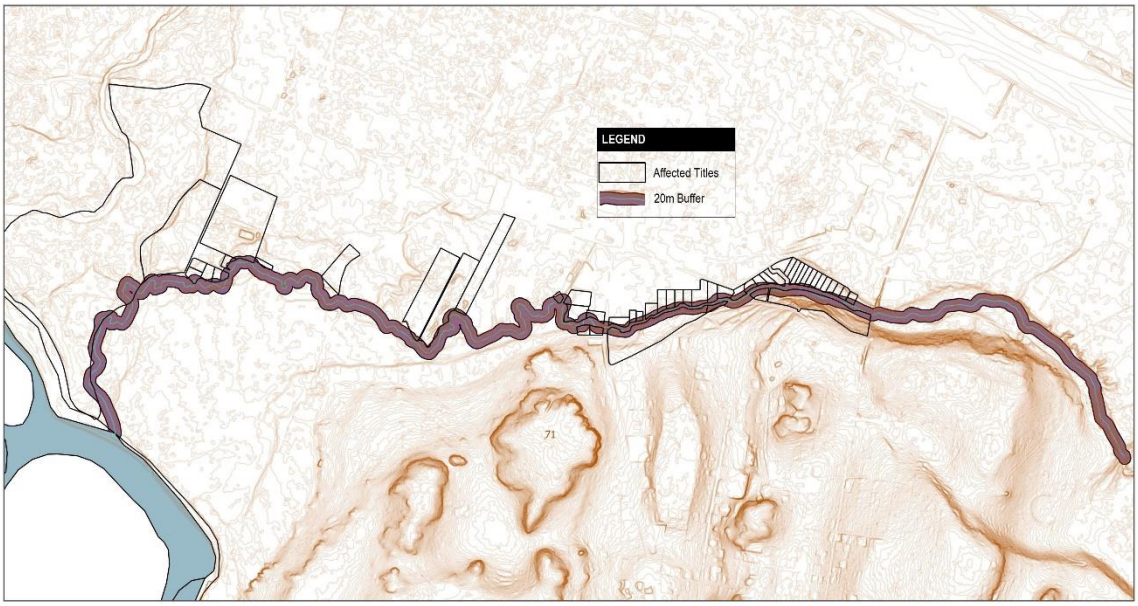
activities. When funds were available, works have been concentrated in the upper catchment and hence, little connection between upstream and downstream portions of the catchment.

Moreover, consistency and suitability of members has been an ongoing issue. Members are selected grounded upon the impact to the TRCA, however some nominated representatives were not appropriate as their roles were not relevant of TRCA activities. Furthermore, retention of members has been low with changes in staff and/or changes in departmental priorities. Strategies to engagement members include sitting allowances, bus fares and provision of food with varied success.

1.1.4. Urban Planning

The TRCA is located within the PVMC boundaries and the Shefa Province Planning area. With no Shefa Planning Regulations and development by-laws, and limited planning within the Port Vila Municipal boundary, development along the Tagabe River has been largely unregulated. The declaration of the MWPZ will assisted in formalising development conditions, however the MWPZ is restricted to the upper catchment.

The lack of coordination and communication between the Department of Lands, Shefa Province and Port Vila Municipal has abetted encroachments of settlements in un-subdivided land. Given the need to compensate households for displacement, authorities must depend on good political will and compliance of custom land owners to remove households from informal settlements. Without enforcement and cooperation of communities and chiefs, some informal settlements have been re-established after relocation of previous occupants and/or refusal of occupants to relocate after accepting compensation. A lack of enforcement is evident when leases along the Tagabe River is analysed. In accordance to Water Resources Management Act No.9 of 2002, a 20-meter buffer zone must be present between river banks and buildings. However, as seen in Figure 11, there are 43 land titles that may be in breech.



Map of Tagabe River with 20m Buffer and Corresponding Leases

Figure 11 Possible land leases infringing on 20m buffer zone along the Tagabe River (Department of Lands, 2017)

4.2 People

Land is typically owned by custom land owners. Land can be leased to individuals for a renewable period of up to 75 years. Governments may also acquire land in the interest of Vanuatu, for example section 31 of the Water Resource Management Act No.9 of 2002: *"the acquisition of interest in land on behalf of the State for the protection, management or use of any water resource"*

With more and more people migrating to urban areas, a lack of affordable housing and limited areas for housing development, coupled with complex land tenure rights intensifies pressures on the TRCA as informal settlements and squatters take root. Households may make informal arrangements with custom owners. As these arrangements are not legalised, there are no formal contracts or terms of agreements. Rather, informal settlers are often promised land in exchange of custom land rent, gifts or political votes. As such, informal settlers do not have land title numbers and hence are not subject of Land Lease Act [CAP163] nor Building Act No.36 of 2013 (O. SiSi, personal communication, 26th June 2017). In the absence of legal recourse to adhere to sanitation regulation or building codes; without connection to electricity and water mains and adequate sceptic systems, informal settlements along the river have become dependent on the river to supplement services such as hygiene, washing, cooking and leisure activities. Inputting pollutants directly into the river increases the risk of poor water quality and consequently detrimental ecological impacts. Furthermore, removal of trees for firewood and the establishing gardens along the river banks has increase erosion and degradation of the river banks.

As population density increase with the inter-island movement and greater number of people shift to urban edges, the prevalence of informal settlements will also likely increase. Informal settlements are in constant states of change; it is estimated that on average, households in informal settlements remain in one area for one to two years. This makes monitoring of household sizes in informal settlements difficult. Awareness activities also prove problematic and resource intensive as constant education and awareness is required.

