



**VANUATU**

**WATER SAFETY PLAN FOR LUGANVILLE**



**URBAN WATER SUPPLY  
SANTO, VANUATU**

Water Safety Plan Programme  
A Project Funded by AusAID -2006-2007



## **NOTE**

This report is one in a five series produced for the Vanuatu Water Safety Plan programme funded by AusAID and implemented by Pacific Applied Geoscience Commission (SOPAC) and World Health Organisation (WHO). For ease of reference and retrieval this report is available digitally in the SOPAC publications library system as **SOPAC Technical Report No.....**

SOPAC wish to acknowledge the kind cooperation of Geology Mines and Water Resources, Ministry of Health. Live and learn Environmental Education Vanuatu and the Water Safety Plans Steering Committee, Vanuatu to make this project a success.

### **List of Other Reports:**

Water Supply System Description – Port Vila and Santo  
Water Safety Plan –Mele Rural Supply, Port Vila  
Improvement Schedules- Luganville Urban Supply  
Improvement Schedule – Mele Rural Supply, Port Vila

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## **Water Safety Plan –Luganville Urban Water Supply**

### **I. Introduction:**

Access to safe drinking water is a basic need and is one of the most important contributors to public health and to the economic health of communities. Pacific island countries have yet to overcome the challenge of providing a safe and adequate supply of drinking water to its populations. Infectious, waterborne diseases, such as Typhoid and Cholera and newly emerging pathogens are a major cause of morbidity and mortality within the Pacific region.

The World Health Organization (WHO) report that about 2 million people in the world die each year due to diarrhoeal diseases, most of them are children less than 5 years of age. The worst affected are the populations in developing countries. Lack of access to safe drinking water is one of the main contributors to this situation.

Traditional approaches that rely on sampling and testing water have failed to achieve extensive improvement in access to safe drinking water. Pacific island countries are committed to achieving targets specified in the Millennium Development Goals (2000), including halving the proportion of people without access to safe drinking water by 2015. A new strategy is now being promoted globally that is based on risk management principles – drinking water safety planning.

#### **1.1. Tasks**

The five day mission to Vanuatu from 30 April- 4 May 2007 was convened to review the Water Safety Plan and Improvement Schedules compiled by the Luganville Water Safety Plan Steering Committee and Public Works Department at Santo.

The team reviewed the water safety plan, carried out field assessment and water analysis. The Luganville Water Supply manager and engineer were consulted and reference was made to the existing reports. At the end of the week draft reports were presented and discussed with Lungaville Water Safety Plan Steering Committee.

#### **1.2 Administrative Support**

Administrative support was given by Public Works Department, Luganville for the transport for field work and office space. A good commitment was shown by Public Works Department and Samna Provincial Council Staff in the project. All information was made available to the mission team by the Public Works Department Staff.

### 1.3 Key Personnel

Davendra Nath, Water Safety Plan Project Officer, (SOPAC)  
Denise Tulley, Drinking Water Assessors, Ministry of Health, New Zealand  
Christopher Edmonds, Drinking Water Assessor, Ministry Of Health, NZ  
Charlie Tari, Manager, Luganville Water Supply. PWD  
James Hakwa, Engineer, Public Works Department  
Erickson Sammy. Manager, Rural Water Supply,(GMWR) Port Vila

### 2. Project Objectives: What is a Water Safety Plan?

The main objective of the Water Safety Plan Programme in the Pacific is to produce Water Safety Plans for urban and rural drinking water supply systems involving all in-country stakeholders.

A Water Safety Plan (WSP) is a comprehensive risk assessment and management tool that encompasses all stages in the drinking water supply from catchment to consumers. It draws on principles and concepts from other risk management approaches including Hazard Analysis Critical Control Point (HACCP) and the 'multi-barrier approach'.

The Improvement Schedules are part of the Water Safety Plans and are compiled after the risk assessment of the water supply system has been completed.

