REPORT

PACIFIC WATER SAFETY PLANS PROGRAMME

NATIONAL TRAINING AND PLANNING WORKSHOP

KINGDOM OF TONGA

Convened By

SOUTH PACIFIC APPLIED GEOSCIENCE COMMISSION (SOPAC)

AND

WORLD HEALTH ORGANIZATION (WHO)

17TH TO 21ST JULY, 2006

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SUMMARY

The workshop on Training and Planning for the Pacific Water Safety Plans was conducted in the Kingdom of Tonga from 17 to 21 July 2006.

The objectives of the workshop were as follows:

- To train the participants on the formulation of Water Safety Plans for the urban and rural water supply systems.
- To plan for the implementation of the Water Safety Plans.
- To do the preliminary risk assessment and management exercise for the Nuku'alofa water supply and a rural community supply.
- To engage all relevant government agencies, NGOs and other potential partners during training and planning of national activities.

As Tonga is one of the four selected Pacific Island countries for the Water Safety Plans programme it is necessary to train and plan for the formulation and implementation processes.

There were twelve participants from Tonga and two participants from Western Samoa. The resource persons were from South Pacific Geoscience Commission (SOPAC), World Health Organisation (WHO) and New Zealand Ministry of Health (MoH-NZ). The participants were from Water Suppliers, Ministry of Health, Department of Environment and Non-governmental organizations. The participants were higher level technical officers and were involved in water sector on various aspects.

The workshop comprised of group work supported by technical sessions led by invited experts from New Zealand ministry of health. A field trip was done for the Nuku'alofa Water supply system and a rural community supply at Lomaiviti village.

The Pacific Water Safety Plans Programme is an outcome of forums such as Tonga Commitment and the Regional Action Plan (RAP) on sustainable water management which provides for the overall policy framework for improving drinking water quality in the Pacific region through inter-sectoral collaboration

1. INTRODUCTION

1.1 Background

A major focus of World Health Organisation (WHO) in the field of Water and Sanitation has been the development and dissemination of guidelines related to drinking Water quality. Special emphasis has been given to the development of guiding document including Water Safety Plans.

Countries of the South Pacific face special circumstances, including costly communications and logistics. Physical isolations often prohibit routine monitoring mechanisms such as laboratory analysis and feedback from being effective. Therefore, approaches that are less dependent on laboratories and specialised equipments and more tuned towards trained observations, sanitary surveys and practical controls are needed. The risk to scarce water resources from increasing population and development is a major concern. A coordinated inter-country approach engaging various development partners, including donor and non-governmental organisations active in the Pacific, would help countries to meet the challenges of their isolations and other special circumstances.

The main drinking water source in urban areas in Tonga is ground water and for rural areas rainwater, with some utilisation of surface river water. Due to the hardness of the ground water, Tongans supplement their ground water supply with household rainwater catchment systems and purchase filtered groundwater.

Responsibility for water supply distribution, operation and maintenance in urban areas and of village committees in rural areas is that of the Tonga Water Board. Monitoring is carried out by the board in urban areas and by the Ministry of Health in rural areas. Town water supply for the capital Nuku'alofa comes from 35 boreholes in the Mataki Eua and Tongan well fields to the south-west of the city where it is pumped from the bores and collected in large concrete tanks and gravity fed into house connections throughout the city. The only treatment it receives is chlorination, however the chlorination dosing system is often breakdown and manual mixing is done.

Data from Ministry of Health suggests that there has been an increase in water related diseases since 1996. Reported cases of diarrhoea and gastro-enteritis have increased from 2281 to 3667 (almost a 33% increase) over a four year period. In urban Nuku'alofa, the Tonga Water Board conducts monthly water quality analysis from fixed sampling points at wells, water tanks, and fixed points in the distribution system, and analyses samples from

urban areas. All samples in the capital and the other urban centres are tested for salinity, total and faecal coliform, and residual chlorine in the distribution system.

1.2 WATER SAFETY PLANS

Water Safety Plans (WSP) can be termed as such approaches that provide most effective means of consistently ensuring the safety of a drinking water supply through the use of a comprehensive risk assessment and risk management. It draws on many of the principles and concepts from other risk management approaches, in particular the multiple barrier approach and HACCP as used in the food industry.

Growing segments of the population are continuously at risk of waters borne disease through polluted drinking, coastal as well as surface waters. This is compounded by the lack of information needed for resource development and protection as well as a lack of awareness of the problem associated with contaminated water. General recognition of the problem is at start, but action for increasing the capacity of Pacific Island Countries to develop and implement Water Safety Plans that address the issues is greatly needed in order to secure safe drinking water.

Water safety plans place an emphasis on ensuring that processes used to produce safe water is controlled and function in such a way that hazards are excluded from water before delivery to consumers. They are catchment to consumer approach, with actions taken from source protection through treatment, storage and distribution

The importance of safe drinking water for health and development has been reflected in the outcomes of many international forums. Under the millennium development goals countries have committed themselves to achieving inter-related targets for sustainable access to safe drinking water. Pacific island countries through the regional action plan (Sigatoka, Fiji 2002) outlined actions needed to achieve sustainable water management through a collaborative effort. The introduction of Water safety Plans conception in the Pacific Island Countries will address all aspects in drinking water such as abstraction, storage and distribution.

A Water Safety Plan comprises as a minimum the three essential actions that are the responsibilities of the drinking water supplies in order to ensure that the drinking water is safe. These are system assessment, operational monitoring and management.

The maim objectives of the Water safety Plans are to prevent contamination of source waters, to treat the water efficiently to reduce contamination and to prevent recontaminations during storage and distribution.

1.3Objectives.

The objectives of the workshop were that at the end of the workshop, the participants were able to demonstrate:

1. Improved understanding of the water safety planning process, through practice.

2. Ability to prepare draft water safety plans for urban (Nuku'alofa) and pilot rural supplies.

3. Ability to prepare a draft National Implementation Plan including identification of roles, responsibilities and the next steps to introduce and implement water safety planning programme in Tonga.

4. Engage all relevant government agencies, NGOs and other potential partners.

1.4 Participants

There were 14 participants, twelve from Tonga and 2 from Samoa. The participants were from all the relevant government organizations such as Ministry of health, Department of Environment, Dept of Lands and Survey, Tonga Water Board. There were two major NGOs such as TANGO and Tonga Trust who work closely with the community. The participants were technical persons and middle managers who had a good knowledge of the water problems in Tonga. The participants showed great interest in the workshop and were present at all sessions. They freely expressed their views on the subjects discussed and their output and experience was seen as an encouragement. A list of participant and resource persons is attaché in Annex 1.

