

SOPAC

**SOUTH PACIFIC APPLIED GEOSCIENCE COMMISSION
AND**

WORLD HEALTH ORGANIZATION

REPORT

PACIFIC WATER SAFETY PLANS PROGRAMME

FOLLOW UP MISSION I

WATER SAFETY PLANS

VANUATU

30 APRIL – 4 MAY 2007

An AusAID Funded Project

CONTENTS

1. INTRODUCTION
2. PURPOSE AND OBJECTIVES OF THE MISSION
3. LIST OF PEOPLE MET
4. EXECUTIVE SUMMARY
5. DAILY ACTIVITIES
6. KEY FINDINGS AND RECOMMENDATIONS

ANNEX 1. MISSION PROGRAMME

ANNEX 2. WATER SAFETY PLANS AND IMPROVEMENT
SCHEDULE -LUGANVILLE



SOUTH PACIFIC APPLIED GEOSCIENCE COMMISSION

To : Manager Community Lifelines, Director SOPAC, and Deputy Director
SOPAC, Water Sector.
From : Davendra Nath, Water Safety Plans Officer.
Date : 14/05/07
Subject: Vanuatu Water Safety Plans Follow Up Mission 1

Vanuatu Water Safety Plans – Follow UP Mission 1

Mission Dates: 30 April – 4 May 2007

Introduction:

The mission to Vanuatu was jointly fielded by the Director, Pacific Islands Applied Geoscience Commission (SOPAC) and the WHO representative, South Pacific following the request from the Geology Mines and Water Works through SOPAC focal point for Vanuatu. The follow up mission I was arranged to assess the rural and urban pilot supplies and to compile an improvement schedules with finalization of water safety plans for Luganville and Mele . Secondly to identify partners for a pilot project to implement water safety plans by reference to the risk management strategies. The mission team comprised of Project Officer Davendra Nath from SOPAC and two technical experts from New Zealand Ministry of Health namely Denise Tulley and Chris Edmonds.

The main drinking water source in Vanuatu is surface water and to some extent rainwater and borehole systems. In Luganville the urban supply is of surface spring water collected in a well catchment and distributed to consumers without much treatment. The water after the addition of chlorine is pumped to the two storage steel tanks and then it is supplied to the households through gravity flow. There is greater demand of water in Luganville due to development and immigration. Estimated demand of water is 80 l/p/day and the wells water production capacity is about 5000 kl/day (SMEC report 1999) . There are also commercial water uses in urban area such as abattoir and food processing factories. There is no or little decrease in water production but in future improvement in this area can be made by the provision of additional boreholes. The team was provided with a draft Water Safety Plan for reference prior to its departure to Vanuatu. The assessment was done for the Luganville supply in relation to the plan. The catchment site and storage and distribution system was assessed. There are four large storage tanks, two steel tanks at Sarakata and Chubpeu and one concrete tank at the hospital and one galvanised tank at the new agriculture school. Due to low pressure especially at higher grounds storage tanks and booster pumps may be required for potential developments. There was some loss of water noted from the distribution system when consumer pipe were not repaired especially in the government houses. Many households in urban areas also use rainwater by use of tanks. The responsibility of the water supply distribution and operation is of Public Works Department and the monitoring and water quality analysis is of Ministry of Health. Some drilling activities were done by Geology and Mines at Solway for additional bore wells but unfortunately the project is abandoned due to lack of funds. Discussions reveal that the Public works department is much interested to upgrade the Sarakata pump station as per the Water Safety

Plans improvement strategies. Monitoring of the drinking water quality was a constraint as sending the water samples to Port Vila was expensive and time consuming. A sub –committee was formed in Luganville known as Luganville Water Advisory Committee which comprises of the members from government, provincial and municipal councils. The committee is very much supportive and commits to implement the Water safety Plans programme in Luganville.

The rural Mele supply in Port Vila is also surface water prone to contamination from human and animal activities. Residents interviewed from this area revealed that they do not drink the piped water but use rainwater collected in household tanks and domestic water containers. There are a lot of improvements needed for the Mele supply in order to make the water more palatable and free from contamination. There is a lot of potential for Mele as it is close to main Port Vila urban centre and secondly the developments are increasing in the vicinity. Data and discussion from the Ministry of Health team reveal that there is increase in skin and diarrhoeal disease in Mele and other rural areas in Vanuatu. The steering committee members from Port Vila comprising of Ministry of Health, Geology Mines and Live and Learn were consulted and commitment obtained for the completion of Mele Water Safety Plan.

Purpose and Objectives

- i) To review and finalise the Water Safety Plans for Luganville urban supply and Mele rural supply.
- ii) To carry out field assessment with the water supplier and the New Zealand experts for the Luganville Water Supply system
- iii) To formulate improvement schedules for the Luganville and Mele water supplies
- iv) To provide the cost analysis of the improvement activities
- v) To met the steering committee at Port Vila and other stakeholders
- vi) To meet Live and Learn and discuss about the contract for the Public Awareness campaign
- vii) To meet with sub-committee at Luganville and discuss about the Luganville Water Safety Plans.

List of People Met:

NAME	POSITION	ORGANISATION	CONTACT
Erickson Sammy	Manager-Rural Water Supply	Geology <mines and Water Resources	amapelao@yahoo.com
Rossette Kalmet	Hydro-geologist	Geology ,Mines and Water Resources	Ross.kalmet@gmail.com
Amy Lynch	Planner/Advisor-Tagabe River Committee	Shefa Province, Port Vila	Amyjo.lynch@gmail.com
Nellie Ham Muru	Environmental Health Officer	Ministry of Health	nham@vanuatu.gov.vu
Peter Lulu	Water Supply Officer	Santo Rural Water Supply	sanma@vanuatu.com.vu
Bultare Prosper	Physical Planner	Sanma Province	Sanma @vanuatu.com.vu
Morris Amos	Environmental Health Office	Ministry Of Health	mamos@vanuatu.gov.vu
James Hakwa	Civil Engineer	Public Works Department, Santos	Ph: 36316 Fax: 36540
Harry Tete	Town Planning Officer	Luganville Minicipality	Ph: 36296 Mob: 55135 Fax: 36648
Robbie Henderson	Director	Live& Learn, Vanuatu	livelearn@optusnet.com.au
Cristain Nelson	Director	Live&Learn	livelearn@optusnet.com.au
Camoren McGowan	Project Officer	Live & Learn	livelearn@optusnet.com.au
Dianne Hinge	Project Officer	Live & Learn	livelearn@optusnet.com.au
Charlie Tari	Manager, Water Supply	Public Works Dept, Santos	Ph:36316 Fax: 36540

Executive Summary:

The one week Follow up mission 1 was from 30 April to 4 May 2007 as per the annexed programme (Annex 1) . The mission was headed by Davendra Nath, Project Officer from SOPAC and two New Zealand Ministry of Health experts. The technical experts were Denise Tulley , Country Facilitator and Chris Edmonds ,Drinking Water Assessor.