The key objectives of a Water Safety Plan are to:

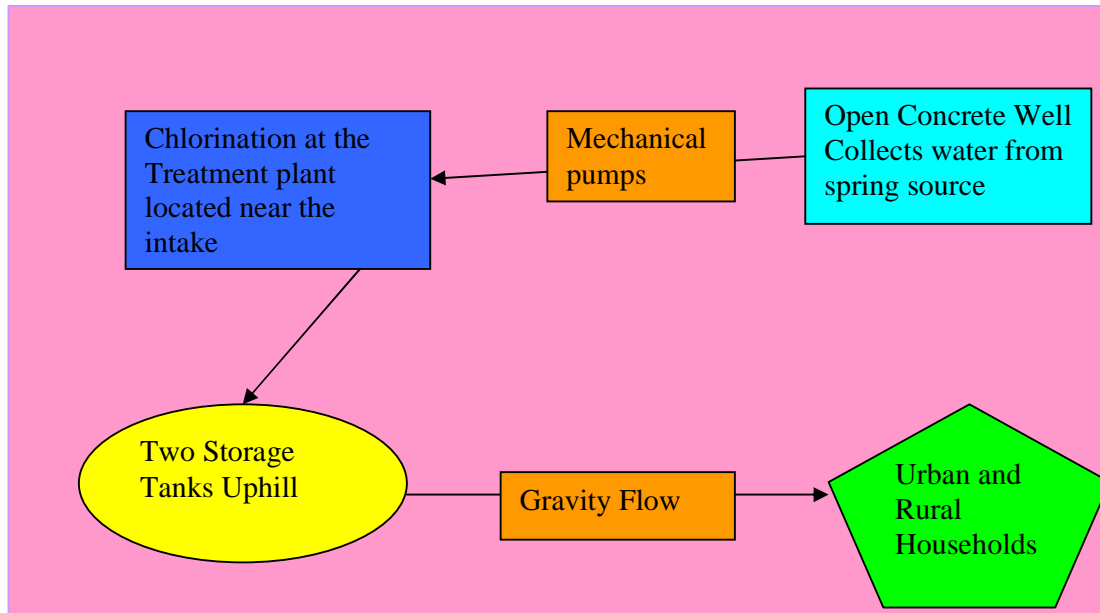
- Prevent the contamination of source waters;
- Treat water to reduce or remove contaminants; and
- Prevent re-contamination during storage, distribution and handling

#### Luganville Water Advisory Committee (WSP Steering Committee)

Chairman: Andrew Ala – Luganville Municipal Council
Secretary: Charli Tari - Public Works Department
Members: Peter Lulu – Rural Water Supply
James Hakwa – PWD Engineer
Albert Bve - Lands and Survey Department
Keith Jacob - Health Inspector, Rural Health Department
Banval Tasi - Lands Dept
Buletare Prosper - Physical Planner, Sanma Province
Harry Tete - Town Planning Officer. Luganville Municipality
Simeon Stanley - Divisional Manager. PWD, Santo

### 3. Luganville Water Supply Description

Luganville urban water supply system flow diagram and locality plan can be seen below. Since the water is from shallow well there is no filtration system in place and thus chlorination is the necessary process to eliminate pathogens from water prior to consumption.