1.5 Organization

The workshop programme is attached as Annex 2
The officers for the workshop were:

Mr.Davendra Nath, Project Manager, Water Safety Plans Programme, from South Pacific Applied Geoscience Commission (SOPAC), Fiji

Mr. Mitesh Mudaliar, Project Assistant. World Health Organization (WHO) ,South Pacific.

Dr. Jan Gregor. Workshop Coordinator, Senior Scientist, ESR. New Zealand
Mrs Judy Williamson, Resource person Water Assessor, MoH-New Zealand.
Mr. Tahi Mortan, Resource Person, Water Assessor, MoH. New Zealand.

The workshop comprised group work and two groups of six participants did exercise and discussion and presented their ideas. Some lectures and instruction were also given by the resource persons. A field trip for the urban and rural supplies was made for the risk assessment exercise for the participants. The trip session was assisted by the Tonga Water Board staff and Ministry of Health briefed on the rural community water supply. Butcher paper was used to record group discussion and then it was placed on the wall for reference. The workshop progressed as per the plan and a rapporteurs Mr Taniela Kailahi was chosen from Tonga Water Board to record the days proceedings.

1.6 Opening Remarks

The opening ceremony was attended by all the participants and the resource persons and the opening speech was delivered by Mr Simone Helu, the Chief Executive Officer of the Tong Water Board. Mr Helu stressed on the importance of having a safe drinking water for the people of Tonga in order to avoid ill health and promote economic development. Speeches were also made by the Project Manager Mr Davendra Nath on the introduction of Pacific Water safety Plans Programme and Dr Jan Gregor brief on the National Training and Planning workshop for Tonga.

The media coverage was done by the Tonga Television and Mr Lindsay Lavemai was interview about the workshop objectives. The CEO of Tonga Water Board was also interviewed about the workshop and their roles in providing the safe drinking water for the urban and rural communities of Tonga.

1.7 Technical Inputs:

The three New Zealand Ministry of Health experts as resource persons provided technical expertise and conducted the workshop as per the programme and covered all relevant topics so that the participants grasp the concepts and knowledge in order to compile the water safety plans for the respective areas.

Many group exercises were done and video session were used to show the formulation of Water Safety Plan in New Zealand context. Similar approach

can be used for the Pacific Island countries. This video was suitable for the participants as they will be preparing the plans and their inputs was necessary as they looked at the situation from different perspective while coming from different work experience. Information was provided by Tonga Water Board and the Ministry of Health on many relevant aspects of the water supply. The participants were also provided with handouts on specific topics.

2: PROCEEDINGS:

2.1 :Workshop Presentations:

Day 1 .Monday, 17/07/06

Session: 1

The registration for the participants commenced at o8.30 and the file and name tags were issued. An attendance sheet was prepared where the participants had to sign each day.

The opening ceremony was from 09.30 and the opening speech was made by Mr Saimone Helu CEO of Tonga Water Board. He stressed on the importance of the safe drinking water supply and it s significance to the public health. He thanked the participant, resource personnel and the supporting organizations and requested the participants to benefit from the training and planning workshop. He also urged all the stakeholders to collaborate in order to full fill the workshop objectives.

The project manager Mr Davendra Nath briefed on the Water Safety Plan and its objectives and thanked the participants and the supporting organisation. Dr Jan Gregor outlined the workshop programme for the week and emphasised on the importance of having National Water Safety Plans.

The media coverage was for the opening ceremony where Tonga Television interviewed Mr Lindsay Lavemai from Tonga Water Board the local coordinator and a participant on the objectives of the workshop. In the second day coverage Mr Saimone Helu CEO of Tonga Water Board was interviewed who informed on the importance of safe drinking water and the purpose of the week long Water Safety Plans workshop.

Session: 2

Introduction to Tonga Water supply session was done by Dr Jan Gregor whereby the participants outlined the urban and rural water supply system. Urban Nuku'alofa supply system uses underground borehole water through a

metered reticulation to supply the main city of about 30,000 people. The rural community also use borehole water which is pumped to the elevated 3000 to 5000 tanks and supplied by pipes to each household through gravity flow. About 80% of the household also use rain water and have household tanks due to unpleasant taste of the reticulated water.

The group work involved the plotting of the supply system on the white board and later it was copied on the butcher paper for recording the participant's view of current roles and responsibilities

Session; 3

This session was conducted by the two water assessors from New Zealand i.e. Judy Williamson and Tahi Morton. Their topics for discussion were on the Introduction of water safety plans and Water Safety Planning processes. Issues such as risk assessment and importance of Water safety plans were discussed. Judy Williamson did group exercise with the participants on Water Safety Planning processes. The two groups were given hexagon shapes and phrases that describe the water safety planning processes and a set of key questions used in water safety planning.

Session: 4

Dr Jan Gregor presented on the Introduction to Tonga National Implementation Plan for Water Safety Plans programme. The plan records the decisions how to develop and implement a WSP programme in Tonga. It maps out how to progress from now to the desired future and identifies the inputs, roles and responsibilities.
The participants expressed their views by writing on sticker papers and later clustering the like ideas which became headings in the plan.

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Day 2 Tuesday 18/07/07

Session: 5

A field trip to Nuku'alofa well field, storage and distribution and the Lomaiviti village was made to collect information that will help answer the key question in particular the risk assessment. Such issues as the supply of safe drinking water and improvement opportunities were considered. The participants moved together to visit the well fields, the storage and treatment systems. The participants then moved to a rural water supply system and inspected a bore hole with diesel pump and two elevated tanks used for the Lomaiviti village.

Session: 6

This session involved the group recall, description and analysis of Nuku'alofa water supply and the Lomaiviti village supply after the field trip. The participants in two groups mapped the two water supplies on the butcher paper and discussed on the risks in the area. All activities in the area were noted and structures plotted.

Session: 7
This session was for risk identification and ranking where the participants ranked the risk in priority on the butcher paper. The participants were given red dot stickers to vote on each priority.

Day: 3 Wednesday 19/07/06

Session: 8 and 9

This session were taken by Judy Williamson and supported by Dr. Jan Gregor which mainly dealt with planning to manage the risks.

Session: 10 and 11

The three New Zealand experts conducted this session on activity matrix .the participants used five butcher paper for designing the WSP in each category for the water supply system. This session considered the more technical elements of Water Safety Planning.

Day 4 Thursday 20/07/06

Session: 12 and 13

These sessions mainly dealt with the activity matrix designing for the Water Safety Plans programme implementation and was take by Dr Jan Gregor, Judy Williamson and Tahi Morton

Sessions 14 and 15

These sessions was based on the developing of activity matrix for Water Safety Plans Programme Review and Evaluation and preparation of the Tonga National Implementation plan. Whiteboard was used to draw the matrix plotting the departmental responsibilities.