The official request was made by the Director , SOPAC via a letter to the Vanuatu SOPAC focal point Mr Russell Nari, Director General , Ministry of lands and Natural resources . Verbal discussion also occurred with Mr Nari, Mr Chris Ioan, Director- Geology Mines and Water Works and Charlie Tari from Public Works Department, Santos in regards to the mission trip. Their assurance and support was obtained prior to the departure for the mission.

The purpose of the mission was to fulfil the objectives mentioned earlier and to meet the steering committee. A number of government and non-government officials were consulted and necessary field trips were made to carry out the assessment of the water supply system. Existing data and reports were referred to gain further knowledge on the system and future development plans.

The mission was successful as all the officials were met and the objectives were achieved. The water safety plan for Luganville was completed with an improvement schedule. The commitment was obtained from the steering committee at Port Vila and sub-committee at Luganville who agreed to complete and implement the plans for Luganville and Mele. Mr Morris Amos from Ministry of Health was very appreciative and agreed to work on the Water Safety Plans for Mele rural supply with assistance from Geology and Mines Department. The staff of the NGO Live and Learn were met and discussion held on the contract task for the Public awareness program for the target population at Luganville and Mele.

Daily Activities:

The programme for the week long mission is attached as annex 1.

Monday -30 April ,2007

On Monday the mission team met the staff of Geology and Mines and the steering committee at the Geology Mines conference room. The committee was briefed on the objectives of the mission and the benefits of having a water Safety Plan and the improvement schedules. The committee informed that due to several commitments and meetings the plans for rural Mele Supply was not completed but the committee realises the importance of having one. The committee was provided with the hard copies of the system description reports and the planning and training workshop report. The New Zealand experts also briefed the steering committee and a good discussion was held. The members requested for the further funding for the programme as improvement strategies under the programme is necessary. The meeting ended at 10.00 am and Mr Erickson Sammy thanked the team and made necessary arrangement for the meetings with other stakeholders as per the mission plan. He also contacted Mr Charlie Tari of Public Works Department at Luganville for the teams visit for the week.

At 11.00 am a meeting was conducted with Live and Learn Vanuatu at their office. The team met the project officer Cameron and Dianne and discussed on the WSP Public Awareness campaign and the preparation of I .E.C. materials for the target population. The project officers were also informed of their tasks and deliverables as per the contract.

At 1200 hrs the Director and the country coordinator of Live and Learn also joined the discussion and few other issues were finalised.

At 2.00 pm a meeting was held with the Ministry of Health staff at their office. Present were Nellie Ham and Morris Amos from Environmental Health section and Erickson Sammy from Geology and Mines. The discussion mostly focussed on the Mele water safety plan and the necessity of its completion. The staff were provide hard copies of the system description report and electronic copies of other reports. The Health staff confirmed their commitment in completion of the plan for Mele Rural Supply. The meeting ended at 3.00 pm.

We also went to pay a courtesy visit to Mr Russell Nari but unfortunately he was not available as he was attending other meeting. In the afternoon arrangements were also made for our flights to Luganville on Tuesday.

Tuesday- 1 May , 2007

The team took an early morning flight to Luganville and were met at the Santos airport by Mr Charlie Tari , manager and James Hakwa engineer of Luganville Water Supply . Tuesday was a public holiday but the two staff elected to work with the team to carry out the assessment of the Luganville water supply system. A meeting was not possible with other members of the steering committee as they were not available due to the public holiday. Consequently the meeting was re-scheduled on Wednesday morning. After checking in the hotels at 0800 hrs we went out for the field trip at 0900 hrs. The Sarakata pumping station was visited and all risk at the catchment was noted. The storage tanks at Sarakata and Chaubpe and the new borehole site at Solway were visited as well. The residential areas and proposed future developments in the Luganville municipality was visited with a trip to the commercial water user the abattoir.

The distribution system was inspected with the storage tanks at the Hospital and the new Agricultural College. It was noted that there is potential for the extension of the system to the new developing areas, therefore new storage tanks will be required. The team managed to visit the necessary site and the surrounding areas for the assessment of the system.

In the afternoon the team looked at the existing data and reports of Luganville water supply. All the meeting were conducted at the Public Works Department office.

Wednesday 2 May,2007

A meeting of the water safety plans sub-committee was held from 0900hrs at Public Works Department office. The sub-committee formed is identified as the Luganville Water Advisory Committee. The members present were as follows:

- Charlie Tari - Manager/Operator, Public Works Department
- James Hakwa - Civil Engineer, Public Works Department
- Peter Lulu -Rural Water Supply Officer, Geology Mines
- Harry Tete -Town Planning Officer, Luganville Municipality
- Buletare Proper -Physical Planner, Sanma Province.
- Andrew Alla - Environmental Health Officer, Luganville Municipality

Mr Charlie Tari Chaired the meeting and welcomed the WSP team from Fiji and New Zealand and introduced them to the members. He also requested the members to support the team and provide the required information and assistance in order to finalise the WSP for Luganville. Mr Davendra Nath from SOPAC briefed the members the objectives of the mission and the benefits of having a Water Safety Plan. Ms Denise Tulley also briefed the members about their roles as technical experts to assist in finalising the Luganville Water Safety Plans. The meeting was informed about the Public Awareness campaign on Water Safety Plans conducted by Live and Learn Vanuatu. The committee was requested to liaise and advise the live and learn on the activities and support them for the contracted task. All members present showed great support and resolved to proceed with the programme to the implementation stages. Some members were not present due to the mayoral election for the municipality. The meeting concluded at 1100hrs.

The team had further discussion with Charlie Tari and James Hakwa on the Luganville system so that the available plans can be updated. The discussion continued in the afternoon and thus the plan was reviewed.

Thursday May 3rd 2007

Once again the team resumed the assessment and review from 0900hrs with the help of Charlie Tari , James Hakwa and Peter Lulu. Discussion revealed that it is necessary to improve the catchment and intake by providing fence, drainage and improvement to the pump station. Later most of the suggestion were incorporated in the improvement schedules.

In the afternoon some of the other members of the committee joined in the discussion and contributed to the finalisation of the Water Safety Plans. Many information were exchanged in hard copies and electronic copies . An invitation was extended for the wrap up meeting to be held on Friday by Charlie Tari.