4.2.1. Community Structure

Information is disseminated to the community by means of three (3) processes: 1) through the Malvatumauri Council of Chiefs, then island council of chiefs followed by area council of chiefs, 2) through the Provincial Area Secretaries, or 3) directly with the chief of the village or tribe.

In some locations, the disintegration of community structures and custom law has led to the misuse of resources and/or loss of respect of chiefs. Some problems that has arisen are:

- It is the responsible of the chief to ensure that people in the area have access to services. However, some chiefs have not been responding to community needs such as unemployed, need land and water to live.
- Chiefs understand the importance of conservation but this empathy is not transferred to young people due to disrespect of the chief's authority
- Politicised chiefs participating in corruption and/or misuse of funds.
- A lack of robust communication system where information can be more effectively and efficiently disseminated

4.3 Environment

4.3.1. Natural disasters and climate change

Vanuatu is the most disaster-prone country in the world. Vanuatu is vulnerable to cyclones, earthquakes, volcanic eruptions, and intermittent drought and flooding. Natural disasters draw additional pressures on services of which are already strained to meet daily needs. Climate change impacts can already be observed as during the drought of the 2015 El Niño. Climate change is projected to decrease in frequency with increase in intensity of natural disasters. Surface and sea temperatures is also projected increase in the future; increasing the frequency and magnitude of above average hot days. With uncertainty in rainfall patterns, it is generally expected that the frequency of extreme rainfalls across Vanuatu will rise coupled with increase of flooding (PCCSP 2013).

4.3.2. Pollution

Pollutants may enter the water stream through two manners: point source and nonpoint source. Point sources are single, identifiable sources of pollution such as sewage drainage or a rubbish dump. Alternatively, pollution may enter the water stream in one location, be diffused across a wide area and thus can affect the environment in a location away from the original source of the pollution: nonpoint sources (EPA Victoria 2012).

Though identification of a single nonpoint source of pollution in the TRCA is a challenge, the impacts of pollution can already be observed downstream. Unregulated waste water discharge from industry and settlements along the river, direct dumping of rubbish, human waste, riverside toilets, and washing into the river has degraded coastal marine habitats in the Black sands area and the lower catchment (McEvoy et al. 2016). Coral reefs need good water quality and minimal sedimentation to live. The impact of pollution from the Tagabe River and the removal of mangroves from the Black sands area has directly impacted the coral reefs, conditions rated as poor with 0 to less than 25% coral coverage (Victoria University Wellington, 2017). Furthermore, a range of freshwater fish, invertebrates, eels, reptiles and frogs reside in freshwater ecosystems (Amos 2007). Without a comprehensive ecological assessment, the impacts of pollution on the Tagabe River ecosystem and subsequent food chain, especially downstream, is unknown.

4.3.3 Invasive Species

Invasive species are introduced to an area, both intentional and unintentional; whose introduction and/or spread results in the loss or damage to biodiversity. Due to the typography of Vanuatu, the distribution and degree of invasive species will vary from island to island. Efate faces challenges from ten common invasive species: Big leaf rope, Mile-a-minute, Pico, Broom weed, Giant sensitive plant, Common sensitive plant, Indian Mynah, Giant African Snail, Red fire ant and Tora (Live and Learn Vanuatu 2015). Invasive species and their impact on the TRCA can be described as in Table 6.

Table 6 Invasive species on the TRCA

Common name	Scientific name	Impact
Mile-a-minute	*Micania micantha*	Widely spread vine, major weed in pastures, plantations, stream banks and disturbed forest. Crawls over trees and gardens, suppressing reproduction of other species (Live and Learn Vanuatu 2015).
Big Leaf Vine	*Merremia peltata*	Crawls up and over forest tree and thickets, forming either a ground cover or canopy; smothering and strangling other vegetation (Live and Learn Vanuatu 2015).

Rain tree	*Samanea saman*	Localised damaged to grass or understorey plants (CABI 2017)
Turkey Berry	*Solanum tovum*	Grows into impenetrable thickets with scattered thorns on stems, spines interfering with passage of birds and animals (Live and Learn Vanuatu 2015).
African Tulip Tree or Fountain tree	*Sparthodea campanulata*	Form dense stands, crowding out native vegetation, especially around waterways, disturbed rainforest and abandoned agriculture (CABI 2017)
Lantana	*Lantana camara*	Heavily branched shrub, can often forming dense thicket, crowding out other species. In disturbed native forest, it can become the dominant understory species (Vanuatu Government 2015)
Sida	*Sida acuta*	A tough, spiny shrub, it infests riparian areas and reduce habitat quality (CABI 2017). It provides food, shelter and reproductive site for insect pest of commercial crops (Vanuatu Government 2015).
Mynah Bird	*Acridotheres tristis*	Out competes native birds by taking over nest, killing chicks and destroying eggs; decline in native bird population. Consumes ripening food crops and can carry and spread diseases (Live and learn Vanuatu 2015)
Rat	*Rattus sp.*	Damages homes, feeds on crops, transmits the Hantavirus Pulmonary Syndrome, and is a carrier of pathogens such as the Murine Typhus (Live and learn Vanuatu 2015)

4.3.4. Livestock

Poor livestock grazing can affect water quality as sediments, nutrients, pathogens and faecal can runoff into the water. Additionally, livestock directly access the water can erode riverbanks and riparian areas. Land titles of the upper catchment is comprised of agriculture and farming activities. As such, intensive farming in the upper catchment poses significant risk to the water supply. In 2002 cattle that was accessing water directly from the Tagabe River within Zone 2 was removed to protect the water quality (M. Stephens personal communications 26th June 2016).