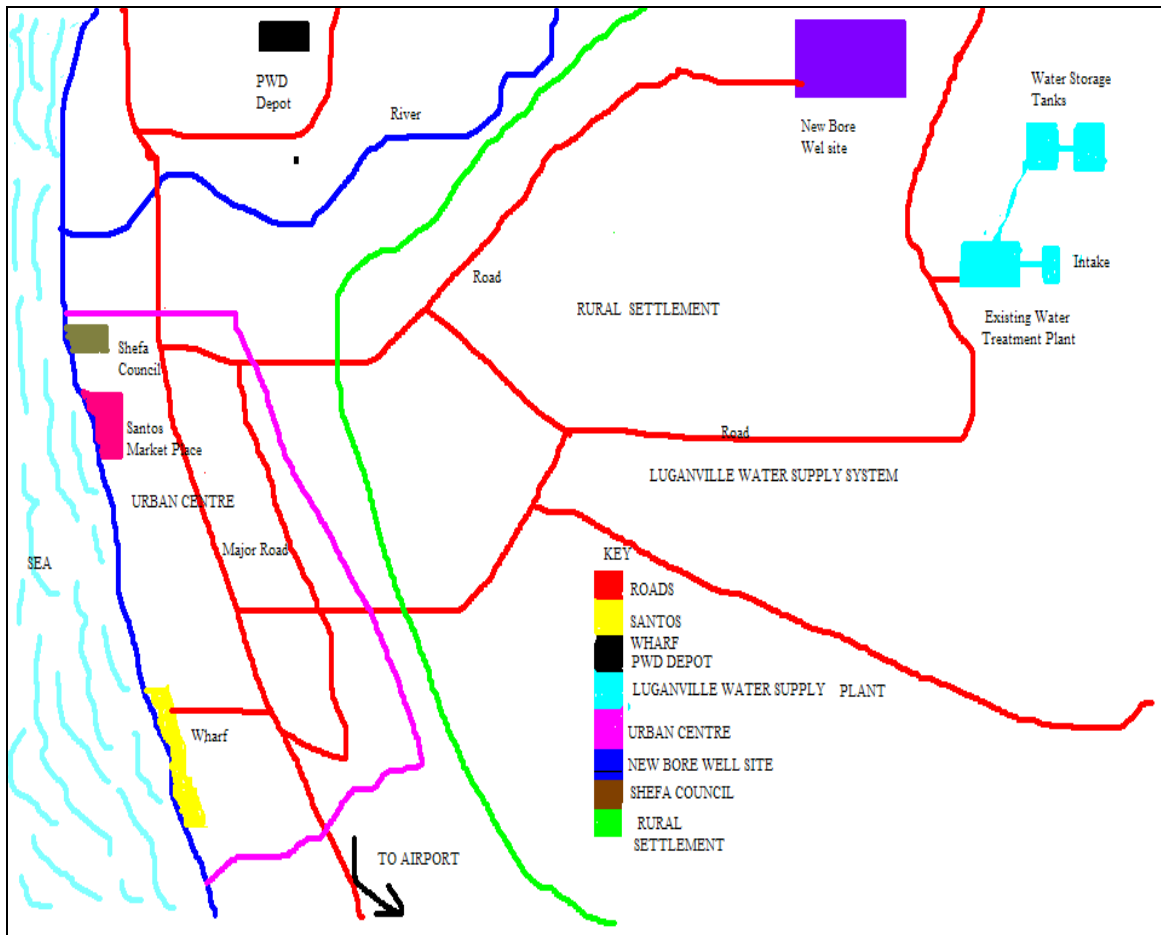


**Figure: 5 Luganville Water Supply Systems (Davendra Nath, SOPAC)**

Luganville water supply is located in the northern part of the Vanuatu Group on the Island of Espiritu Santo which is the largest island. The population of Luganville is 15,350 and is likely to increase in future due to tourism activities.

Luganville water supply is owned by Vanuatu Government under the Ministry of Public Utilities. There are five officers working under Urban Water Supply Unit in Luganville.

The Luganville water supply system was built by the American soldiers, during the World War II in 1942 and the Public Works Department in Santo continues to maintain. The source is from a spring and the water flows into an open well from where it is pumped uphill into the storage tanks. A layout of the system is provided in Figure 6.