Friday May 4th, 2007

A wrap up meeting was held at 0930hrs and most of the members of the sub-committee were present. Once again Mr Charlie chaired the meeting and welcomed the members present. The members resolved that they should proceed with the implementation strategies and requested if funds are made available. There are some funds in their recurrent departmental budget but this is not sufficient to carry out the major improvement to the system. It was also resolved that monitoring should be done in Luganville and therefore there is need for trained personnel and infrastructure.

The Water safety Plan and the Improvement Schedule was finalised and electronic copies were distributed to Public works Department and other committee members present. The New Zealand experts explained about the improvement schedules and requested for the cost analysis for the proposed works.

The meeting concluded at 1230 hrs.

Key Findings and Recommendations

Key Findings	Recommendation	Action
The steering committee at port Vila agreed to work together to prepare the Mele WSP	Ministry of Health and Geology and Mines Rural water supply section to work together	Erickson Sammy, Rosette, and Morris Amos
The NGO live and Learn needs guidance from the committee	The committee at Luganville and Port Vila and the MOH should liaise on issue of Public Awareness	MOH, Live and Learn and Geology Mines to liaise
The sub-committee formed at Luganville did not meet regularly.	The sub-committee need to meet more regularly and liise with stakeholders at Port Vila.	Erickson Sammy/Charlie Tari, Morris Amos/Andrew Ala
Lack of Health and monitoring Data	Collect all health data/and conduct regular monitoring of drinking water	Charlie Tari, James Hakwa, MOH
Chlorination system to be improved	Install an automated system and provide the chlorine injecting chamber and storage facilities.	Public Works Department
Staff of both Moh and Public Works are not well trained	Training is needed for MOH and PWD staff engaged in Water supply	Public Works Dept and Ministry of Health
There is no set monitoring and analysis procedures in Place	Monitoring plan is needed.	PWD/MOH
Water Samples are sent to Port Vila for Analysis	Provide equipments and set up an analysis lab	PWD/MOH
No public awareness on drinking water safety and liable contamination.	Public awareness methods to be improved	NGOs/MoH/PWD
Financial constraint for the supplier	Increase govt /municipal budgets. Request donor funding.	MoH/ PWD/ Municipal and provincial council
The catchment needs improvement to eliminate contamination at source.	Erect fence, provide drainage, improve structure	PWD/MoH/Provincial council
The pressure is low in the distribution system during peak hours	Additional storage tanks are needed with booster pumps .	PWD
Most of the water meter is leaking and unprotected from damage.	Meter cover is required for the installed meter	PWD
Building development is seen with in the catchment zone	Relocate people and necessary legislation formulated	Lands Dept Geology Mines Municipal Council

ANNEX

:1

Work plan for Vanuatu Follow Up Mission I 30 April – 4 March ,2007

Venue: Dept of Geology and Mines, Port Vila/Public Works Department, Luganville.

Day/dates	Session	WSP Activities	Facilitators/Team
Monday 30/04/07	8.30 am	Meeting with WSP Steering Committee- Dept of Geology and Mines	Dept of Geology and Mines
	10.00 am	Meeting with (MOH. Live and Learn,) Port Vila	
	12.00 pm	Courtesy visit to SOPAC National Rep, Mr Russel Nari	
	2.00 pm	Discussion about WSP /Mele with Lead Agency Dept of Geology and Mines/Ministry of Health	
Tuesday 01/05/07	9.00 am	Meeting with Charlie Tari from Public Works Department and other Stakeholders in Luganville.	Charlie Tari/ PWD Santos
	2.00 pm	System Assessment ,urban/rural ,check distribution system	
Wednesday 02/05/07	9.00 am	Steering Committee meeting Review and Complete WSPs Complete risk assessment & prioritisation Check SOP	PWD, Santos. WSP Team/SOPAC/MoH-NZ
	2.00 pm	Complete Improvement Schedules	
Thursday 03/05/07	9.00 am	Finalize WSP for Luganville (Further input into WSP draft, if required) Finalise Improvement Schedules Preparation for wrap-up meeting	Public Works Department /Provincial Council in Luganville
	2.00 pm		
Friday 04/05/07	10.00 am	Wrap up meeting with steering committee and others consulted	WSP Team/ steering committee
	2.00 pm	Any follow ups Finalize mission report and distribution to counterparts.	

Team: Davendra Nath, Project Officer, SOPAC
Denise Tulley , Country Facilitator, Ministry of Health , New Zealand
Chris Edmonds , Technical Expert, Drinking Water Assessor, Ministry of Health.

WATER SAFETY PLANS



LUGANVILLE URBAN WATER SUPPLY SANTOS, VANUATU

Compiled By: Luganville Water Advisory Committee

An AusAID Funded Project: 2007

**WATER SAFETY PLANS AND IMPROVEMENT SCHEDULE –
LUGANVILLE**

WATER SAHETY PLAN

Supply Name: Luganville Urban Water Supply

Step 1: Flow Chart

Step 1: Flow Chart

Catchment & Intake:

Shallow spring well at the back of valley
Cattle farm right above source at 150 meters
Residential areas in front and side of the source
Fence well-head



Treatment:

Water pumped from well and chlorinated with Sodium Hypochlorite. Two chlorinator dosing points not in shed..

Chlorine dose control (feedback loop from manual FAC tests (see below))



Storage and Distribution:

Pumped to two main reservoirs on a nearby hill
No back up reservoir tank.

A good flow supply, gravity fed to 2900 houses (metered) in total. This is a small city authority supply, where the Public Works Department manage and look after the supply.

Frequent FAC measurements (at both ends of 2 distribution zones)

Catchment and Intake

List what could happen that may cause drinking water to become unsafe (Deterioration in water quality)	Is this under control?	If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness,
1. Contamination of the source by a PWD staff residence that includes activities such as a septic tank, poultry, piggery and storage of old machinery.	No – A PWD staff quarters is too close to the source and is keeping animals and old machineries within the vicinity of the water source.	Yes – Animals and machinery at such close proximity to the source pose a real water quality risk.
2. Contamination of source (it is a shallow aquifer) from surface activities in the recharge zone that lead to soil erosion and sedimentation in the source. Ex: -felling of trees -gardening -burning of trees -fire	No - Nearby communities not having knowledge of their impact on the water source will lead to continuous contamination of the water source. Continuous deforestation can lead to soil erosion causing sedimentation in the source and a murky water colour	Yes – Happens throughout the watershed, and on a large and continuous scale.
3. Contamination of source by surface activities from illegal settlements and/or residential areas.	No Persons within zones 1&2	Yes
4. Increase in Subdivisions. Custom Land Owners and Leaseholders and are in the process of subdividing land in the areas immediately upslope from the source.	No - Residential subdivisions close to source waters will contribute to an increase in coliform count by further increasing deforestation and the number and density of toilets in the area.	Yes – The number of subdivisions is rapidly increasing in the areas, and in places that will negatively affect water quality.
5. Contamination of source from dust and particles caused by heavy use of the public road close to the	No - Hydrocarbons entering the source cannot be treated and, when entering the source, can be visible on the	Yes – As hydrocarbons cannot be treated, it poses a real water quality risk.