4.3.5. Sand Mining

Excesses sand mining can cause degradation of the river. By intercepting the movement of sediment along the river, sand mining can disturb the sediment balance that has been established over geological time periods. Indiscriminate sand mining can adversely impact the ecological balance of the river by changing river ecosystems such as river banks, river beds, water quality and quantity and subsequently flora and fauna as well as communities that rely on the river (Padmala & Maya 2014). Presently, sand mine is extracted along the Mele coastline for construction and household purposes. Not to diminish the potential environmental impacts of over extraction, especially to the coral reef and vegetation along the river, although the sand mining is currently undertaken in the lower catchment with limited to no impacts on the water supply, there is concern that practices may be expanded to the upper catchment and thusly potential to effect the water supply. Declaration of the MWPZ should assist in sand mining prevention in the upper catchment. Continuous monitoring by the Department of Geology and Mines and ecological assessments by the DEPC is needed to ensure that the ecosystem is not endangered.

4.3.6. Efate Land Management Area

The Efate Land Management Area (ELMA) is a proposed protected conservation area, located in the central region of Efate. Over six (6) rivers are sourced within the ELMA, one of which is the Tagabe

River. The ELMA comprises eight upper water catchment areas for the island of Efate. The ELMA faces many environmental challenges: unauthorised settlements, illegal logging and felling, increased water pollution and loss of native flora and fauna, invasive species, a lack of governance and regulation and intensification of unregulated agriculture and livestock farming. Currently there is no legal protection of the ELMA (Shefa Provincial Government Council 2017). With potential to impact the Port Vila water supply, it is important to additionally review and regulate activities in other adjoining rivers and catchments such as the ELMA, to ensure that the water supply is not affected. Collaboration between the TRMC and the ELMA office is encouraged

4.3.7. Water scarcity

Community concern of the capacity of the TRCA reserves have led to speculation that the current groundwater reservoir is dwindling and thus, a need to identify an alternative water supply. Given the lack of a comprehensive hydrogeological and hydrological report as to the volume of extractable water, as well as absence of a risk assessment study of the current Port Vila water supply, a comprehensive understanding of current demands, projections of water use and subsequent ability of the TRCA to continue to supply potable water to the residents of Port Vila and peri-urban areas is needed. It is only until this assessment has been conducted that the requirement to identify alternative or additional sources can be validated.

4. Management Plan

This management plan is a living document for which it shall be reviewed and amended to reflect changes to demographics, demand and climate. This plan acknowledges the importance and need of connecting upstream and downstream activities to ensure the health of the whole catchment. However, given limited resources, both financial and human, it is judicious to prioritise actions. Three (3) levels has been assigned: high priority indicates actions that need to be completed immediately, medium priority are activities that should be completed in the near future while low priority are activities that should be considered in the future.

This plan reflects a staged approach, with securing the Port Vila water supply the priority, as reflected in section 5.5. Implementation Plan 2017- 2030. Once the securement of the water supply are observed, downstream activities will be reviewed and implemented. Broadly, this plan can be separated into two implementation stages: Stage 1- securing the water supply of Port Vila, and Stage 2- reducing development and urbanisation impacts in the lower catchment of the downstream TRCA (Figure 12).

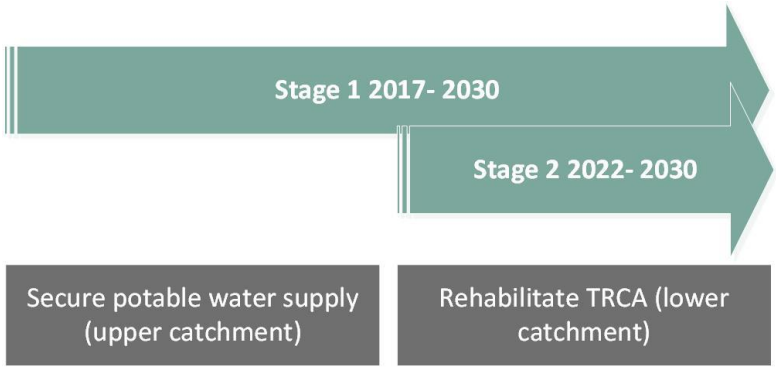


Figure 12 Two stage implementation plan

5.1 Vision and goals

The vision of the Tagabe River Catchment Area Management Plan is a catchment which enables:

Sustainable access to sufficient and safe water for Tagabe River Water Catchment area users

To achieve this vision, the goal of this plan is:

The management the Tagabe River Catchment Area based on enforceable legal frameworks, continuous monitoring and effective advocacy programs.

5.2. Objectives

Objectives delineate clear strategic targets in achievement of the goal. The objectives of this management plan (in no order) are to:

9. Improve and establish effective governance and enforceable legal framework/s to safe guard the TRCA
10. Improve and establish monitoring program for water quality and land use activities within the TRCA
11. Develop and implement advocacy and awareness programs for the protection of the TRCA to all national and local stakeholders
12. Rehabilitate the catchment area to secure the water supply of Port Vila
13. Implement environmentally sound management of solid and liquid waste through effective legislation and enforcement
14. Scientific research to identify capacity of current water supply and where needed, alternative water source/s for Port Vila
15. Mobilize financial resources to align with the needs of the TRCA
16. Improve TRMC capacity to effectively secure the Port Vila water supply and manage the TRCA

5.3. Stakeholder engagement

Community participation and engagement is vital to the successful implementation of activities. Without adequate contribution from communities, activities may encounter implementation difficulties or barriers that arise from issues which are not adequately addressed in the planning stages. To ensure a comprehensive study of stakeholders and the uses of the river is canvassed, it is vital to fully engage stakeholders in the development of long term plans and activities.

