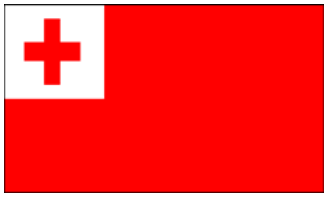

TONGA

WATER SAFETY PLAN FOR LOMAIVITI RURAL SUPPLY
TONGATAPU

Niu Fakakovikaetau, Ministry of Health, Tonga
Linisi Lavemai, Tonga Water Board 13/03/07

Water Safety Plan Programme
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NOTE

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SOPAC wish to acknowledge the kind cooperation of Tonga Water Board, Ministry of Health and the Water safety Plans Steering Committee, Tonga to make this project a success.

List of Other Reports:

Water Supply System Description – Nuku'alofa /Lomaiviti
Water Safety Plan – Nuku'alofa Urban Supply
Water Safety Plan - Rain Water Tank
Improvement Schedules –Nuku'alofa Urban Supply
Monitoring Plans - Urban and Rural Supply

TABLE OF CONTENTS

Water Safety Plan for Lomaiviti Rural 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 that 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 Tonga from 12-16 March 2007 was convened to review the Water Safety Plan and Improvement Schedules compiled by the Tonga Water Safety Plan Steering Committee and the Tonga Water Board.

Mr. r Roly Hayes (engineer) also joined the mission to carry out the assessment of the Nuku'alofa Urban Water Supply. Other experts on this mission were Drinking Water Assessors from New Zealand Ministry of Health.

The team reviewed the water safety plan, carried out field assessment and water analysis. The Tonga Water Board Engineer was consulted and reference was made to the Tonga Water Board Reports. At the end of the week draft reports were presented and discussed with Tonga Water Board and the Water Safety Plan Steering Committee.

1.2 Administrative Support

Administrative support was given by Tonga Water Board for the transport for field work and office space. A good commitment was shown by Tonga Water Board as the lead agency in the project. All information was made available to the mission team by the Tonga Water Board

1.3 Key Personnel

Judy Williamson, Drinking Water Assessor, Ministry of Health, New Zealand
Rebecca Fox, Drinking Water Assessor, Ministry of Health, New Zealand
Scott Rostrom, Drinking Water Assessor, Ministry of Health, New Zealand
Roly Hayes, Water Engineer, Dunedin, New Zealand
Davendra Nath, Water Safety Plan Project Officer, (SOPAC)
Katusi Fielei, Chief Engineer, Tonga Water Board
Lindsy Lavemai, Water Manager/Coordinator, Tonga Water Board
Taniela Kailahi. Project Engineer, Tonga Water Board

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 Drinking Water Safety Plan (DWSP) 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

3. WATER SAFETY PLANS FOR LOMAIVITI RURAL WATER SUPPLY

SUPPLY NAME: LOMAIVITI VILLAGE

Flow Chart

Catchment & Intake

- Source: Freshwater lens (groundwater)
- One hand-dug well, with a diesel operated pump
- The pump is operated for about 10 hours per day (5 am to 10am and 5pm to 10pm)
- Very little soil cover with porous (limestone) ground underneath
- Covered well-head (concrete)
- There is a pump shed at the well to protect the pumps, which is secure (shed has gate and is kept locked)
- Diesel is filled when needed and is not normally stored at the shed
- Some cultivation and farming activities within 100m of the well
- Dwelling Houses nearby

Storage & Treatment

- The well pumps water into 2 elevated header tanks
- Elevated tanks height of 15 m
- 50 mm pipes used
- No Treatment
- Two Header tanks (fibre glass) 20,000 litres on steel frame.

Distribution

- Distribution is by gravity feed to the community
- Households supplement the reticulated supply with Rainwater Catchment. Most households have a rainwater tank.
- 50 mm PVC pipes for village reticulation.
- Household connection by 12 mm
- All rural households metered for water rates and demand control

Worksheets

Catchment & 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.*
Contaminated aquifer water from surface activities (e.g. farming, household waste-water and sewage) in the recharge zone reaches the well.	No. The porous nature of the ground offers little protection against contaminants entering the aquifer. The extent/area of the groundwater lens is currently unknown.	Yes
Diesel spills and leaks in the pump-shed could seep into the well though cracks in casing.	Yes. The wellhead is well protected. Diesel usage and spills are well contained to prevent seepage into the well.	yes
Sabotage / Vandalism	Yes. The wellhead as well as the diesel pump is well enclosed within a secured pump-shed, which has a gate that is kept locked.	yes
Increasing Diesel costs may make the supply not viable.	No	Yes. Alternative means of running the system i.e. electricity needs to be considered in light of increasing diesel prices.
Not enough water can be drawn from the wells because severe weather conditions (e.g. drought) could lead to a decrease in the amount of freshwater available.	Yes, because this is an unlikely event. The community has considered use of rainwater catchment to supplement the well. The Village Water Committee has a system of metering the water supply and collect water rates from households on a monthly basis. This ensures the responsible use of water in the community.	