source.	surface. Without intervention, people will continue to create new access roads close to the source.	
6. Contamination of source by grazing animals (ex. livestock farming) within the catchment area.	No - Excessive cattle farming will contribute to a high coliform count in the water source.	Yes – Poses a real water quality risk.
7. Cyclones and other severe weather, affecting the treatment plant through excessive run-off and flooding.	No – Proposed channelling will be undertaken to prevent flooding at Water Treatment Plant	Yes, at present could flood during heavy rainfall event
8. Power cuts	Yes, new generators have been installed to provide power	
9. Possibility of water shortages during long drought period	Yes – No history of droughts, However, needs to be taken into account for future water resource planning	
10. Contamination of ground water due to low water level.	No - No data for well level (source) and no continuous monitoring, meaning no clear indication of the water level.	Yes, some method of monitoring needed for well level.
11. Contamination of well from roof catchment over well head	No – Contamination to source water is possible through run-off during heavy rain events such as cyclones.	Yes –Serious health risk and with Vanuatu's climate a frequent problem.

Treatment

List what could happen that may cause drinking water to become unsafe (Deterioration in water quality)	Is this under control?	If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness,
1. Over/under dosing of chlorine	–No, At present FAC measurements to confirm a chlorine residual (target 0.5 mg/l) is undertaken in distribution However no routine monitoring at plant after 30 minutes contact time.	Yes, FAC levels at plant need to be measured after 30 minutes contact time. Need to investigate best method for chlorine dose control long term
2. Chlorine dosing failure	Yes. Backup generators in	

due to power outage.	place.	
3. Chlorine supply may run out, resulting in untreated water being distributed to the communities.	Yes. A stock replenishment system is in place to ensure that approx. 1 months' stock of chlorine is in stock. Powder is used when liquid solution cannot be sourced. (e.g 1 drum lasts 5 days)	
4. Residual Chlorine levels in distribution, too high or too low.	No. Daily residual chlorine is undertaken in both zones, however need to record results.	Yes
5. The pH is too high for effective disinfection with Chlorine.	No. pH level monitoring at the intake or storage is inadequate.	Yes, monitoring at plant needs to be undertaken to ensure effective chlorination.
6. There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	No. Investigation of source water will help identify if this is a risk	Yes
7. Chlorine injection points outside of treatment shed	No, could be vandalised/damaged	Yes, needs urgent attention.
8. Leakage of chemicals/fuel into source- deterioration of engine close to the source	No,	Yes, needs some method e.g. bunding, to prevent spills contaminating water
9. Contamination of source through pump malfunction.	No – There is no standby chlorine pumps so when the current pumps stops, water entering reservoirs is not disinfected.	Yes – Unsanitary reservoir water is a serious health risk.
10. Excess deposition of calcium in chlorine injection output valve causing obstruction of chlorine flowing into pipe lines	No – Calcium deposition is a common occurrence.	Yes – Serious health risk.
11. Direct source contamination or unsanitary source water due to public interference at storage facility.	No - No proper storage facility for chemicals, especially chlorine, meaning public could have access the chemicals and contaminate the source or empty the stores (chlorine drums.)	Yes – Serious health risk.

Storage and Distribution

List what could happen that may cause drinking water to become unsafe (Deterioration in water quality)	Is this under control?	If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness,
1. Contamination of reservoir from sediment build-up in reservoir.	No - No regular cleaning of water tank resulting in murky, smelly water. No backup tank.	Yes
2. Leakage on tank due to damages floater	No –	Yes
3. Leakage from tank from the lack of an electric cut-off switch?	No – No electric cut-off switch on Sarakata Reservoir.	Yes
4. Breaks, leaks or damage to pipes allowing contaminants to enter treated water. Ex. Ongoing leakage or illegal use of fire hydrants to extract water.	No – Pipes that cannot withstand water pressure and ongoing leakage could allow contamination. It is difficult to identify damage that will lead to contamination.	Yes
5. Low Pressure could result in some communities being deprived of water.	No. For some communities in elevated areas it could be a problem.	Yes
6. Water and contaminants enter treated water during repairs to the distribution system.	No – Potential contamination during or after repairs of pipeline	Yes – Poses a water quality risk.
7. Interrupted distribution and/or contamination of water due to human intervention in water storage and distribution (cutting pipes, etc.)	No - Insecure water supply system facilities such as - ladder to top of reservoirs is not secured with pad locks, -fence around reservoirs is not well secured, -insecure pipelines -tanks on private properties (Nitchiku)	Yes - Could result in interrupted water service and/or contamination of water in the network.

	Potential damage to water meters.	
Backflow into distribution system	No, Could be a problem if backflow occurs.	Yes

User's system and others

List what could happen that may cause drinking water to become unsafe (Deterioration in water quality)	Is this under control?	If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness,
1. Leakage inside buildings - mostly in government houses	No – Leakages are continuous and have been happening for some time. Inappropriate use/loss of water.	Yes – Ongoing problem. (Ministry of public works housing section responsible for improving pipe quality)
2. Leakage in underground pipelines within houses and properties.	No – Leakages are continuous and have been happening for some time. Inappropriate use/loss of water.	Yes – Ongoing problem.
3. Illegal tapping by end users	No - Leads to cross-contamination and unsanitary water.	Yes – Ongoing problem which poses a water quality risk
4. Inadequate ongoing staff training e.g. taking water samples	No, ongoing training required in taking water samples etc.	Yes, ongoing training should be undertaken.
5. No documentation of operating procedures could result in treatment failure.	No. Lack of documented procedures e.g. SOPs for all significant plant processes, may result in water quality issues.	Yes, SOPs should be written for significant plant processes
Lack of Water Quality Monitoring at plant and in distribution zones.	No, increased monitoring both at plant and in zone required. e.g. microbiological monitoring and physical parameters	Yes.