The Global Environmental Facility International Waters Secretariat of the Pacific Community Ridge to Reef Program Vanuatu assisted the engagement with stakeholders in the first consultation. Representatives from government, business, communities and NGOs initially met to set out the fundamentals of this management Plan where the vision, goal, objectives and actions was drafted (Attachment 1). Further engagement and in-depth consultation was conducted with relevant stakeholders as detailed in Attachment 1.

5.4. Linkages to national strategies

The management of the TRCA is an inter-governmental issue, thusly many indirect activities will also have an impact on the TRCA. Although these activities may have TRMC members as leading actors and support TRMC's efforts, they do no directly pertain to TRMC activities. It is for this reason that they have been separately identified below.

Activity	Implementing agencies (L-lead)	Outcome	Timeframe
Objective 1: Improve and establish effective governance and enforceable legal framework/s to safe guard the TRCA			
A. Develop drinking quality standards and regulation	DoWR (L), MLNR, State Law	Drinking quality standard regulation gazette	2017
B. Develop regulation to enforce Forestry Act	DoF	Forest regulation gazetted	2017-2018
C. Develop regulation for water works and water use	DoWR (L), State Law	Regulations for water works and water use gazette	2017
Objective 2: Improve and establish monitoring program for water quality and land use activities within the TRCA			
A. Rainfall monitoring	METEO (L), DoWR	Monthly Reports	Ongoing
Objective 3: Rehabilitate the catchment area to secure the water supply of Port Vila			
A. Collection of endemic species	DoF	Inventory of endemic species	Ongoing
Objective 6: Implement environmentally sound management of solid and liquid waste through effective legislation and enforcement			
A. Implementation of the Shefa Solid Waste Management Plan	Shefa Province (L), DEPC, TRMC	Yearly monitoring reports	2017-2020
B. Development of waste water standards	DEPC, Dep. Public Health, DoWR, TRMC	Waste water standards regulation approved by COMs	2019
Objective 7: Mobilize financial resources to align with the needs of the TRCA			
A. Explore payment for ecosystem services opportunities	DoF	Opportunities for payment for ecosystem services program identified and plan created to implement plan created	Ongoing

5.5. Implementation Plan 2017-2030?

Below details activities, implementing agencies, monitoring indicators and timeframes for the implementation of this management plan. Three levels are attributed to priority levels: H- High, M- Medium, and L- Low. 'Ongoing' refer to continuous activities which has commenced prior to the development of this plan and shall be carried forward until the end of this plan. 'Onwards' refer to activities which do not have a predetermined conclusion, rather activities should be implemented until the end of this plan or when deemed no longer necessary.

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
Objective 1: Improved effective governance and enforceable legal frameworks					
Stage 1	1.1. Gazette MWPZ	DoWR (L), MLNR, State Law	Regulations gazette Publication of MWPZ	July 2017	H
Stage 1	1.2. Water protection zones incorporate into Department of Lands , Land Management Planning Committee, PVMC and Shefa Province leases	DoWR, PVMC, Shefa Province, Survey Department, MLNR	Variations of conditions of issued leases, restriction of new leases, publication of MWPZ and inform leases, leasers and custom land owners	Aug 2017-2018	H
Stage 1	1.3. Awareness of MWPZ with Department of Lands, Land Management Planning Committee, PVMC and Shefa Province	TRMC (L), PVMC, Shefa Province, Survey Department, MLNR	MWPZ included in relevant planning policies and processes	2017	H
Stage 1	1.4. Awareness of MWPZ with Department of Fisheries, Livestock and Agriculture, Department of Industries, VIPA and Department of Tourism	TRMC (L) Department of Livestock, DoF, DARD, Department of Fisheries; Department of Industries, Vanuatu Investment Promotional Authority and Department of Tourism	1)No restricted activities within respective zones 2)Reporting on activities approved and rejected from respective departments	Ongoing 2018 onwards	H H
Stage 1	1.5. Strengthen relevant existing legislation and enforcement for water protection	TRMC (L), State Law	1)Request State Law to look into the compatibility of MWPZ and existing Acts	2017	H

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
Stage 1	1.6. Hire 2 rangers from communities effected to enforce compliance within MWPZ	TRMC (L), DoWR, and communities	1)Rangers hired 2)Training of rangers in compliance, monitoring and reporting 3)Quarterly site inspection reports 4)Reduction of vandalism within MWPZ	2018 onwards	H
Stage 2	1.7. Implement regulations for river buffer zones within the TRCA	Department of Lands (L), DoWR, State Law, MLNR	1)Survey conducted of land titles along the Tagabe River 2)No developments along the 20m buffer zone	2018-2022	M
Objective 2. Improve and establish monitoring program for water quality and land use activities within the TRCA					
Stage 1	2.1. Regular ground and surface water quality monitoring	UNELCO and DoWR	1)Minimum of 4 surface and ground water reports presented to the TRMC per year 2) Water quality results included in annual TRMC annual report	Ongoing Ongoing	H H
Stage 1	2.2 Request Department of Lands to audit land use activities in MWPZ	TRMC (L), Department of Lands, Department of Industry and VIPA	1)Quantity of land use activities and types within the MWPZ 2)Quarterly reports within TRMC meetings	2018 onwards	H
Stage 2	2.3. Request Department of Lands to audit land use activities in TRCA	TRMC (L), Department of Lands, Department of Industry and VIPA	1) Quantity of land use activities and types in the TRCA 2) Land use activities within the TRCA reported annually to the TRMC	2020 onwards	L