**Figure: 6 Locality Plan- Luganville Water Supply – Urban and Rural (Davendra Nath, SOPAC)**

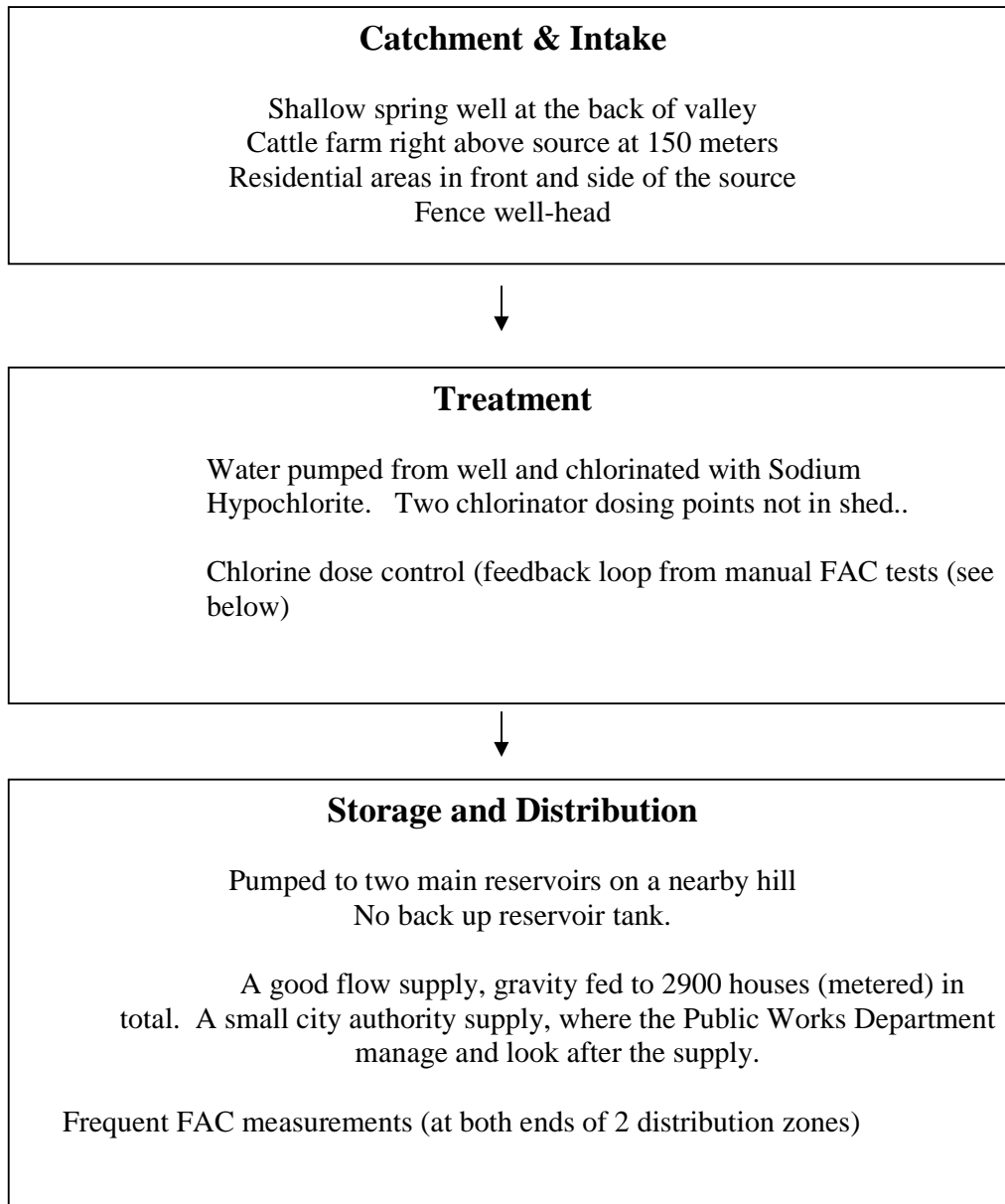
## 4. WATER SAFETY PLAN

Supply Name: Luganville Urban Water Supply

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### Step 1: Flow Chart

#### Flow Chart





## 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 source.	No - Hydrocarbons entering the source cannot be treated and, when entering the source, can be visible on the surface.  Without intervention, people will continue to create new access roads close to the source.	Yes – As hydrocarbons cannot be treated, it poses a real water quality risk.