<p>Copy the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.</p>	<p>IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required</p>	<p>Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water</p>	<p>What management plan is in place until the cause is removed or reduced or remedied? Who needs to know and how quickly? Who can help?</p>
<p>1. Contamination of the source by a PWD staff residence that includes activities such as a septic tank, poultry, piggery and storage of old machinery. Potential contamination of well from septic tank onsite at pump station.</p>	<p>Water Treatment Manager of PWD to serve notice to officer to vacate the house. House to be used for storage of fittings.</p> <p>Undertake analysis of source water to identify physical parameters and levels of microbiological contamination.</p> <p>This information will Be used to improve treatment.</p> <p>Shut down toilet at pump station, in interim use toilet at PWD staff residence</p>	<p>Water is murky after rain and looks, smells, or tastes abnormal.</p> <p>High incidence of illness in those using water directly from the source.</p> <p>Difficulty maintaining acceptable residual chlorine levels.</p>	<p>Water quality will be monitored periodically and PWD notified if there is a problem. If a problem with water is detected, treatment is increased to deal with situation.</p>
<p>2. Contamination of source (it is a shallow aquifer) from surface activities in the recharge zone that lead to soil erosion and sedimentation in the source.</p>	<p>PWD and the LWRAC to carry out awareness to nearby communities residing around the catchment area.</p> <p>PWD and the LWRAC to consult with landowners and lease holders on</p>	<p>Same as above.</p> <p>Evidence of large amounts of soil erosion in water e.g. increased visual turbidity.</p>	<p>Same as above.</p>

<p>Ex:</p> <ul style="list-style-type: none"> -felling of trees -gardening -burning of trees -fire 	<p>importance of replanting within the catchment area.</p> <p>Committee will liaise with Live and Learn on best method of communicating awareness programmes to communities</p>		
<p>3. Contamination of source by surface activities from illegal settlements and/or residential areas.</p>	<p>Upgrading fencing around source intake and water pumping station. [Additional funding will be required.]</p> <p>Public awareness notice to stress the importance of keeping the catchments area free from possible contaminants. PWD to erect notices around the supply facilities.</p>	<p>Same as above</p>	<p>Same as above</p>
<p>4. Increase in Subdivisions. Custom Land Owners and Lease holders are in the process of subdividing land in the areas immediately upslope from the source</p>	<p>Municipal and Provincial Councils to undertake awareness on land conservation and catchment protection to nearby communities residing around the catchment area. (zone 2)</p> <p>Department of Geology and Mines to lobby Lands Department to take action to stop subdivisions in zone 2.</p>	<p>Same as above</p>	<p>Same as above.</p>

<p>5. Contamination of source from dust and particles caused by heavy use of the public road close to the source</p>	<p>PWD to negotiate sealing road leading to pump station and make the communities affected aware of the importance of sealing the road access.</p> <p>Same as above.</p>	<p>Same as above.</p>	<p>Nothing in place</p>
<p>6. Contamination of source by grazing animals (livestock farming) within the catchment area.</p>	<p>Municipal and Provincial Councils to undertake awareness with cattle farmers on effect of cattle farming on the deterioration of water quality around the catchment area. (zone 2) Department of Geology and Mines responsible for enforcing Zone 1 & 2 controls.</p> <p>Designed concrete stormwater drain to remove runoff from settlements in zone 2. Funding needs to be allocated to allow construction</p>	<p>Same as above.</p>	<p>Water quality will be monitored periodically and PWD notified if there is a problem. If a problem with water is detected, treatment is increased to deal with situation.</p>
<p>7. Cyclones and other severe weather. Affecting treatment plant through excessive run-off and flooding</p>	<p>Channelling will be undertaken to prevent flooding at Water Treatment Plant. Investigate other options to reduce flooding at pump station e.g. roof improvements, raising floor level etc. (See SMEC Report June 1999 for recommended options)</p> <p>Municipal and Provincial Councils</p>	<p>Pumps flooded, no water pumped until fixed.</p>	<p>Notify communities that there is no water available through media and that people need to use other sources e.g. stored water. This also requires an awareness programme for alternative water supplies e.g. rainwater.</p>

	<p>and Department of Geology and Mines to scope alternate source of water e.g. proposed bores for alternative safe water source,</p> <p>Currently 3 Monitoring and one main bore in place.</p>		
10. Contamination of ground water due to low water level.	<p>Propose a well level indicator to allow accurate measurements of well levels.</p> <p>3 monitoring boreholes in place –</p>	<p>Water is murky after rain and looks, smells, or tastes abnormal.</p> <p>High incidence of illness in those using water directly from the source.</p> <p>Difficulty maintaining acceptable residual chlorine levels.</p> <p>Low water availability</p>	<p>Water quality will be monitored periodically and PWD notified if there is a problem. If a problem with water is detected, treatment is increased to deal with situation.</p>
11. Contamination of well from roof catchment over well head	<p>Propose putting in new guttering and new lid for well to minimise contaminant entry into well.</p>	As above	<p>PWD staff to do a regular cleaning of roof catchment</p>

Copy the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.	IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required	Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water	What contingency management plan is in place until the cause is removed or reduced or remedied? Who needs to know and how quickly? Who can help?
1. Over/under dosing of chlorine	<p>Investigate method for monitoring FAC in process following 30 minute disinfection contact time</p> <p>Investigate best method for chlorine dose control system (e.g. manual, flow proportional or automated) depending on chlorine demand, and flow through the plant.</p> <p>This will require sampling to better determine the characteristics of the source water</p>	<p>FAC levels in distribution too high/low</p> <p>faecal coliforms found in treated water</p>	Manually adjust chlorine if too high or low
4. Residual Chlorine levels in distribution, too high or too low.	<p>FAC level taken daily in both distribution zones, however needs to be documented. Investigate the need for new FAC monitoring equipment for distribution monitoring</p>	<p>As above</p> <p>Potential taste issues if too high</p>	As above
5. The pH is too high for effective disinfection with Chlorine.	Insufficient pH data available. More detailed information	As above.	As above