Day 5 Friday 21/07/06

Sessions: 16 and 17

These sessions were on the planning for officers from the implementing agencies for the presentation to government agencies and the steering committee. The participants contributed on their departmental roles and next steps were planned. The session was taken by Mr.Davendra Nath and the findings were captured by Mr Mitesh Mudaliar for records. The outcome of this planning discussion was presented to the steering committee.

Sessions: 18 and19

This wrap up session was with the staff of Tonga Water Board and the steering committee. The discussion was based on the future activities involved in formulating the National Plan and the compilation of water safety plans for Tonga. The Waketon Video based on the tragic incident in relation to the improper drinking water treatment was also shown to the participants prior to the closing ceremony. On behalf of he participant Mr Simi Silapelu thanked the resource persons and requested the other participants to play their in the formulation and implementation of Water Safety Plans.

The last session was closing ceremony and CEO Tonga Water board Mr. Saimone Helu delivered the closing address. He addressed the importance of the entire organisation to work together in formulating the necessary plans to ensure safe water for both urban and rural communities. All participants were thanked for their contribution and were awarded with the certificate of participation. With a vote of thanks by Davendra Nath, Programme Manager the workshop concluded at 1.30 pm.

3. Recommendation:

1. Mobilising the steering committee with the involvement of all departments to complete the National Plan.

2. Prioritise all actions and identify those that can be acted upon immediately and incorporated into departmental plans and budgets.

3. Preparation of proposals for funding and assistance where departmental budgets are insufficient for the proposed improvement to the water supply system.

4. Evaluating progress as per the national plan

5. Soliciting continuous support from regional organization and expert advice to complete the Water safety Plan.

6. Involvement of various government departments and the NGOs in public awareness in regards to ensuring supply of safe water for human consumption and use.

7. It was also agreed in the planning and closing sessions that a national water committee is formed which may have legal powers to make decisions in the disaster and for management of water supply.

8. Regular monitoring of both urban and rural water supply to be conducted by Tonga Water Board and Ministry of Health and all information to be recorded and shared.

4. CONCLUSION

The work shop was conducted in a very congenial and efficient manner whereby the participants freely expressed their views on the many subjects discussed in the sessions. The resource person's deliverance was appropriate and the group work was done to make the workshop interesting. The workshop proceeded as per the programme and all sessions were completed. The use of butcher paper and the sticker paper to capture the imagination of the participant views was well accepted and produced maximum out put. The group exercises focussed the attention of the participants on how to draw the plans and carry out necessary assessment of the water supply systems.

The participants from the various departments agreed to work together with the guidance of the Tonga Water Board and other agencies

WORKSHOP OUTCOMES

ANNEX 1

OUTCOMES

Draft Water Safety Plan for Nuku'alofa system

Draft Water Safety Plan for Lomaiviti village system

Draft National Implementation Plan

WHO NEEDS TO BE INVOLVED?

The following agencies have a key role to play in the further development of the WSP Programme in Tonga:

- Tonga Water Board
- Ministry of Health
- Department of Environment
- TANGO, Tonga Trust & other NGOs
- Village Water Committees
- Lands & Survey, MAFF, Min. of Agriculture
- Emergency & Disaster Office
- Finance, Legal and National Planning Office

NEXT STEPS

1. Mobilizing of Steering Committee
2. Steering Committee completes the National Plan
3. Actions are prioritized to identify those that can be acted on immediately
4. Agencies incorporates these actions into their plans and budgets
5. Prepare proposals for external assistance when departmental budgets are not sufficient to complete actions
6. Periodically check progress of actions against the National Plan
7. As soon as relevant actions are complete, begin preparing Water Safety Plans

SUPPORT

SOPAC & WHO will continue supporting National Activities
NZ MoH will provide expertise as required (and when requested by the Steering Committee

WHAT THE PARTICIPANTS HAD TO SAY

'we have been concerned with sustainability of water resources for a long time, but for the first time we have been discussing water safety'

'Water Safety Plan is a very important programme to leave unfinished, so I hope the agencies will do their best to continue the work that was initiated at this workshop'

'the methodologies used during the workshop was very INCLUSIVE and it was good because it made us feel that whatever we are contributing has some relevance to the process'

'I had not realized that Water Supply is such a multi-sectoral issue and now appreciate that for better management of water supply, all key stakeholders need to be involved'

ANNEX 2

PACIFIC WATER SAFETY PLANS PROGRAMME
PLANNING AND TRAINING WORKSHOP
17TH TO 21ST July - TONGA

PARTICIPANTS LIST ORGANIZATION CONTACTS

TONGA

1. Lindsay Lavemai Tonga Water Board - llavemai@Yahoo.com
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10. Kelepi Mafi Ministry of Lands &Survey-
11. Viliami Soakai Tonga Trust - vsoakai@tcdt.to
12. Mrs Vao Lagi TANGO - seiuhila@Yahoo.com

SAMOA

13. Larissa Toelupe -Snr Water Resource Officer, Dept of Environment toelupelari@ gmail.com
14. Thomas Soon. - Lab Technician, Samoa Water Authority. Thmas@ swa.gov.ws

RESOURCE PERSONS;

1. Dr. Jan Gregor, Senior Scientist, ESR, NZ
2. Mrs Judy Williamson, Water Assessor, MoH-NZ

3. Mr Tahi Morton , Water Assessor ,MoH –NZ
4. Davendra Nath, Programme Manager, Water Safety Plans, SOPAP, Fiji
5. Mitesh Mudaliar ,Programme Assistant, Water Safety Plans ,WHO, Fiji

ANNEX 3

PACIFIC WATER SAFETY PLAN PROGRAMME

NATIONAL WATER SAFETY PLAN

TRAINING & PLANNING WORKSHOP

KINGDOM OF TONGA

17 – 21 July 2006

DAY 1	**MONDAY**	**17 July**
08.30	Registration	
09.00	Opening Ceremony	
	Welcome and opening remarks Address by CEO Mr Saimone Helu, Tonga Water Board Address by Davendra Nath, Programme Manager, WSP Address By Dr Jan Gregor, Workshop Coordinator,MoH-NZ	
10.30	Morning Tea	
11.00	Introduction to Tonga Water Supplies	
12.30	Lunch	
13.30	Introduction to Water Safety Planning	
14.30	The Water Safety Planning Process	
15.45	Afternoon Tea	
16.00	Introduction to Tonga National Plan for Water Safety Plan Programme	
16.30	Re-cap Day 1	
17.00	End of Day	

DAY 2	TUESDAY	18 July
08.30	Field Trip to Nuku'alofa well field, storage and distribution	
13.00	Lunch	
14.00	Nuku'alofa system description and analysis	Stage 2 of WSP
15.30	Afternoon Tea	
15.45	Risk identification and ranking	Stage 4 of WSP
16.45	Re-cap Day 2	
17.00	End of Day	