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 due to power outage.	Yes. Backup generators in place.	
3. Chlorine supply may run out, resulting in untreated	Yes. A stock replenishment system is in place to ensure	

water being distributed to the communities.	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)  Potential damage to water meters.	Yes - Could result in interrupted water service and/or contamination of water in the network.
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.

## Catchment and Intake

Copy of the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.	<b>IMPROVEMENT SCHEDULE:</b> 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 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>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>Ex:</p> <ul style="list-style-type: none"> <li>-felling of trees</li> <li>-gardening</li> <li>-burning of trees</li> <li>-fire</li> </ul>	<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 importance of replanting within the catchment area.</p> <p>Committee will liase with Live and Learn on best method of communicating awareness programmes to communities</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>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)</p> <p>Department of Geology and Mines responsible for enforcing Zone 1 &amp; 2 controls.</p> <p>Designed concrete stormwater drain to remove runoff from settlements in zone 2. Funding needs to be</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>

	allocated to allow construction		
7. Cyclones and other severe weather. Affecting treatment plant through excessive run-off and flooding	<p>Channelling will be undertaken to prevent flooding at Water Treatment Plant.</p> <p>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 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>	Pumps flooded, no water pumped until fixed.	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.
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>	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.
11. Contamination of well from roof catchment over well head	Propose putting in new guttering and new lid for well to minimise contaminant entry into well.	As above	PWD staff to do a regular cleaning of roof catchment



## Storage and Catchment

Copy of the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.	<b>IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required</b>	<b>Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water</b>	<b>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?</b>
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>	<p>Manually adjust chlorine if too high or low</p>
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>	<p>As above</p>
5. The pH is too high for effective disinfection with Chlorine.	<p>Insufficient pH data available. More detailed information 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>	<p>As above.</p>	<p>As above</p>
6. There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	<p>Investigate if protozoa treatment/barrier required</p>	<p>Potential protozoan illness in the community</p>	
7. Chlorine injection points outside of	<p>Investigate either housing or moving</p>	<p>Evidence of damage</p>	<p>Visual check of injection points</p>

treatment shed	dosing points into shed	FAC levels low	
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.	Provide training on chlorinating supply. [additional funds will be required]  Purchase proper safety equipment  Purchase two standby chlorine dosing pumps	Visual check that the chlorine dosing pump is not functioning.  No or low FAC residual in distribution.  There is a high incidence of illness in the community.	Maintain and monitor the existing pump.  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.
10. Excess deposition of calcium in chlorine injection output valve causing an obstruction of chlorine flowing into pipe lines	Clean chlorine injection output valve 2 times per week. Needs an SOP for the process and needs to be recorded	No residual of chlorine in the system.  Over or less dosing  There is a high incidence of illness in the community	Keep chlorine testing tablets in stock. 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.
11. Direct source contamination or unsanitary source water due to public having access to storage and dosing areas.	Progress fencing and concrete pad for chlorine drums 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	See evidence of forced entry.  See leakages of chemicals or fuel.  See chemicals or fuel suspended in water.  There is a high incidence of illness in the community.  Water is murky and/or smelly.	Water quality will be monitored periodically and PWD notified if there is a problem.