	<p>of source water characteristics required to know if significant variation in pH which could affect chlorine disinfection.</p> <p>If pH problem identified then may require pH monitoring at plant for adequate chlorination control.</p>		
6. There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	Investigate if protozoa treatment/barrier required	Potential protozoan illness in the community	
7. Chlorine injection points outside of treatment shed	Investigate either housing or moving dosing points into shed	Evidence of damage FAC levels low	Visual check of injection points
8. Leakage of chemicals/fuel into source- deterioration of engine close to the source	Investigate installing a bund to capture spillages. Produce an SOP for dealing with spillages e.g. chlorine.	Evidence of spill	Clean up spill.
9. Lack of treatment through chlorine injector pump malfunction.	<p>Provide training on chlorinating supply. [additional funds will be required]</p> <p>Purchase proper safety equipment</p> <p>Purchase two standby chlorine dosing pumps</p>	<p>Visual check that the chlorine dosing pump is not functioning.</p> <p>No or low FAC residual in distribution.</p> <p>There is a high incidence of illness in the community.</p>	<p>Maintain and monitor the existing pump.</p> <p>Water quality will be monitored periodically and PWD notified if there is a problem. If a problem with water is detected, treatment is increased to deal with situation e.g. hand dose chlorine.</p>
10. Excess deposition of calcium in chlorine injection output valve causing an obstruction of chlorine	Clean chlorine injection output valve 2 times per week. Needs an SOP for the	No residual of chlorine in the system.	Keep chlorine testing tablets in stock. Water quality will be monitored periodically

<p>flowing into pipe lines</p>	<p>process and needs to be recorded</p>	<p>Over or less dosing</p> <p>There is a high incidence of illness in the community</p>	<p>and PWD notified if there is a problem. If a problem with water is detected, treatment is increased to deal with situation e.g. hand dose chlorine.</p>
<p>11. Direct source contamination or unsanitary source water due to public having access to storage and dosing areas.</p>	<p>Progress fencing and concrete pad for chlorine drums Improve storage housing for water supply system's spare parts. [additional funds will be required]</p> <p>Construct an improved structure for fuel tank. [additional funds will be required]</p> <p>Identify a better site for display of old generator</p>	<p>See evidence of forced entry.</p> <p>See leakages of chemicals or fuel.</p> <p>See chemicals or fuel suspended in water.</p> <p>There is a high incidence of illness in the community.</p> <p>Water is murky and/or smelly.</p>	<p>Water quality will be monitored periodically and PWD notified if there is a problem.</p>

<p>Copy the ‘Needs Urgent Attention’ from the worksheets. Expect no more than 3 – 5 in each worksheet.</p>	<p>IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required</p>	<p>Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water</p>	<p>What management plan is in place until the cause is removed or reduced or remedied? Who needs to know and how quickly? Who can help?</p>
<p>1. Contamination of reservoir from sediment build-up in reservoir.</p>	<p>Develop a project proposal/document to seek funding for the construction of two back-up tanks to allow for tank cleaning periodically (5-10 years) [additional funding required - see above Other options to allow reservoir cleaning should also be investigated. See SMEC Report June 1999 pg. 38.</p>	<p>Water is murky and/or smelly.</p> <p>You can see the sediment build-up in the tank.</p>	<p>Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.</p> <p>Water quality will be monitored periodically and PWD notified if there is a problem</p>
<p>2. Leakage on tank due to damaged floater</p>	<p>Repair damaged floater</p>	<p>See overflow leakages and damage to valves at the reservoirs</p> <p>Continuous leakage that may cause contamination to reservoirs</p>	<p>Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.</p> <p>Water quality will be monitored periodically and PWD notified if there is a problem.</p>
<p>3. Leakage from tank from the lack of an electric cut-off switch?</p>	<p>Install an electric cut-off pump switch for Sarakata reservoir – PWD to install. [additional finding required.]</p>	<p>See overflow leakages and damage to valves at the reservoirs</p> <p>Continuous leakage that may cause contamination to reservoirs</p>	<p>Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.</p> <p>Water quality will be monitored periodically and PWD notified if</p>

			there is a problem.
4. Breaks, leaks or damage to pipes allowing contaminants to enter treated water.	<p>Standardise pipeline materials by PWD Engineers. PWD to develop a standard manual for material use in water supply network</p> <p>Unintentional damage of pipeline by other company's institutions should be repaired at their cost e.g. Telecom. PWD to develop a memorandum of agreement with other companies and Institutions to gather repair cost.</p> <p>(PWD and other utility staff always on site together.)</p> <p>Establish Leakage Detection measures. PWD to initiate a leakage detection programme [Training for personnel needed]</p> <p>Encourage general public to report on any damage pipe/leakage. Public awareness on reporting of damages and leakages and set up a free telephone line for reporting and any other enquiry on water related issues</p> <p>Advise general public on the consequences of unauthorized tapping of water at the fire hydrants. Investigate putting in a new flow meter in</p>	<p>Leaks and damaged pipes are being reported.</p> <p>Water is not flowing in some areas.</p> <p>High incidence of illness in the community.</p>	Continue ongoing maintenance and monitoring of pipe system.

	water pipe prior to Chapuis Reservoir, as for Sarakata reservoir.		
5. Low Pressure could result in some communities being deprived of water.	One of the requested two tanks can be high enough to relieve this problem. See SMEC Report June 1999 pg. 38.)	Low pressure in parts of distribution zone.	Water pressure will be monitored periodically and PWD notified if there is a problem
6. Water and contaminants enter treated water during repairs to the distribution system.	<p>Perform water quality tests after major repairs of pipelines.</p> <p>Establish written procedures e.g. SOPs for fixing distribution problems, including hygiene procedures.</p> <p>Seek funds for the installation of a new water quality laboratory [additional funding will be required.]</p> <p>Training will be necessary as part of establishing a lab.</p>	High incidence of illness in the community.	<p>Water quality will be monitored periodically and PWD notified if there is a problem.</p> <p>Continue ongoing maintenance and monitoring of pipe network to prevent the need for large repairs.</p>
<p>7. Interrupted distribution or contamination of water due to vandalism and unauthorized entry into water facilities (cutting pipes, etc.)</p> <p>People damaging water meters with vehicles etc</p>	<p>Public notices to stress importance of pipelines that are exposed and stop vandalism. PWD to put up public notices at the facilities.</p> <p>Investigate physical barriers to prevent water meter damage from vehicles etc.</p>	<p>Leaks and damaged pipes are being reported.</p> <p>Water is not flowing in some areas.</p> <p>High incidence of illness in the community.</p> <p>Damaged water meters</p>	<p>Water quality will be monitored periodically and PWD notified if there is a problem.</p> <p>Monitor the network and water facilities.</p>
Backflow into distribution system	Education programme for new and existing	Water is murky after rain and looks, smells, or tastes abnormal.	Water quality will be monitored periodically and PWD notified if

	<p>industry which pose a significant threat if backflow occurred.</p> <p>Backflow prevention devices installed if required</p> <p>Investigate making condition of building permits.</p>	<p>High incidence of illness in those using water directly from the source.</p> <p>Difficulty maintaining acceptable residual chlorine levels.</p>	<p>there is a problem. If a problem with water is detected, treatment is increased to deal with situation.</p>
--	---	--	--