Storage & 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.*
There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	No	Yes. Consider treatment / manual for removal.
Disruptions to water supply may result from damage to the elevated header tanks from natural disasters such as earthquakes or cyclones.	No	Yes. The header tanks should be well secured. Other options for storage need to be considered.
Insufficient treatment and storage of chemicals	No	Yes, Training for the operators
Birds and animals sheltering on the tanks.	no	Yes, Fencing and covering of the tanks

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.*
Illegal connections could lead to cross-contamination	No. Illegal connections are discovered only when meter readers are out to read meters. The illegal connection could go un-noticed for several weeks.	Yes. More stringent enforcement of the relevant laws by the village water committee is needed.
Cross-connection of rainwater system with the reticulated supply could lead to cross-contamination.	No. No monitoring of rainwater systems (and connections).	Yes. Need for monitoring of rainwater systems by the village water committee.
Low Pressure could result in some communities being deprived of water.	No. It is assumed that gravity feed is sufficient to supply water to all households connected to the system.	Yes. Need for booster pumps.
Leakages within the distribution network could result in cross-contamination.	No	Yes
Breakages in underground pipeline from other activities such as digging for electrical/ telephone cables, construction etc.	No	Yes
Untrained personnel may take long to repair pipes and contaminate the system	No	Yes. Need training
Sabotage/tribal disputes	No	Yes. Needs policy/legislation

Plan to Manage the 'Needs Urgent Attention'

Catchment & Intake

Risks that 'Needs Urgent Attention'	Improvement Schedule: How can you remove or reduce or remedy the cause and by when? Indicate where additional resources will be needed.	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, reduced or remedied? Who needs to know and how quickly? Who can help?
1. Contaminated aquifer water from surface activities (e.g. farming, household waste-water and sewage) in the recharge zone reaches the well.	Carry out full analysis of the source water to identify what chemical or microbiological (if any) contaminants may be present Introduce treatment e.g. chlorination	Water smells, looks or tastes abnormal Increase in public dissent about taste, appearance or smell of water. Cannot maintain adequate levels of residual chlorine.	Send out public health messages to all households in the village about possible risk of contamination. Advise them to take necessary precautionary measures e.g. boil or filter water. Advise consumers to switch to rainwater for drinking.
2. Increasing Diesel costs may make the supply not viable.	Alternatives for diesel operated pumps need to be considered, e.g. electric pumps maybe installed instead.	Generators operate less often (and for shorter periods of time). Public complaints about lack of water or low pressure.	Same as 1 above.
3.Contamination from Storm water and animals	Fencing and drainage of the borehole area.	Observation visits and bacteriological analysis of water	Same as above
4.Insufficient Chlorination	Storage Facilities for chlorine Training of operators	Sampling/ analysis of the drinking water. Inspection by Health /Water Authority	Same as above
5.Pollution	Awareness on chemical use for farming, Ban polluting Chemicals	Chemical analysis of drinking water regularly.	Water cartage to people. Use alternate source eg rain-water
6.Intrusion of Sea Water in boreholes	Relocate boreholes inland	Chemical analysis	Look for alternate source eg rain water

Storage & Treatment

Risks that 'Needs Urgent Attention'	Improvement Schedule: How can you remove or reduce or remedy the cause and by when? Indicate where additional resources will be needed.	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, reduced or remedied? Who needs to know and how quickly? Who can help?
7. There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	Install a filtration system to remove the protozoa. The capital costs are not budgeted. A proposal needs to be prepared and presented to potential donors, with the WSP providing sufficient justification for the needed capital works.	Water smells, looks or tastes abnormal Increase in water-borne disease cases in the community.	As in 1 above
8. Disruptions to water supply may result from damages to the elevated header tanks from natural disasters such as earthquakes or cyclones.	Secure elevated tanks to ensure they do not topple over during natural disasters. Install a booster pump to be used if the elevated tanks are damaged.	Visible damage to elevated tanks and piping.	As in 1 above.

Distribution

Risks that 'Needs Urgent Attention'	Improvement Schedule: How can you remove or reduce or remedy the cause and by when? Indicate where additional resources will be needed.	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, reduced or remedied? Who needs to know and how quickly? Who can help?
9.Illegal connections could lead to cross-contamination	The Village Water Committee needs to monitor connections to identify illegal connections on a regular basis.	The water appears muddy or smells and tastes abnormal.	As in 1 above.
10.Cross-connection of Rainwater system with the reticulated supply could lead to cross-contamination.	A regular monitoring / surveillance schedule for rainwater system connections. Allocate wardens in the village.	The water appears muddy or smells and tastes abnormal.	As in 1 above
11. Low pressure could result in some households being deprived of water.	Install a booster pump where low pressure could be a problem.	Households complain of low pressure or no water.	Advise on collecting water. Make arrangements for water distribution (i.e. by a water truck).
12. Leakages within the distribution network could result in cross-contamination.		Members of the community report leakages.	As in 1 above
13. Breakages in underground pipeline from other activities such as digging for electrical/ telephone cables, construction etc.	Ensure that permission is sought from the Village Water Committee for construction/digging works in the village.	The water appears muddy or smells and tastes abnormal.	As in 1 above.