DAY 3	WEDNESDAY	19 July
08.30	Planning to manage risks	Stage 5 of WSP Process
10.00	Morning Tea	
10.30	Planning to manage risks (cont..)	
13.00	Lunch	
14.00	Developing Activity Matrix for Water Safety Plan Programme Preparation	
15.30	Afternoon Tea	
16.00	Developing Activity Matrix for Water Safety Plan Programme Preparation	
16.30	Recap Day 3	
17.00	End of Day	

DAY 4	THURSDAY	20 July
08.30	Developing Activity Matrix for Water Safety Plan Programme Implementation	
10.00	Morning Tea	
10.30	Developing Activity Matrix for Water Safety Plan Programme Implementation	
13.00	Lunch	
14.00	Developing Activity Matrix for Water Safety Plan Programme Review and Evaluation	
16.30	Recap Day 4	
17.00	End of Day	

DAY 5	FRIDAY	21 July
08.30	Preparation for Presentations to Government Delegation	
09.30	Steering Committee Meeting	
10.30	Morning Tea	
11.00	Presentation to Government Delegation	
13.00	Lunch	
14.00	Wrap-up	
15.00	End of Day	

WATER SAFETY PLAN PROGRAMME

DRAFT

NATIONAL PLAN

KINGDOM OF TONGA
JULY
2006

Prepared during the National Water Safety Plan Training & Planning Workshop at Dateline International Hotel, Nuku'alofa, Tongatapu, Kingdom of Tonga, 17th – 21st July 2006.

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INTRODUCTION

The importance of safe drinking water for health and development in the Pacific Island Countries has been reflected in many regional action plans and policies. Through the Regional Action Plan on Sustainable Water Management (Sigatoka, Fiji, 2002) Pacific Island Countries outlined actions that were needed to achieve sustainable water management through collaborative efforts by water sector authorities and inter-sectoral partners.

The WHO workshop on Drinking Water Quality Standards and Monitoring in Pacific Island Countries (Nadi, Fiji, 2005) developed a Framework for Action on Drinking Water Quality and Health in Pacific Island Countries, designed to support the implementation of drinking water quality actions envisioned in the RAP.

The Pacific Island Countries embraced the Water Safety Plan concept during the workshop and this was reflected in the Regional Framework. It was recommended that PICs should use Water Safety Plans to better manage their water supplies to ensure safe quality drinking water for Pacific communities.

The Government of Tonga, through various government and non-government agencies including Tonga Water Board, Ministry of Health, Ministry of Lands and Survey, NGOs and Community Groups, are committed to establish Water Safety Plans for urban, rural and outer-island water supplies.

A Steering Committee for the Tonga Water Safety Plan Programme has been established and consists of relevant agencies, both government and non-government. The Tonga Water Board is the secretariat for the Steering Committee as well as the lead implementing agency.

Other agencies such as the Ministry of Health, Ministry of Lands, Survey and Natural Resources, Department of Environment, National Planning Office, TANGO, Tonga Community Development Trust, Ministry of Finance and Ministry of Fisheries and Forestry have committed to support the programme.

BACKGROUND

The Pacific Water Safety Plan Programme

The Pacific Water Safety Plan Programme is a joint initiative of the South Pacific Applied Geo-science Commission (SOPAC) and the World Health Organization (WHO).

Funded by AUSAID, the programme is a response to the regionally endorsed Framework for Action on Drinking Water Quality and Health and will be implemented over the period 2006-2007.

The programme plans to improve the health of people in the Pacific through strengthening of national capacity to maintain safe drinking water supply systems.

Water Safety Plans (WSP), as promoted by WHO in the Guidelines for Drinking Water Quality (Third Edition), are tools that allow for proactive approaches to ensuring safety of a drinking water supply using risk assessment and management approaches to identify risks of contamination of water supply and allow for sufficient mechanisms to manage these risks.

The primary objective of a Water Safety Plan is to minimize contamination of water sources, prevent or remove contamination during treatment and prevent contamination during storage and distribution.

These objectives are equally applicable to large reticulated water supplies, smaller community managed systems as well as individual household systems.

WHO Guidelines for Drinking Water Quality

Drinking-water quality control is a key issue in public health policies. From 1950 to 1970 the World Health Organization (WHO) published standards for drinking-water quality that served as a scientific basis for monitoring the quality of the water produced and delivered by water suppliers. Later on, other legislative and regulatory approaches were published by the WHO and the European Union (EU): WHO Guidelines for Drinking Water (1st edition, 1984, and 2nd edition, 1993), and EU Directives 80/778/EC, and 98/83/EC (EC, 1998). This legislation was strongly focused on standards for treated drinking water and on compliance monitoring. Water quality was guaranteed by the so-called end product testing, based on spot sampling of the water produced. With this procedure it was possible to bring the very widespread water-borne diseases under control, especially those of bacterial origin.

Over the years, several shortcomings and limitations of the end-product testing methodology has been identified. Some of them are related to the following aspects:

a) There is a multitude of water-borne pathogens that cannot be detected or they can be detected insecurely with the classical indicators *E. coli* Coliforms and *Enterococci*, particularly viruses and protozoa. There are examples of water-borne disease outbreaks

(*e.g.*, Milwaukee - U.S.A., in 1993) that occurred through water supply systems that met the standard for absence of indicator micro-organisms.

b) Often, monitoring results are available out of time of intervention needed to maintain the safety of a supply system. End product testing only allows checking if the water delivered was good and safe (or unsafe) after distributed and consumed.

c) End-product testing hardly can be considered a sound method for representative water quality *status*. A very small fraction of the total volume of water produced and delivered is subject to microbiological and chemical analysis. Moreover, the monitoring frequency does not guarantee representative results in time and space, as well.

d) End-product testing does not provide safety in itself. Rather is a mean of verification that all the supply system components and installed control measures are working properly.

In recognition of these limitations, primary reliance on end-product testing is presently considered not to be sufficient to provide confidence in good and safe drinking-water, moving towards to process monitoring by introducing a management framework for safe water (Bartram *et al.*, 2001). The 3rd edition of the WHO Guidelines for Drinking-water Quality, (GDWQ) proposes a more effective risk assessment and risk management approach for drinking-water quality control. The GDWQ emphasize the multi-barrier principle, establishing a systematic process for hazards identification and effective management procedures for their control through the application of a preventive Water Safety Plan (WSP) that comprises all steps in water protection, from catchments to the consumer (2001; WHO, 2004).