<p>Copy the ‘Needs Urgent Attention’ from the worksheets. Expect no more than 3 – 5 in each worksheet.</p>	<p>IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required</p>	<p>Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water</p>	<p>What contingency management plan is in place until the cause is removed or reduced or remedied? Who needs to know and how quickly? Who can help?</p>
<p>1. Leakage inside buildings - mostly in government houses</p>	<p>Awareness for conservation of water to all public servants. Acquaint householders with the side-effects of contaminated water usage.</p> <p>PWD to repair and maintain leakages within pipelines/ taps within government buildings where budget permits. Liaise with government officials to increase funding PWD to repair and maintain leakages within pipelines/ taps within government buildings where budget permits. PWD to increase housing maintenance budget</p>	<p>High incidence of illness within the household</p> <p>Very high water service cost.</p> <p>See leaks in the household.</p> <p>Reduced or low flow in the household.</p>	<p>Encourage households to prevent leakage.</p> <p>Encourage households to report unusually high water bills or low flow</p>
<p>2. Leakage in underground pipelines within houses and properties.</p>	<p>Recommend standardisation of pipes to be used after water meters by consumer. PWD to advise property owners to use standardised pipes</p> <p>Encourage upgrading of old pipelines within houses/properties. Advise property owners</p>	<p>Very high water service cost.</p> <p>See leaks in the household.</p> <p>Reduced or low flow in the household.</p>	<p>Encourage households to prevent leakage??</p> <p>Encourage households to report unusually high water bills or low flow</p>

	on advantages of using standardised pipes		
3. Illegal tapping by end users	<p>PWD, Municipal and Provincial Councils to carry out awareness on consequences of illegal tapping and stop illegal tapping at the end users.</p> <p>Municipal an Provincial Councils to establish regulations to assist in implementing the Water Resources Management Act 2003 and stop illegal tapping into the system. Departments and respective responsible authorities to identify relevant issues for inclusion in water regulation.</p>	<p>High incidence of disease in the area.</p> <p>Very high water service cost</p> <p>Reduced or low flow to some areas.</p>	Encourage households to report unusually high water bills or low flow.
4. Inadequate staff training e.g. taking water samples	<p>Undertake training needs assessment for all water staff.</p> <p>Following assessment implement identified training for all water staff.</p> <p>This training should be timetabled to correlate with improvements to the water supply.</p> <p>Training on WSP Implementation</p> <p>Health and Safety training</p>	Many potential water safety/quality issues if inadequate training.	
5. No documentation of operating procedures could result in treatment failure.	<p>Develop Standard Operating Procedures. for example:</p> <ul style="list-style-type: none"> • Chlorine Dosing Control • Ensuring quality, consistency and 	As above	

	<p>adequate stock of chlorine solution.</p> <ul style="list-style-type: none"> • Mixing chlorine solution on site when cannot source solution from supplier. • Hand dosing reservoir when chlorine dose pump fails. • Daily checks • Pump maintenance • Power supply • FAC monitoring • Microbiological monitoring. • Main repairs disinfection <p>Examples from New Zealand will be given outlining SOPs.</p>		
Lack of Water Quality Monitoring (microbiological and physical parameters) at plant and in distribution zones.	Water quality Monitoring programme for plant and distribution zones to be developed.	As above	
Rainwater	Mele Steering committee will include rainwater in the Mele WSP. This could be used as an example to include in the Lunganville WSP.		

Improvement Schedule

CATCHMENT AND INTAKE

Risks identified	Priority	Improvement	Costs	Responsibilities and timeline	Comments
Contamination of the source by a PWD staff residence that includes activities such as a septic tank, poultry, piggery and storage of old machinery.	Moderate	PWD Sanma to serve notice to officer to vacate the house. House to be used for storage of fittings.		Charlie Tari December 2007	
Potential contamination of well from septic tank onsite at pump station.	Moderate	Undertake analysis of source water to identify physical parameters and levels of microbiological contamination. This information will Be used to improve treatment.		PWD and Unelco	
	High	Shut down toilet at pump station, in interim use toilet at PWD staff residence.		PWD	
2. Contamination of source (it is a shallow aquifer) from surface activities in the recharge zone that lead to soil erosion and sedimentation in the source. Ex: -felling of trees -gardening -burning of trees -fire	High	PWD and the LWRAC to carry out awareness to nearby communities residing around the catchment area.		PWD & LWRAC & Municipal and Provincial Councils	
	High	PWD and the LWRAC to consult with landowners and lease holders on importance of replanting trees within the catchment area.			
	High	Committee will liaise with Live and Learn on best method of communicating awareness programmes to communities			

	Moderate	controls. Designed concrete stormwater drain to remove runoff from settlements in zone 2. Funding needs to be allocated to allow construction.		Mines PWD	
7. Cyclones and other severe weather. Affecting treatment plant through excessive run-off and flooding	High	Channelling will be undertaken to prevent flooding at Water Treatment Plant. Investigate other options to reduce flooding at pump station e.g. roof improvements, raising floor level etc. (See SMEC Report June 1999 for recommended options) PWD and Department of Geology and Mines to scope alternate source of water e.g. proposed bores for alternative safe water source, Currently 3 Monitoring and one main bore in place.		PWD PWD and Department of Geology and Mines	
10. Contamination of ground water due to low water level.	Moderate	Propose a well level indicator to allow accurate measurements of well levels. 3 monitoring boreholes in place –		PWD & Department of Geology and Mines	
11. Contamination of well from roof catchment over well head	High	Propose putting in new guttering and new lid for well to minimise contaminant entry into well		PWD May 2007 for guttering	
<i>TREATMENT</i>					

1.Over/under dosing of chlorine	Moderate	Investigate method for monitoring FAC in process following 30 minute disinfection contact time		PWD	
	Moderate	Investigate best method for chlorine dose control system (e.g. manual, flow proportional or automated) depending on chlorine demand, and flow through the plant. This will require sampling to better determine the characteristics of the source water		PWD	
4. Residual Chlorine levels in distribution, too high or too low.	High	FAC level taken daily in both distribution zones, however needs to be documented.		PWD	
	Moderate	Investigate the need for new FAC monitoring equipment for distribution monitoring.		PWD	
5. The pH is too high for effective disinfection with Chlorine.	High	Insufficient pH data available. More detailed information of source water characteristics required to know if significant variation in pH which could affect chlorine disinfection.		PWD	
	High	If pH problem identified then may require pH monitoring at plant for adequate chlorination control.		PWD	
6. There is no treatment / barrier for protozoa, so it could be assumed	High	Investigate if protozoa treatment/barrier required.		PWD	

that they are present in water.					
7. Chlorine injection points outside of treatment shed	Moderate	Investigate either housing or moving dosing points into shed		PWD	
8. Leakage of chemicals/fuel into source-deterioration of engine close to the source	Moderate	Investigate installing a bund to capture spillages.		PWD	
		Produce an SOP for dealing with spillages e.g. chlorine.		PWD	
9. Lack of treatment through chlorine injector pump malfunction.	Moderate	Provide training on chlorinating supply. [additional funds will be required]		PWD	
	Moderate	Purchase proper safety equipment		PWD	
	Moderate	Purchase two standby chlorine dosing pumps. Dependent on chlorine system assessment.		PWD	
10. Excess deposition of calcium in chlorine injection output valve causing an obstruction of chlorine flowing into pipe lines	High	Clean chlorine injection output valve 2 times per week.		PWD	
	Moderate	Needs an SOP for the process and needs to be recorded		PWD	