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
Stage 2	2.4. Extend water monitoring program to include the lower catchment	DoWR and UNELCO	Yearly reports presented to the TRMC	2020	L
Objective 3. Develop and implement advocacy and awareness programs for the protection of the TRCA to all national and local stakeholders					
Stage 1	3.1. Development of communications plan entailing targeted communities, messages and communication tools	TRMC, WSB and communities,	1)Communication plan endorsed by TRMC 2)Implementation of the communication plan	2018 Q1 2018 Q3 onwards	M M
Stage 1	3.2. Develop advocacy and awareness tools such as posters, flyers, radio script, billboards, plays, video documentary etc.	TRMC (L), WSB and communities	1)Development of poster, flyers, 1 billboard and 1 play 2)Distribute awareness materials	2017 Q4 2017 onwards	M M
Stage 1	3.3. Promote TRMC activities in major news outlets and social media	TRMC	At least 2 articles published per year in news outlets	Ongoing	M
Stage 1	3.4. Include awareness of TRMC contact for community issues/complaints	TRMC	1)Number of messages/letters received 2)Number of responses to messages received	2017 Q4 2017 Q4	M M
Stage 1	3.5. Establish TRMC webpage in the MLNR website: including contact details, relevant legislation and regulation, TRCA Management Plan and GIS mapping of the MWPZ	TRMC	Webpage active	2017 Q4	M
Objective 4: Rehabilitate the catchment area to secure the water supply of Port Vila					
Stage 1	4.1. Establishment of new Botanical gardens from Zone 2 for tourism and education	DOF (L), TRMC, communities	1)Number of endemic species collected 2)Number of flora planted 3)Botanical garden in zone 2 established	2018-2022	M
Stage 1	4.2. Replanting of trees in Zone 1	DoF and UNELCO	1)Number of trees planted per year	ongoing	H H

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
			2)Increase in area of tree cover from 2016 baseline		
Stage 1	4.3. Tree planting in between pegs along zone 2 boundary	DoF, communities	Trees planted along the Zone 2 boundary	2017 onwards	M
Stage 1	4.4. Tree planting Zone 2, including community green spaces and state land	DoF, communities	Number of trees planted in Zone 2 community green spaces and state land	2017 -2020	M
Stage 1	4.5. Tree planting in Zone 3	DoF, communities, and land owners	1) Negotiation with land title owners to plant trees on their property 2) Increase in trees planted from 2017 baseline	2017- 2030	L
Stage 2	4.6. Revegetation of riparian areas along the Tagabe river (downstream)	DoF, communities	Total area revegetated from 2017 baseline	2020 - 2030	L
Objective 5: Environmentally sound management of solid and liquid waste through effective legislation and enforcement					
Stage 1	5.1. Monitoring of waste water discharge into the TRCA	DEPC/Public Health (L+), Public Works, Shefa Province and PVMC. + Lead will be dependent outcomes of amendments to the Public Health Act (June 2017)	1)Acquire of monitoring devices 2) Establish regular monitoring program 3) Half yearly reports	2019	M
Stage 1	5.2. Implementation and enforcement of pollution discharge permit	DEPC	1)Number of permits issued 2) Number of stop notices issued to businesses in breach of permit	2019 onwards 2020 onwards	H H
Stage 2	5.3. Increase access of downstream communities to solid waste collection services	Shefa Province, communities	1) Increase in number of households using sold waste collection services 2) Reduction in litter in the river	2020 - 2030	M
Objective 6: Scientific research to identify capacity of current water supply and where needed, alternative water source/s for Port Vila					

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
Stage 1	6.1. Hydrogeological assessment of the TRCA inclusive of evaluation of capacity of the catchment, Population growth assessment projections, Land use assessment and future planning zones.	TRMC (L), DoWR,	Hydrogeological assessment report of the TWRCA	2019-2022	H
Stage 1	6.2. Conduct feasibility studies on potential alternative water sources (nearby catchments, surface rivers, rainwater & desalination)	DoWR (L), TRMC,	Alternative water sources report	2019-2022	H
Stage 1	6.3. Risk analysis of existing TRCA	TRMC, UNELCO	Risk analysis report	2018-2022	M
Stage 2	6.4. Conduct ecological study of the TRCA	DEPC (L), TRMC	Ecology report	2022	M
Objective 7. Mobilize financial resources to align with the needs of the TRCA					
Stage 1	7.1. Identify key implementing partners and funding opportunities	TRMC	1)Identification funding partners and possible funding opportunities identified 2)Secure funding for projects	ongoing	H
Stage 1	7.2. Develop concept notes of possible projects for potential funding opportunities	TRMC, DoWR	List of projects and concepts notes developed	Ongoing	H
Stage 2	7.3. Secure budget for TRMC secretary in DoWR budget	DoWR	Budget allocated to TRMC	2022	M
	7.4. Secure budget for TRMC ranger in DoWR 2018 budget	DoWR	Budget allocated	2017	H
Objective 8: Improve TRMC capacity to effectively secure the Port Vila water supply and manage the TRCA					
Stage 1	8.1. Develop governance structure and TOR of the TRMC, inclusive of roles, terms, reporting and minimum meetings per year	TRMC	Governance structure endorsed by TRMC	2017	H
Stage 1	8.2. Annual Reports written and presented to the TRMC and government, inclusive of activities completed and finances	TRMC	Annual reports published on MLNR website	ongoing	H
Stage 1	8.3.TOR with SPC R2R program finalised	TRMC	TOR endorsed	2017	H