Water Safety Plan

A Water Safety Plan (WSP) is an improved risk assessment and management tool designed to ensure the delivery of safe drinking water to consumers. It identifies:

- hazards that the water supply is exposed to and the level of risk associated with each;
- how each hazard will and/or can be controlled;
- how the means of control will be monitored;
- how the operator can tell if control has been lost;
- what actions are required to restore control; and
- how the effectiveness of the whole system can be verified.

Developing a Water Safety Plan

The development of a WSP involves a systematic approach for:

- preventing the contamination of source waters
- treating water to reduce or remove contaminants; and

- preventing re-contamination during storage, distribution and handling of treated water

In order to do this, the water authority or supplier needs to:

- assemble a team that understands the system;
- identify risks, hazards and hazardous events;
- identify means for controlling these risks, hazards and hazardous events;
- establish a monitoring system to ensure consistent supply of safe drinking water; and
- periodically review the Water Safety Plan.

To develop and establish a WSP, some essential prerequisites are required such as getting commitment from Government, Managers and Executive Officers.

Once commitment is achieved, a WSP steering committee is established (consisting of relevant stakeholders such as health and environment professionals as well as the water supplier), the water supply system is described and risks identified, control measures are identified and monitoring systems developed.

ORGANISATIONS INVOLVED

Tonga Water Board

The Tonga Water Board (TWB) is the agency responsible for planning, installation, operation and maintenance of public water systems in selected urban areas of Nuku'alofa, Eua, Ha'apai, and Vava'u. Tonga Water Board is the lead implementing agency for the Tonga Water Safety Plan Programme and are a key agency in the replication of WSPs in other supplies in Tonga. They are also the secretariat for the National Steering Committee.

Ministry of Health

The Ministry of Health is the agency responsible for implementing and maintaining village water supply schemes and for monitoring and surveillance of the biological quality of public water supply schemes.

There are existing programme for regular water quality monitoring of public supplies as well as sanitary surveys and monitoring of village water supplies. These could be strengthened through Water Safety Plan pilots.

The MoH also have awareness programme for communities on health issues including water-borne diseases and could play a key role in developing awareness programme for water quality issues.

Ministry of Lands, Survey and Natural Resources

The Ministry of Lands, Survey and Natural Resources is the agency responsible for assessment and monitoring of water resources throughout the Kingdom of Tonga and for advise on future development and management of water resources. The Ministry has a key role in the Tonga Water Safety Plan Programme as the experts in water resource monitoring.

Village Water Committees

The Vai Pule or Village Water Committees are responsible for operating and maintaining the village water supply systems. They are also responsible for collecting water rates from households connected to the village water supply. Since they already have an established role in village water supplies, they have a key role in the Tonga Water Safety Plan Programme especially in awareness raising and monitoring.

Tonga Community Development Trust

The Tonga Trust (TCDT) is a major Non-Government Organisation in Tonga and has various community-based programmes. They have a strong relationship with communities in Tonga and therefore have a key role in the Tonga Water Safety Plan

Programme, especially in developing awareness materials and conducting community workshops.

TANGO

The Tonga Association of NGOs is widely recognized by International donors and has secured funding for a number of community projects, including installation of rainwater tanks in villages. TANGO has a key role in the Tonga Water Safety Plan Programme especially because of their relationship with donors, expertise in writing project proposals for funding and links with all local NGOs and community based organizations in Tonga.

Ministry of Finance

The Ministry of Finance is the agency responsible for preparing the national budget and thus has an impact on capital and recurrent funding for water supply projects. Their involvement in the Tonga Water Safety Programme is vital, as some improvements will need small-scale capital works that could be Government funded rather than donor funded.

National Planning Office

The National Planning Office is the agency responsible for overall coordination and monitoring of aid projects, and for coordination of development plans including those affecting the water sector. They also provide the secretariat for the National Water Resource Committee.

National Water Resource Committee

The National Water Resource Committee is a sub-committee of the Development Coordination Committee and is responsible for initiating and reviewing development proposals related to water resources, and making recommendations to the Cabinet.

Department of Environment

The Department of Environment (Ministry of Lands Survey & Natural Resources) is the agency responsible for environmental issues and concerns including pollution, conservation, waste management, climate change and EIAs.

NATIONAL WATER RESOURCE & SUPPLY STATUS

Status of Water Resources (Urban, rural & outer island)

To be completed by the Steering Committee

Existing Legislation, Plans & Policies

To be completed by the Steering Committee

Existing water quality standards & guidelines

To be completed by the Steering Committee

ACTIONS FOR PREPARATION OF WATER SAFETY PLANS

SYSTEM DESCRIPTION & ANALYSIS

1. Assemble a team of people who have good knowledge of the system

Assemble a team for water supply description and analysis. The team should include people with relevant technical and operational knowledge of the system.

2. Develop checklists for describing a water supply system

The team should develop appropriate methodologies for describing the system including tools such as checklists and maps.

3. Carry out surveys do describe a water supply system

The team should conduct surveys in order to describe and analyze the system in the form of systematic diagrams, maps, layouts or reports.

RISK ASSESSMENT

4. Develop relevant tools for risk assessment of the water supply system

The team should gather relevant resources and expertise to assist with identification of risks. These resources could include:

- Photos and maps of the water supply
- Risk assessment guidelines (e.g. NZ MoH and WHO guidelines)
- Videos on risk assessment (e.g. NZ MoH DVDs)
- Reports (of previous studies)
- Experts (e.g. mechanics, plumbers, operators, civil engineers, hydrologists, soil scientists, laboratory personnel, health officials and others as needed)
- Funding

RISK RANKING

5. Strengthen stakeholder collaboration

- Establish and strengthen the National Steering Committee by including all agencies that have a role (or responsibility) in the management of drinking water quality in Tonga.

6. Conduct public consultations and workshops to consult relevant agencies on issues and concerns relating to drinking water quality and health.

7. Improve sharing of information among agencies

- Establish a working group that would collate data and prepare annual reports on the following:

    i. Drinking water quality of various supplies (urban, rural and outer-island) in Tonga
    ii. Water-borne disease statistics

- The membership of this working group should include agencies that are directly responsible for water quality monitoring or health surveillance such as Tonga Water Board, Ministry of Health and Department of Environment. The NGOs and village water committees should also be represented in this working group.

- Inter & intra governmental relationships and networks should be strengthened to improve information sharing

- Establish a network between other PICs that have or are in the process of developing and implementing WSPs to share lessons learnt.

MONITORING & INSPECTION PROGRAMME

8. Develop new or strengthen existing water quality monitoring and health surveillance programmes

- Review current monitoring programmes to identify gaps and weaknesses

- Collate past water quality monitoring and health surveillance data (including customer complaints records and disease statistics)

- Conduct public consultations and organize workshops for key agencies to discuss a strategy to improve coordination between existing monitoring programmes.