Water Safety Plan **CATCHMENT & INTAKE**

Hazard event	Cause	Risk	Control Measure	Critical Limits		Monitoring			Corrective Action	Verification
				Target	Action	What	When	Who		
Chemicals	Farming	low	Public awareness zoning	Ban chemical use	Formulate national standards	Maximum acceptable range	Bi-annually	MOH/TWB	Relocate bore wells/	Water Analysis
Diesel Spills	Sub-standard pump sheds	high	Design and construct proper sheds.	No diesel spills						

STORAGE AND TREATMENT

Storage and Treatment

Hazard event	Cause	Risk	Control Measure	Critical Limits		Monitoring			Corrective Action	Verification
				Target	Action	What	When	Who		

DISTRIBUTION

Hazard event	Cause	Risk	Control Measure	Critical Limits		Monitoring			Corrective Action	Verification
				Target	Action	What	When	Who		

4. WATER SAFETY PLAN - TONGA
IMPROVEMENT SCHEDULE

By, Niu Fakakovikaetau, Environmental Health Officer, Ministry of Health 16th March, 2007

IMPROVEMENT SCHEDULE FOR RURAL WATER SUPPLY IN TONGA

#	Improvement Needed	Revel of Risk	Health Priority	Can the improvement be made within the next few weeks	Staff time	Equipment and installation costs (who is responsible for the improvement	Overall priority for making the improvement	Comments	Cost of the task
1.	Improve the Security of the old dug well head	High	1	No. Completed in 3 month	Moderate	$150/well head. Niu Fakakovikaetau and Village water committee	1	Cost-sealing the well, using local equipment and labour	$8700.
2.	Improve the Security fence for the water sources (Bore hole and water tank)	moderate	3	NO, Completed in 6 month	Moderate	$450/water supply. Niu Fakakovikaetau and Village water committee	3	Cost- Fence the Bore hole and water tank	$26100
3.	Improve the Security for the water tank cleaner (fence around the tank and Ladder.	High	1	No, Completed in 1 year	High	$940/water tank. Niu Fakakovikaetau and Village water committee	2	Cost- Protection fence around the tank and Ladder from tank stand	$54520.
4.	Contamination get	High	1	No,	Moderate	$450/water	1	Cost- Install a	$26100.

	into the storage tank (no covered at the top)			Completed in 6 month		tank. Niu Fakakovikaetau and Village water committee		water tank covers from the top.	

SUMMARY OF ESTIMATED COSTS:-

1. bore and dug well head estimated
   58 water supply x $150/each = $8,700.00

2. fence for the water source
   58 water supply x $450/ each =$26,100.00

3. Ladder and Galvanize Fence for water tank
   58 water supply x $940/each = $54,520.00

4. Top cover for water tank
   58 water supply x $250/each =$26,100.00

TOTAL COSTS = $115,420.00

5. Conclusion

The Water Safety Plan and the Improvement Schedules for the rural area were compiled by the Ministry of Health, Tonga since they have the jurisdiction in the rural community to provide safe drinking water. There are a number of small rural supplies serving the population and the water supply system comprises of a borewell with diesel pump which pumps the water to the elevated tanks. The water from the elevated tanks is distributed to the community by gravity force. The diesel pumps run for at least four hours a day to fill tanks in order to have sufficient water for the community. Observation reveals that the pumps operated by diesel fuel leaks and contaminates the borewell. Secondly the bore well do not have a secured structured and are not fenced to exclude animals. Borewell are contaminated by human and animal activities. There is a great need for the improvement of these community supplies in order to maintain a safe water supply for human consumption

Reference:

1. PPK Consultants Pty Ltd 1992, Water Resources and Assessment-Tonga
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-Tonga Water Board

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	• Occurs like clockwork • Occurs every week, month or season
Likely	• Has occurred more than once before • Expected to occur every year
Possible	• Has occurred before • Expected to occur every 2-5 years
Unlikely	• Has occurred before • Expected to occur every 5-10 years
Rare	• Has never occurred before and unlikely to occur less than every 10 years

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

Consequence Score	Possible Descriptions
Insignificant	• No illness expected in the community or interruption to water availability
Minor	• Very few of the community ill, or some interruption to water availability
Moderate	• Some of the community ill
Major	• Most of the community ill
Catastrophic	• Most (or all) of the community ill with anticipation of some deaths

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.