## Distribution

Copy of the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.	<b>IMPROVEMENT SCHEDULE:</b> 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 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. Contamination of reservoir from sediment build-up in reservoir.	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.  ]	Water is murky and/or smelly.  You can see the sediment build-up in the tank.	Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.  Water quality will be monitored periodically and PWD notified if there is a problem
2. Leakage on tank due to damaged floater	Repair damaged floater	See overflow leakages and damage to valves at the reservoirs  Continuous leakage that may cause contamination to reservoirs	Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.  Water quality will be monitored periodically and PWD notified if there is a problem.
3. Leakage from tank from the lack of an electric cut-off switch?	Install an electric cut-off pump switch for Sarakata reservoir – PWD to install. [additional finding required.]	See overflow leakages and damage to valves at the reservoirs  Continuous leakage that may cause contamination to reservoirs	Continue ongoing maintenance monitoring of reservoirs and stocking of spare parts.  Water quality will be monitored periodically and PWD notified if there is a problem.
4. Breaks, leaks or damage to pipes allowing contaminants to enter treated water.	Standardise pipeline materials by PWD Engineers. PWD to develop a standard manual for material use in water supply network  Unintentional damage of	Leaks and damaged pipes are being reported.  Water is not flowing in some areas.	Continue ongoing maintenance and monitoring of pipe system.

	<p>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 water pipe prior to Chapuis Reservoir, as for Sarakata reservoir.</p>	High incidence of illness in the community.	
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</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</p>

	<p>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>		<p>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>
<p>8. Backflow into distribution system</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>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>

## Users System and Others

Copy of the 'Needs Urgent Attention' from the worksheets. Expect no more than 3 – 5 in each worksheet.	<b>IMPROVEMENT SCHEDULE: How can you remove or reduce or remedy the cause and by when? Indicate clearly where additional resources are required</b>	<b>Until remedied, how will you know when this is actually causing deterioration towards unsafe drinking water</b>	<b>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?</b>
1. Leakage inside buildings - mostly in government houses	<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>
2. Leakage in underground pipelines within houses and properties.	<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 on advantages of using standardised pipes</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>
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>High incidence of disease in the area.</p> <p>Very high water</p>	<p>Encourage households to report unusually high water bills or low flow.</p>

	<p>Municipal and 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>service cost</p> <p>Reduced or low flow to some areas.</p>	
<p>4. Inadequate staff training e.g. taking water samples</p>	<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>	<p>Many potential water safety/quality issues if inadequate training.</p>	
<p>5. No documentation of operating procedures could result in treatment failure.</p>	<p>Develop Standard Operating Procedures. for example:</p> <ul style="list-style-type: none"> <li>• Chlorine Dosing Control</li> <li>• Ensuring quality, consistency and adequate stock of chlorine solution.</li> <li>• Mixing chlorine solution on site when cannot source solution from supplier.</li> <li>• Hand dosing reservoir when chlorine dose pump fails.</li> <li>• Daily checks</li> <li>• Pump maintenance</li> <li>• Power supply</li> <li>• FAC monitoring</li> <li>• Microbiological monitoring.</li> <li>• Main repairs disinfection</li> </ul> <p>Examples from New Zealand will be</p>	<p>As above</p>	

	given outlining SOPs.		
6. 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	
7. Rainwater	Mele Steering committee will include rainwater in the Mele WSP. This could be used as an example to include in the Lunganville WSP.		

## 5. Conclusion

The Water Safety Plan was finalised during the follow up mission 1 and improvement schedules was also compiled. The draft documents were presented to the Steering Committee who initially endorsed them as the final document. The committee was also requested to provide the cost of the improvements in local currency. It was realised that these two documents were very important for the countries to divert further funding in this area. The completed Water Safety Plan is an ideal document for donor agencies for implementation of water programmes.



**ANNEX: 1**

**Drinking water Risk Assessment Table**

**Judging Priorities – systematic risk assessment**

*i. For each hazard event, decide on the likelihood of the event happening*

Likelihood Score	Possible Descriptions
Almost Certain	<ul style="list-style-type: none"> <li>Occurs like clockwork</li> <li>Occurs every week, month or season</li> </ul>
Likely	<ul style="list-style-type: none"> <li>Has occurred more than once before</li> <li>Expected to occur every year</li> </ul>
Possible	<ul style="list-style-type: none"> <li>Has occurred before</li> <li>Expected to occur every 2-5 years</li> </ul>
Unlikely	<ul style="list-style-type: none"> <li>Has occurred before</li> <li>Expected to occur every 5-10 years</li> </ul>
Rare	<ul style="list-style-type: none"> <li>Has never occurred before and unlikely to occur less than every 10 years</li> </ul>