9. Identify resources (e.g. finance, experts etc) that would be needed to strengthen existing monitoring programmes and establish means for securing those resources.

IMPROVEMENT SCHEDULE

10. Complete Water Safety Plans to identify areas that need improvement.

11. Rank the improvements based on the resources (funding, capital works, infrastructure development, human resources) and time needed to complete them.

Activity & Responsibility Matrix

	Actions	TWB	MoH	DoE	L&S	EDO	Fin	Legal	MAFF	NPO	TT	TANGO	VWC
1	Assemble a team of people who have good knowledge of the system	R	I	I	I	I	A	A	I	A	I	I	R
2	Develop checklists for describing a water supply system	R	I	I	I	I	A	A	I	A	I	I	R
3	Carry out surveys do describe a water supply system	R	I	I	I	I	A	A	I	A	I	I	R
4	Develop relevant tools for risk assessment of the water supply system	R	I	I	I	I	A	A	I	A	I	I	R
5	Strengthen stakeholder collaboration	R	R	R	I	I	I	I	I	I	I	I	I
6	Conduct public consultations and workshops to consult relevant agencies on issues and concerns relating to drinking water quality and health.	R	R	I	I	I	A	A	I	A	I	I	R
7	Improve sharing of information among agencies	R	R	R	I	I	I	I	I	I	I	I	I
8	Develop new or strengthen existing water quality monitoring and health surveillance programmes	R	R	R	I	I	A	I	I	A	I	I	R
9	Identify resources (e.g. finance, experts etc) that would be needed to strengthen existing monitoring programmes and establish means for securing those resources.	R	R	I	I	I	I	I	I	I	I	I	I
10	Complete Water Safety Plans to identify areas that need improvement.	R	R	I	I	A	A	A	A	A	I	I	R

11	Rank the improvements based on the resources (funding, capital works, infrastructure development, human resources) and time needed to complete them.	R	R	R	I	I	A	A	I	A	I	I	R

Key: R - Responsible I – Involved in the action A – Aware of action

Products & Outputs

1. National Policy promoting Water Safety Plans
2. Checklists developed for system description and analysis
3. Maps, schematics, layouts etc for water supply systems
4. Checklists developed for risk assessment
5. Improved water quality monitoring programmes by TWB and MoH
6. Strategies developed for public consultation and community participation
7. Improvement Schedule
8. Network established for sharing of information including water resource status reports, water quality monitoring data and health surveillance statistics

ACTIONS FOR IMPLEMENTATION OF WATER SAFETY PLANS

AWARENESS & COMMUNITY PARTICIPATION

1. **Develop awareness programmes**

    - Establish a working group for community awareness & education that would be responsible for developing IEC materials for awareness raising on drinking water quality and health issues.

    - The Awareness Working Group should engage in public consultations to identify issues and concerns of the public in relation to drinking water and health.

2. **Conduct workshops to empower village communities to take more ownership and responsibility of their drinking water**

    - Promote the linkages between drinking water quality and health issues through village workshops.

    - Promote better understanding of water supplies by training village water supply operators and managers on technical aspects of water supply management including plumbing, pump maintenance and treatment options.

    - Empower communities to maintain safe quality water by training them on simple water quality tests and sanitary surveys e.g. H2S test kits and WHO sanitary survey forms.

WATER RESOURCE MANAGEMENT

3. **Conduct studies to establish the extent of underground aquifers (including area, quality and quantity) that is the main source of water for the people of Tonga**

    - Identify resources (including experts, finance etc) needed for such studies

    - Identify experts and/or agencies to assist with the studies

    - Develop funding proposals for donor funding of such studies if experts are not locally available

4. **Establish strategies for sustaining the quality and quantity of water resources in Tonga**

5. **Strengthen monitoring of drinking water quality**

- Strengthen MoH surveillance and monitoring of drinking water supplies (including urban and rural supplies)
- Strengthen TWB monitoring of public water supplies.
- Establish strategy for sharing of data among agencies.
- Prepare annual reports on drinking water quality status.

INSITUTIONAL ARRANGEMENTS

6. **Capacity Building for agencies in developing and implementing WSPs**

- An ongoing Capacity Building and Training programme needs to be established to ensure local expertise is available to assist with WSP development & implementation.
- Conduct training workshops to train staff from other agencies on development and implementation of WSPs.
- A strategy for maintaining expertise within agencies needs to be developed (e.g. staff passing on their knowledge to successors).

7. **Improve sharing of information among agencies**

- Establish a working group that would collate data and prepare annual reports on the following:

    i. Drinking water quality of various supplies (urban, rural and outer-island) in Tonga
    ii. Water-borne disease statistics

- The membership of this working group should include agencies that are directly responsible for water quality monitoring or health surveillance such as Tonga Water Board, Ministry of Health and Department of Environment. The NGOs and village water committees should also be represented in this working group.
- Inter & intra governmental relationships and networks should be strengthened to improve information sharing
- Establish a network between other PICs that have or are in the process of developing and implementing WSPs to share lessons learnt.

8. **Strengthen monitoring of drinking water quality**

- Strengthen MoH surveillance and monitoring of drinking water supplies (including urban and rural supplies)

- Strengthen TWB monitoring of public water supplies.

- Establish strategy for sharing of data among agencies.

- Prepare annual reports on drinking water quality status.

9. Establish a National WSP Working Group (*Expert group that will help other supplies prepare a WSP*)

- Assemble a working group that would assist operators of other supplies (e.g. rural and outer island supplies) in developing and implementing WSPs.

- Organize a training of trainers' workshop on Water Safety Planning for this working group.

10. Enforce existing legislation or draft new legislation to address national water supply concerns such as water theft, illegal connections or cross connections between reticulated and rainwater systems.

- Conduct a legislative review of various acts and regulations that regulate water resource, water supply or water quality management.

- Make amendments to existing legislation to address key issues in water resource, water supply and water quality management.

FINANCING

11. Identify funding sources

- Agencies need to identify sources (national budget and donor aid) for funding WSP implementation.
- Review current and projected budgets to identify funding for needed capital or institutional improvements for implementation of WSPs.
- Establish an advisory service for preparation of funding proposal.

12. Allocate funding for needed improvements (capital works or institutional arrangements) or capacity building

- Complete Water Safety Plans for water supplies to use as justification for funding or donor support for needed improvements.

- Prepare an Improvement Schedule to identify (prioritize) those improvements that can be made with existing funding and those that will need additional funding from Government or donor support.