STAGE	ACTIVITY	IMPLEMENTING AGENCIES (L-LEAD)	INDICATORS	TIMEFRAME	PRIORITY (H, M & L)
Stage 1	8.4. Site visit to MWPZ	TRMC	TRMC site visit to MWPZ completed	2017	H
Stage 1	8.5. Site visits to overlapping projects (ELMA, Teouma Ville)	TRMC	TRMC site visit to ELMA completed	2017	M
Stage 2	8.6. Improve knowledge of management of water catchments based on best practice	TRMC	1)TRMC information gathering to catchments (both domestic and internationally) 2)Knowledge sharing with partners and counterparts (domestic and international)	Ongoing	L

6. Monitoring and Evaluation

To ensure the effectiveness of this management plan in securing Port Vila's water supply whilst ensuring environmental flows and development, it is vital that a robust monitoring and evaluation plan is established. Currently, evaluation of activities is conducted on an ad-hoc basis with limited to no reporting.

To ensure that learnings, challenges and milestones are captured, this plan shall be regularly monitored with quarterly progress reviews at TRMC meetings. See Figure 13 for the monitoring framework and Attachment 4. Annual report template for the annual report template. The annual TRMC reports shall report against section 5.5. Implementation plan 2017- 2030, and include but not limited to:

- Activities implemented and milestones;
- Water quality monitoring results;
- Challenges and learnings;
- Financials;
- Changes to governance structure, if any;
- Number of TRMC meetings and attendance list; and
- Any substantial amendments to the Implementation Plan

Given that this document is a live, working document, it is expected that actions will be amended to reflect changes in priorities. Any amendments shall be attached to the appendix of the original management plan.

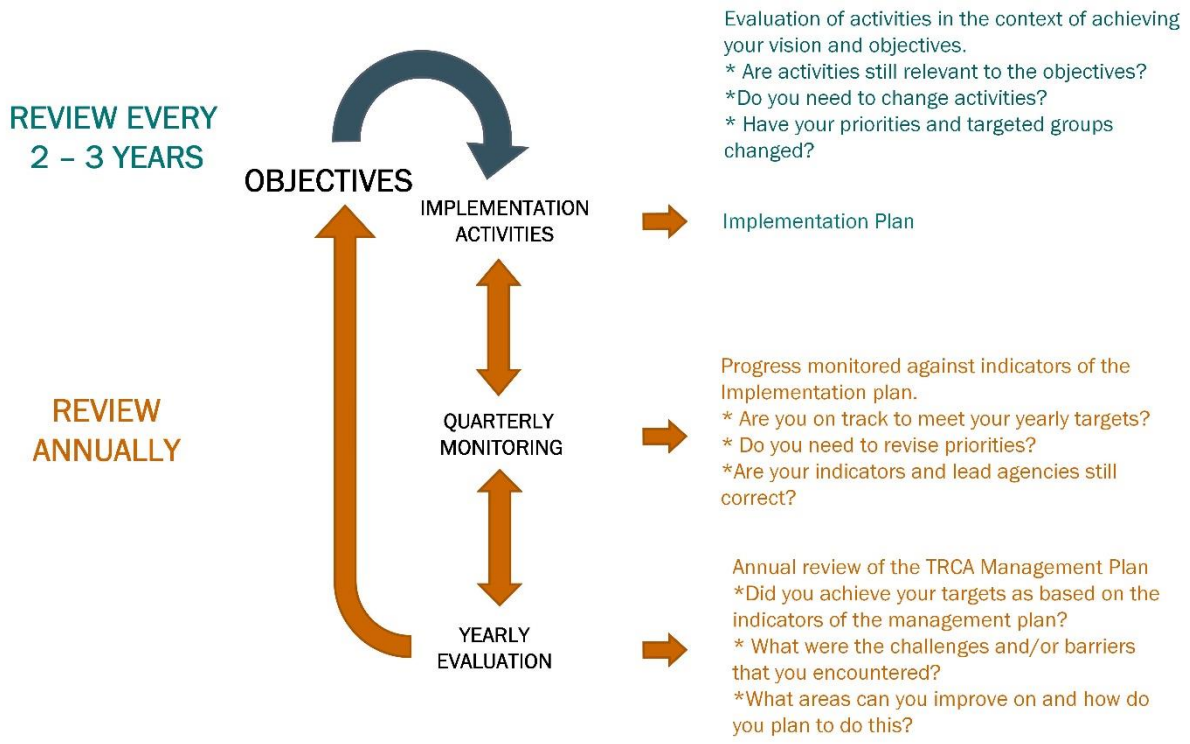


Figure 13 Monitoring and evaluation framework

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Attachment 1. Stakeholder consultation

Global Environmental Facility International Waters Secretariat of the Pacific Community Ridge to Reef Program Vanuatu Workshop on Management Plan - Registration List