*ii. For each hazard event, decide on the consequence to people’s health if it did happen.*

Consequence Score	Possible Descriptions
Insignificant	<ul style="list-style-type: none"> <li>No illness expected in the community or interruption to water availability</li> </ul>
Minor	<ul style="list-style-type: none"> <li>Very few of the community ill, or some interruption to water availability</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>Some of the community ill</li> </ul>
Major	<ul style="list-style-type: none"> <li>Most of the community ill</li> </ul>
Catastrophic	<ul style="list-style-type: none"> <li>Most (or all) of the community ill with anticipation of some deaths</li> </ul>

*iii. For each hazard event, look up the likelihood and consequence scores in this table to find the corresponding priority (very low, low, medium, high, very high)*

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	medium	medium	high	high	very high
Likely	medium	medium	medium	high	high
Possible	very low	low	medium	high	high
Unlikely	very low	very low	low	medium	high
Rare	very low	very low	low	medium	medium

*(Adapted from NZ MoH, 2007)*

*Instruction: Using either of the methods outlined above, consider each of the hazard events separately and determine the priority for each. Enter the priority rating into the third column of the DWSP matrix.*

**Reference:**

1. SMEC International Pty Ltd, Cooma, NSW, Australia, Consultancy Report, 1999.
2. Ministry of Health, 2005, Small Drinking Water Supplies- Preparing a Public Health Risk Management Plan. Wellington, New Zealand.
3. Water Supply Plans Books 1&2 -2004, WEDC Publication-Loughborough University, UK
4. Engineering Section Report-January 2007-Public Works Department, Santo



REPUBLIC OF VANUATU  
MINISTRY OF INFRASTRUCTURES AND PUBLIC UTILITIES  
PUBLIC WORKS DEPARTMENT

SOILS, MATERIALS &  
WATER TESTING  
LABORATORY

WATER QUALITY REPORT SHEET

*ELE Paqualab System 418-160, 418-150, 418-100*

Sample Number	: SAN-002/07	Sampling Date	: 24-Jul-07
Location	: Luganville, Santo	Testing Date	: 24-Jul-07
Source	: Borehole - Sarakata Pump Station	Technician	: UN
Physical Description	: Clear, no visible dirt / solids.		
Odour / Taste	: No distinct smell, no odour. Tastes ok.		

TESTS		WHO Standards (max. value)	RESULTS				
Test	Unit		Source	Chapuis Tank	Sarakata Tank	St Michel	Pekoa Airport
Turbidity	NTU	5	1.29	2.16	1.53	0.63	2.84
Conductivity	µS/cm	400	469	476	474	476	647
Temperature	°C	-	25	25	25	25	25
pH		6.5 - 8.5	7.8	7.7	7.7	7.9	7.9
Total Dissolved Solids	mg/L	1000	2810	2820	2820	2850	3890
Free Chlorine Residual	mg/L	5		0.55	0.59	0.85	0.29
Total Chlorine	mg/L	5		0.55	0.61	0.87	0.29
Ammonia	mg/L	1.5	0.04	0.15	0.18	0.40	0.50
Nitrate	mg/L	10	0.22	0.22	0.34	0.45	0.40
Faecal Coliforms	col/100ml	0	0	0	0	0	0
Total Coliforms	col/100ml	0	0	0	0	0	0

Unsatisfactory Results (+)				
Recommended Action				

Observations	Results show that water quality of the source well is still good despite the heavy rain last weekend. No coliform bacteria are found, and levels of nitrate and ammonia are low.

Senior Materials Technician : WARLAN IAVRO	Chief Materials Engineer: WILLIE WATSON
Signature :	Signature:
Date : 25/7/07	Date: Public Works Department