APPROPRIATE TECHNOLOGY

13. Develop National Guidelines for Septic Tank construction

- Determine the restrictions that need to be applied to construction of septic tanks to protect groundwater resources

- Review the National Building Code to identify areas that need to be enforced or strengthened for septic tank installations

14. Conduct studies to determine if septic tanks are affecting groundwater quality

- Develop maps showing locations of septic tanks on each island

15. Identify appropriate infrastructure and equipment to strengthen on-going monitoring of drinking water quality (e.g. purchase of appropriate equipment for measuring residual chlorine in distribution system)

SUSTAINABLE AGRICULTURAL PRACTICES

16. Improve farming practices to reduce reliance on chemical fertilizers and pesticides.

- Encourage NGOs and Community-based organizations to promote organic farming.

- Develop an education and awareness programme for farmers on risks to drinking water quality from agricultural chemicals.

- Develop national policies and guidelines for best practice for sustainable farming.

17. Establish a National Registry for agricultural chemicals

Activity & Responsibility Matrix

	Actions	TWB	MoH	DoE	L&S	EDO	Fin	Legal	MAFF	NPO	TT	TANGO	VWC
	Develop awareness programmes	I	R	R	I	I	A	A	I	A	R	R	I
	Conduct workshops to empower village communities to take more ownership and responsibility of their drinking water	I	R	R	I	I	A	A	I	A	R	R	R
	Conduct studies to establish the extent of underground aquifers (including area, quality and quantity) that is the main source of water for the people of Tonga	R	A	I	R	A	A	A	R	A	A	A	I
	Establish strategies for sustaining the quality and quantity of water resources in Tonga	I	I	I	R	I							
	Strengthen monitoring of drinking water quality												
	Capacity Building for agencies in developing and implementing WSPs												
	Strengthen monitoring of drinking water quality												
	Establish a National WSP Working Group (*Expert group that will help other supplies prepare a WSP*)												
	Enforce existing legislation or draft new legislation to address national water supply concerns such as water theft, illegal connections or cross connections between reticulated and rainwater systems.												
	Identify funding sources												
	Allocate funding for needed improvements (capital works or institutional arrangements) or capacity building												
4	Develop National Guidelines for Septic Tank construction	R	R	R	I	I	I	R	I	I	I	I	I
5	Conduct studies to determine if septic tanks are affecting groundwater quality	R	R	R	R	I	R	I	I	I	R	R	I
	Identify appropriate infrastructure and equipment to strengthen on-going monitoring of drinking water quality (e.g. purchase of appropriate equipment for measuring residual chlorine in distribution system)												
	Improve farming practices to reduce reliance on chemical fertilizers and pesticides.												
6	Improve farming practices to reduce reliance on chemical fertilizers and pesticides.	A	A	I	I	A	A	I	I	A	R	R	I

Key: R - Responsible I – Involved in the action A – Aware of action

Products & Outputs

1. National Policy promoting Water Safety Plans
2. National Steering Committee established
3. Drinking water quality monitoring working group established
4. Awareness programme(s) established
5. Education & Awareness materials introducing WSPs are developed and distributed (translated in Tongan)
6. Strategy for information sharing developed
7. Capacity building and training workshops completed
8. Capacity building and Training workshops completed
9. Drinking water quality surveillance and monitoring programme established by Ministry of Health
10. Source water and drinking water quality monitoring programme established by Tonga Water Board
11. Annual reports on drinking water quality status of all supplies in Tonga
12. National WSP Expert Group established
13. Legislation review completed
14. National Plans and policies reviewed to include WSPs
15. Water Safety Plans completed for Nuku'alofa and Lomaiviti Village supplies
16. Improvement schedule completed for Nuku'alofa water supply
17. National guidelines for sustainable farming developed

REVIEW AND EVALUATION

Indicators of success

1. Safe drinking water for all communities including reticulated and rainwater supplies (Quality).
2. Sufficient drinking water for communities (Quantity).
3. Less number of water-borne diseases reported
4. Improved water quality monitoring
5. Improved sanitation and health surveillance
6. Improved collaboration between key agencies
7. Improved sharing of water quality monitoring data among agencies
8. Improved quality of source water
9. Less reliance on rainwater
10. Better sanitary services, surveillance and monitoring
11. Less bottled water imported
12. Active community participation in water supply management (especially rural water supplies

Who benefits?

	Indicators	TWB		MoH		DoE		L&S		NGOs	
		U	R	U	R	U	R	U	R	U	R
1	Safe drinking water for all communities including reticulated and rainwater supplies (Quality)	P	S	P	P	P	P	S	S	P	P
2	Sufficient drinking water for communities (Quantity)	P	S	S	P	P	P	P	P	P	P
3	Less number of water-borne diseases reported	P	S	P	P	P	P	S	S	P	P
4	Improved water quality monitoring	P	S	S	P	P	P	P	P	P	P
5	Improved sanitation and health surveillance	P	S	P	P	P	P	S	S	P	P
6	Improved collaboration between key agencies	P	P	P	P	P	P	P	P	P	P

7	Improved sharing of water quality monitoring data among agencies	P	P	P	P	P	P	P	P	P	P
8	Improved quality of source water	P	P	P	P	P	P	P	P	P	P
9	Less reliance on rainwater	P	S	S	P	P	P	P	P	S	S
10	Better sanitary services, surveillance and monitoring	P	S	P	P	P	P	P	P	P	P
11	Less bottled water imported	P	P	P	P	P	P	P	P	P	P
12	Active community participation in water supply management (especially rural water supplies	P	P	P	P	P	P	P	P	P	P

Key: P – Primary benefit S – Secondary benefit

Verification

	Indicator	Means of Verification
	Safe drinking water for all communities including reticulated and rainwater supplies (Quality)	
	Sufficient drinking water for communities (Quantity)	
	Less number of water-borne diseases reported	
	Improved water quality monitoring	
	Improved sanitation and health surveillance	
	Improved collaboration between key agencies	
	Improved sharing of water quality monitoring data among agencies	
	Improved quality of source water	
	Less reliance on rainwater	
	Better sanitary services, surveillance and monitoring	
	Less bottled water imported	
	Active community participation in water supply management (especially rural water supplies	

REPLICATION

To be complete by the Steering Committee

WATER SAFETY PLAN

SUPPLY NAME: NUKU'ALOFA

Step 1: Flow Chart

Catchment & Intake

- Source: Freshwater lens (groundwater)
- A network of 36 wells (hand-dug or tube) in a 140 acre well field
- Very little soil cover with porous (limestone) ground underneath
- 33 Diesel operated and 3 electrically operated pumps
- Covered well-head
- Pump shed at each well to protect the pumps, but not secure (sheds are not locked)
- Diesel storage at every well and refilled regularly (every second day)
- Some cultivation / farming activities within the well field

Storage & Treatment

- Each of the 36 wells pump water into one of 6 storage reservoirs
- Treatment: dosing with Calcium Hypochlorite
- Chlorine mixing is done at the Chlorination chamber about 100m from the reservoirs
- Chlorine dosing is done via an injector at the main line, prior to distribution

Distribution

- Distribution is by gravity feed to the city and surrounds
- Supply rate is 6/7 ML per day
- Every property is required to connect to the reticulated system
- Households have the option of supplementing the reticulated supply with Rainwater Catchment. Most households have a rainwater tank

Step 2: 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.	No. Condition of casing, wellheads etc appears to be old and worn-out.	Yes
The electrical pumps could stop operating during power outage.	Yes. Even during a power outage, 33 diesel-operated wells continue to operate.	
Sabotage / Vandalism	No. Even though some security personnel have been recruited, the area is too wide and wells too many to assign security guards to all of them.	Yes
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 will not happen overnight. The current system is utilizing only 70% of the available freshwater in the aquifer.	