Date: 17 May 2017
Time: 8:00 am
Venue: VCC Conference Room

	Name	Organization
1	Presly Dovo	Forestry Department
2	James Samuel	Forestry Department
3	Joseph Lagoiala	Ministry of Lands
4	Gordon Willie	Department of Lands
5	Samson Garae	Freswota 5
6	Morry Rarua	Freswita 5
7	Taman James	Freswota 6
8	Erie Sami	Department of Water
9	Frederic Petit	Vanuatu Services
10	Morris Stephen	Department of Water
11	Maurice Horry	Biosecurity Department
12	Ratu Bani	Health Department
13	Reedly Tari	DEPC
14	Lengsao Joel	UNELCO
15	Benjamin Siro	Tagabe Community
16	Emil Samuel	Live & Learn

17	Gwen Tari	DARD
18	Annie Samuel	DoWR
19	Rossette Kalmet	DoWR
20	Vanessa Organo	Shefa Province-ELMA
21	Erickson Sammy	DOWR
22	Khana Andrew	Tourism Department-Shefa
23	Josephine Rambay	DEPC
24	Toufau Kalsakau	Department of Forestry
25	Carol Rovo	DEPC
26	Amy Yang	DEPC
27	Sero Kautonga	MLNR
28	Yoan Tabisal	Tusker
29	Hon. Ralph Regenvanu	MLNR
30	Alick Berry	DEPC

Individual consultation with stakeholders

Date	Name	Organisation
14th June 2017	Brian Roberts	Wan Smol Bag
20th June 2017	Yoan Tabisal	Tusker
23rd June 2017	Gordon Willie	Department of Lands
23rd June 2017	Nellie Ham	Department of Public Health
26th June 2017	Owen Sisi	Shefa Province
27th June 2017	Christina Saw	Vanuatu Environment Science Society
27th June 2017	David Loubster	SPREP

Community consultation

Date	Name	Community
18th July 2017	Samson Garae	Freshwota 5
	Morry Rarua	Freshwota 5
19th July 2017	Ben Siro	Tagabe Community
20th July 2017	Rotha Bule	Ohlen Freshwind
	Helen Obed	Ohlen Freshwind
	Marie France	Ohlen Freshwind

	Deborah Sam	Ohlen Freshwind
	Marise Mawa	Ohlen Freshwind
	Emmie Mawa	Ohlen Freshwind
	Esther Obed	Ohlen Freshwind
	Annick Mabontapa	Ohlen Freshwind
20th July 2017	Enneth David	Ohlen SDA
	Rose Tobi	Ohlen SDA
	Tina Nagof	Ohlen SDA
	Caroline Nangof	Ohlen SDA
20th July 2017	Betty Kenneth	Ohlen Napanga
	Kathleen Tabisini	Ohlen Napanga
	Alice Dork	Ohlen Napanga
	Rachel Kalsong	Ohlen Napanga
	Rawawa Joe	Ohlen Napanga
	Christian Nicolls	Ohlen Napanga
	Jenny Malon	Ohlen Napanga
	Leilare Toara	Ohlen Napanga
	Lidia Sam	Ohlen Napanga
	Lucy Mick	Ohlen Napanga
	Alice Pakoa	Ohlen Napanga
	Meltret Kalsong	Ohlen Napanga
	Helen Lop	Ohlen Napanga
21st July 2017	Harry Pierre	Representative on behalf of Tagabe Bridge youth

Attachment 2: Matnakara Water Protection Zone

DIVISION III – PURPOSES FOR WHICH THE ZONES ARE CONSTITUTED

1. Tabu Area (Zone 1)

(1) The following land uses and activities should **only** be permitted:

(a) pedestrian and vehicular traffic associated with the supply of water to Port Vila; and
(b) building and development associated with the supply of water to Port Vila.

(2) Any activities not listed above are considered **not** permitted within the boundaries of Zone 1 and this includes but is not limited to the following specific activities:

(a) all uses not permitted in Zone II and III;
(b) application of fertilizers
(c) application of herbicides and pesticides;
(d) quarries, cemeteries, landfill sites;
(e) settlement or treatment ponds;
(f) any works, activities, settlements or facilities other than those which are strictly necessary for the operation, surveillance and maintenance of the water collection and treatment facilities ;
(g) pedestrian and vehicular traffic;
(h) all kinds of agricultural use;
(i) collection of water from the river ;
(j) construction of permanent or temporary facilities other than those which are necessary for water business activities (such as the production and the treatment of water) ;
(k) public roads;
(l) livestock activities; and
(m) storage and dumping of any product

2. Recharge Area (Zone 2)

(1) The following land uses and activities should **only** be permitted:

(a) non intensive agriculture or horticulture; and

(b) unsealed roads.

(2) Any activities not listed above are considered **not** permitted within the boundaries of Zone II and this includes but not limited to the following specific activities:

(a) all uses which are not permitted in Zone III.

(b) The following uses:

1) excessive use of fertilizers ;

2) use of herbicides and pesticides ;

(c) Surface and underground works such as :
1) soil excavation works;

2) construction of facilities used for infiltration of waste water or storm water ;

3) digging of ponds or water holes, prospection and drilling activities, quarries, mining and cemeteries ;

4) cutting down of any trees or bush clearing with machinery or fire ;

5) earthworks which alter the plant cover and leave the bare soils ;

6) tailings ponds, treatment ponds ; and

7) parking areas, sporting fields and campsites.