11. Direct source contamination or unsanitary source water due to public having access to storage and dosing areas.	High	Progress fencing and concrete pad for chlorine drums. Include bunding to capture spilled chemicals. Improve storage housing for water supply system's spare parts. [additional funds will be required] Construct an improved structure for fuel tank. [additional funds will be required] Identify a better site for display of old generator		PWD	
	Moderate			PWD	
	Moderate			PWD	
High					
STORAGE AND DISTRIBUTION					
1. Contamination of reservoir from sediment build-up in reservoir.	Moderate	Develop a project proposal/document to seek funding for the construction of two back-up tanks to allow for tank cleaning periodically (5-10 years) [additional funding required - see above] Other options to allow reservoir cleaning should also be investigated. See SMEC Report June 1999 pg. 38.		PWD	
2. Leakage on tank due to damaged floater	Moderate	Repair damaged floater		PWD	

<p>3.</p> <p>Leakage from tank from the lack of an electric cut-off switch.</p>	<p>Moderate</p>	<p>Install an electric cut-off pump switch for Sarakata reservoir – PWD to install. [additional finding required.]</p>		<p>PWD</p>	
<p>4. Breaks, leaks or damage to pipes e.g. earthquakes, allowing contaminants to enter treated water.</p>	<p>Moderate</p>	<p>Standardise pipeline materials by PWD Engineers. PWD to develop a standard manual for material use in water supply network</p>		<p>PWD</p>	
	<p>High</p>	<p>Develop contingency plans for extreme events e.g. earthquakes, volcanic eruptions</p>		<p>PWD, Geology and Mines, Ministry of Health.</p>	
	<p>High</p>	<p>Unintentional damage of pipeline by other company's institutions should be repaired at their cost e.g. Telecom. PWD to develop a memorandum of agreement with other companies and Institutions to gather repair cost.</p>		<p>PWD</p>	
	<p>Moderate</p>	<p>(PWD and other utility staff always on site together.)</p> <p>Establish Leakage Detection measures. PWD to initiate a leakage detection programme [Training for personnel needed] Sopac Water Demand Management Programme to fund/train leakage detection programme.</p>		<p>PWD & SOPAC</p>	
	<p>High</p>	<p>Encourage general public to report on any damage pipe/leakage.</p> <p>Advise general public on</p>		<p>PWD</p> <p>PWD</p>	

	High	the consequences of unauthorized tapping of water at the fire hydrants			
	High	Investigate putting in a new flow meter in water pipe prior to Chapbues Reservoir, as for Sarakata reservoir.		PWD	
5. Low Pressure could result in some communities being deprived of water.	Moderate	One of the requested two tanks can be situated high enough to relieve this problem and further development. (See SMEC Report June 1999 pg. 38.)		PWD	
6. Water and contaminants enter treated water during repairs to the distribution system.	High	Perform water quality tests after major repairs of pipelines.		PWD	
	Moderate	Establish written procedures e.g. SOPs for fixing distribution problems, including hygiene procedures.		PWD	
	Moderate	Seek funds for the installation of a new water quality laboratory [additional funding will be required.]		SOPAC & PWD	
	Moderate	Training will be necessary as part of establishing a lab.			

<p>7. Interrupted distribution or contamination of water due to accidental damage</p> <p>People damaging water meters with vehicles etc</p>	<p>High</p> <p>Moderate</p>	<p>Public notices to stress importance of pipelines that are buried or exposed to stop damage.</p> <p>Investigate physical barriers to prevent water meter damage from vehicles etc.</p>		<p>PWD & Municipal, Provincial councils</p> <p>PWD</p>	
<p>Backflow into distribution system</p>	<p>Moderate</p> <p>Moderate</p>	<p>Education programme for new and existing industry which pose a significant threat if backflow occurred.</p> <p>Backflow prevention devices installed if required. Investigate making condition of building permits</p>		<p>PWD</p> <p>Municipal Council</p>	
<p><i>OTHER</i></p>					

1. Leakage inside buildings - mostly in government houses	High	Awareness for conservation of water to all public servants. Acquaint householders with the side-effects of contaminated water usage.		PWD	
	High	Encourage households to report unusually high water bills or low flow		PWD	
	High	PWD to repair and maintain leakages within pipelines/ taps within government buildings where budget permits.		PWD	
	High	PWD to increase housing maintenance budget.		PWD Housing Maintenance Section	
2. Leakage in underground pipelines within houses and properties.	High	Recommend standardisation of pipes to be used after water meters by consumer. PWD to advise property owners to use standardised pipes		PWD to inform householders. Householders to carry out the work.	
	High	Encourage upgrading of old pipelines within houses/properties. Advise property owners on advantages of using standardised pipes		PWD	

<p>5. No documentation of operating procedures could result in treatment failure.</p>	<p>High</p>	<p>Develop Standard Operating Procedures. for example:</p> <ul style="list-style-type: none"> • Chlorine Dosing Control • Ensuring quality, consistency and adequate stock of chlorine solution. • Mixing chlorine solution on site when cannot source solution from supplier. • Hand dosing reservoir when chlorine dose pump fails. • Daily checks • Pump maintenance • Power supply • FAC monitoring • Microbiological monitoring. <p>Main repairs disinfection</p> <p>Examples from New Zealand will be given outlining SOPs.</p>		<p>PWD with assistance on writing SOPs.</p>	
---	-------------	--	--	---	--

<p>Lack of Water Quality Monitoring (microbiological and physical parameters) at plant and in distribution zones.</p>		<p>Water Quality Monitoring programme for plant and distribution zones to be developed.</p>		<p>PWD, Department Geology Mines, Ministry of Health, LWRAC.</p>	
---	--	---	--	--	--