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.*
Chlorine dosing failure due to power outage.	Yes. During power outage, operators switch to manual dosing at the reservoirs.	
Chlorine supply may run out, resulting in untreated water being distributed to the communities.	Yes. A stringent stock replenishment system is in place to ensure that several months' stock of chlorine is in stock.	
Residual Chlorine levels in distribution, too high or too low.	No. The monthly testing for residual chlorine is not sufficient.	Yes
The pH is too high for effective disinfection with Chlorine.	No. pH level monitoring at the intake or storage is inadequate.	Yes
There is no treatment / barrier for protozoa, so it could be assumed that they are present in water.	No	Yes. Consider treatment / removal.

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.*
There is not enough contact time with chlorine before the first consumer, resulting in water not properly disinfected.	No. The first few consumers are less than 200m away.	Yes
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 is needed.
Cross-connection of Rainwater system with the reticulated supply could lead to cross-contamination.	No. No relevant laws, policies to restrict / control household rainwater systems.	Yes. Need for monitoring of rainwater systems.
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.	Yes. A Leak detection programme has been mobilized by the TWB.	
Breakages in underground pipeline from other activities such as digging for electrical/ telephone cables, construction etc.	No	Yes
Free available chlorine levels in the distribution system could be too low.	No. Current monitoring for FAC is insufficient.	Yes

Step 3: 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 Improve treatment (based on what you find out from the source water analysis)	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 through local media informing consumers 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. Diesel spills and leaks in the pump-shed could seep into the well though cracks in casing.	Inspect casings, wellheads, pipefittings, joints, valves etc and repair or replace as necessary. Include these inspections into the regular maintenance schedule.	Water smells of fuel, appears discolored or 'oily' and tastes abnormal. Regular monitoring results show presence of Hydrocarbons or Oil in water.	As in 1 above.
3. Sabotage / Vandalism	Secure wellheads and pump-sheds to ensure that vandals do not get access to the well, pumps or piping.	Water smells, looks or tastes abnormal Pump breaks down and there are signs of sabotage or vandalism.	As in 1 above.

Storage and 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?
4. Residual Chlorine levels in distribution, too high or too low.	Develop a regular (daily) monitoring schedule for residual chlorine.	Increase in Public dissent about taste, appearance or smell of water. Regular monitoring results show low levels of Chlorine.	As in 1 above
5. The pH is too high for effective disinfection with Chlorine.	Develop a regular (daily) monitoring schedule for residual chlorine. Include mechanism for reducing Ph in the system, prior to chlorine dosing.	Water smells of fuel, appears discolored or 'oily' and tastes abnormal. Regular monitoring results show low levels of Chlorine.	As in 1 above
6. 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

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?
7. There is not enough contact time with chlorine before the first consumer, resulting in water not properly disinfected.	Temporary storage tank(s) needs to be installed.	Increase in Public dissent about taste, appearance or smell of water. Regular monitoring results show low levels of Chlorine.	As in 1 above.
8. Illegal connections could lead to cross-contamination	A regular monitoring / surveillance schedule for illegal connections. Allocate wardens in each zone/area/community.	Regular monitoring results show low levels of Chlorine.	The residual chlorine will provide protection (provided the levels of contaminants are low) until repairs are complete.
9. Cross-connection of Rainwater system with the reticulated supply could lead to cross-contamination.	A regular monitoring / surveillance schedule for inspection of household rainwater systems. Allocate wardens in each zone/area/community. Write a National Guideline for Rainwater System Installation.	Increase in water-borne disease cases in the community.	The residual chlorine will provide protection (provided the levels of contaminants are low) until repairs are complete. Advise the public against cross-connecting rainwater and reticulated systems.
10. Low Pressure could result in some communities 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).
11. Breakages in underground pipeline from other activities such as digging for electrical/ telephone cables, construction etc. allowing contaminants to enter the supply.	Engineers responsible for the distribution system are trained in main flushing, disinfection etc.	Cannot maintain required level of residual chlorine.	The residual chlorine will provide protection (provided the levels of contaminants are low) until repairs are complete.

Step 4: Water Safety Plan

Catchment & Intake

Hazard event	Cause	Level of Risk	Control Measure	Critical Limits		Monitoring			Corrective Action	Verification
				Target	Action	What	When	Who		
Contamination of aquifer from household wastewater and sewage.	Household septic tanks seep into aquifer.	Moderate								
Contamination of aquifer from agricultural chemicals.	Chemicals applied to farms seep into aquifer.	Moderate								
Contamination from Diesel	Diesel Leaks & Spills.	Likely								
Electrical pumps stop operating.	Power outage.	Moderate								
Intentional contamination or damage to pump or well.	Sabotage / Vandalism	Unlikely & Catastrophic								
Level of Freshwater in the aquifer decreases.	Prolonged drought									

Catchment & Intake

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

Catchment & Intake

Hazard	Cause	Risk	Control	Critical Limits	Monitoring	Corrective	Verification

event			Measure	Target	Action	What	When	Who	Action	

WATER SAFETY PLAN

SUPPLY NAME: Lomaiviti Village

Step 1: 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 (5-10am and 5 to 10pm)
- Very little soil cover with porous (limestone) ground underneath
- Covered well-head
- 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

Storage & Treatment

- The well pumps water into 2 elevated header tanks
- No Treatment

Distribution

- Distribution is by gravity feed to the community
- Households supplement the reticulated supply with Rainwater Catchment. Most households have a rainwater tank.

Step 2: 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.	
Sabotage / Vandalism	Yes. The wellhead as well as the diesel pump are well enclosed within a secured pump-shed, which has a gate that is kept locked.	
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 / removal.
Disruptions to water supply may result from damages 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.

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

Step 3: 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.

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?
3. 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
4. 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?
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.
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
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).
Leakages within the distribution network could result in cross-contamination.		Members of the community report leakages.	As in 1 above
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.

Step 4: Water Safety Plan

Catchment & Intake

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

Catchment & Intake

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

Catchment & Intake

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