(d) Storage and discharge of:

1) household wastes, garbage, industrial wastes, radioactive products and any solid, liquid and gaseous products ; and

2) chemical products, hydrocarbons and flammable liquids and products used for industry.

(e) Installing pipes for :

1) domestic and industrial waste water ; and

2) hydrocarbons and liquid or gaseous chemical products

(f) Sewage of :

1) human waste ;

2) industrial waste water and wash water;

3) agricultural or farming effluents, in particular slurry;

(g) Construction of :

1) facilities or fences which may imped the water flow or which may alter the stream's longitudinal or sectional area ;

2) residential houses even for temporary purposes;

3) camping and bivouac sites ;

4) treatment plants or any effluents treatment facilities of any nature;

5) animal treatment facilities (such as animal pools, spraying lanes);

6) car washing areas and garages ;

7) any commercial or industrial activities including storage of equipments and materials;

8) farming facilities (such as stock yards, silos, manure storage areas); and

9) grazing for more than 1.5 livestock head per hectare.

3. Water Catchment Area (Zone 3)

(1) The following land uses and activities should **only** be permitted:

(a) non intensive agriculture or horticulture;

(b) sealed roads;

(c) low density settlement subject to the standardized construction and maintenance of the septic tanks ;

(2) Any activities not listed above are considered **not** permitted within the boundaries of Zone III and this includes but not limited to the following specific activities:

(a) excessive application of fertilizers;

(b) application of herbicides and pesticides;

(c) quarries, cemeteries, landfill sites;

(d) settlement or treatment ponds;

(e) percolation of waste water;

(f) Activities using substances hazardous for water (oil refineries, steel works, chemical plants, etc.);

(g) all industrial and commercial activities (such as storage facilities), mining, livestock or other activities which may alter the regime and the quality of the ground or surface waters and which do not have the prior authorization of the competent authorities;

(h) intensive livestock farming (>5 head cattle per hectare);

(i) sewerage treatment plants;

(j) residential areas, estates , in cases where waste water is not completely and safely sewered out of the water protection zone;

(k) locations for the sale and refilling of oil, diesel, and other substances contaminating water;

(l) military sites;

(m) dump sites and car wrecking sites;

(n) newly established cemetery;

(o) the use of substances hazardous to water used in road hydraulic engineering (such as tar, some bitumen and cinder);

(p) increase in settlement density;

(q) Abandonment of dead animals, waste from butchers' shops, manures, feces and generally animal residues.

Attachment 3: Annual water quality monitoring parameters

Parameters analysed and results of a yearly analysis (UNELCO laboratory analysis 2015)

Parameter	**Element**	**2015 results**	**Unit of measurement**
Organoleptic	Turbidity	<0.80	NFU
Physio-chemical	Aluminium	<0.004	mg/l
	Calcium	95.0	mg/l
	Chlorides	10.8	mg/l
	Conductivity	497.0	µS/cm
	Potassium	2.4	mg/l
	Magnesium	4.2	mg/l
	Sodium	10.2	mg/l
	pH	7.29	
	Silica	5.6	mg/l
	Sulfate	4.7	mg/l
	Complete alkalimetric title	25.7	^{0}f
	Temperature measured at conductivity	19.6	^{0}C
	Temperature measured at pH	19.6	^{0}C
Unwanted metals	Boron	0.2	µg/l
	Barium	18	µg/l
	Bromate	<5	µg/l
	Total organic carbon	0.5	mg/l
	Fluorides	0.2	mg/l
	Iron	<3	µg/l
	Magnesium	<0.5	µg/l
	Ammonium	<0.01	mg/l
	Nitrites	<0.2	mg/l
	Nitrates	3.5	mg/l
	Phosphorous	<0.1	mg/l
Toxic metals	Arsenic	0.7	µg/l
	Cadmium	<0.1	µg/l
	Cyanides	<0.005	mg/l
	Mercury	<0.2	µg/l
	Lead	<0.2	µg/l
	Antimony	<0.1	µg/l
	Selenium	<1	µg/l
Pesticides	Aminomethylphosphonic acid	<0.020	µg/l
	Glufosinate	<0.02	µg/l
	Glyphosate	<0.02	µg/l

Attachment 4. Annual report template

Suggested below is the annual report template.

Summary: Overview of Activities and Milestones

Short paragraph about the major events and achievements for the year.

Governance

TRMC structure, note any changes from the previous year

TRMC meetings held with members attended as below.

Date	Venue	TRMC members who attended	Main agenda of meeting

Implementation Plan

Monitoring and evaluation of the implementation plan. Here lead agencies should complete their sections.

- Activity (as per implementation plan)
- Lead Agent (lead agent to take lead responsibility for reporting activities)
- Indicators (as per implementation plan)
- Outcomes (what you did. Does this align with the indicators? What was the impact?)
- Progress (Completed, not completed, hasn't started)
- Comments (reasons why not completed or hasn't started including challenges or barriers faced, how it was dealt with or how you will deal with them in the future)

Activity	Lead Agent	Indicators	Outcomes	Progress	Comments

Challenges and Barriers

- What were the major challenges TRMC faced this year?
- How was it dealt?
- Do they need to be further addressed into the future and how do you plan to do this?

Water Quality Monitoring Results

Summary of the annual water monitoring results, including parameters tested, did they meet standards (specify which standards you are comparing them to) and overall diagnosis of the water quality.

Complaints

- Did you receive any complaints?
- Detail here the complaint and how it was dealt with

Finances

How much money was spent and on what works- minimal financial reporting of funds spent from Article 29 of the concession agreement.