Water Safety Plan Handbook

For

Rural Water Supply Systems

PRODUCED BY

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ENGINNERING SERVICES DIVISION
MINISTRY OF HEALTH, MALAYSIA
2011

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EXECUTIVE SUMMARY

Drinking water safety is a vital public health issue. Many types of infectious diseases can be transmitted through the consumption of water tainted with bacteria, parasites, viruses or chemicals.

During the 1960's, high incidences of water borne and excreta related diseases were reported in the country. Much of it was due to the fact that most people were using unsanitary water supply where piped water supply was available to only 3.6% of the population. Much of the rural population at the time was using unsanitary wells.

With this in mind, the Environmental Health and Engineering Unit in the Ministry of Health (MOH) were created to tackle the problem. It sole purpose, in tandem with the Health Division, was to reduce the number of cases significantly through the use of engineering solutions, especially in the rural areas.

In 1974, a programme called Rural Environmental Sanitation Programme (RESP) was introduced by MOH. This programme involves the construction of rural water supply systems, sanitary latrines and proper facilities for the disposal of sullage water and solid waste in the rural area.

One of the objectives of this programme is to provide adequate safe water supply to rural community. The programme incorporates simple technological principles that emphasized on simple design, construction and maintenance. The requirement for the system is that to deliver sufficient quantities of water that meets the basic health and hygiene requirement at minimum cost. These systems produce untreated but wholesome water and therefore the rural people are advised to boil their drinking water.

The types of systems installed throughout rural area in Malaysia and they are;

a) Gravity-feed system or GFS,

b) Sanitary well,

c) Sanitary well with house connection and

d) Rainwater collection system.

Subsequently, the programme (which have been renamed as BAKAS Bekalan Air dan Kebersihan Alam Sekeliling), have managed to achieve the target of

reducing the incidences of water borne and excreta related diseases in the country. However, as the nation proper, new issues concerning the safety of rural water supply emerge.

Issues such as the emergence of new contamination points, the presence of in-situ minerals or chemical parameters in the soil which are previously not considered as a risk or pollution from increase development activities in rural areas, are a number of new areas of concern that should be look at thoroughly.

Therefore, as the lead agency in matters of public health and in accordance with the recommendations of WHO, MOH Malaysia has taken up the lead in promoting the use of WSP in managing water supply around the country. Although some water purveyors have implemented WSP's with a number of their water supply systems, most did not have a comprehensive plan that encompasses all aspects of their systems.

1.0 Introduction

An adequate supply of safe and good quality water supply is essential for the promotion of public health. It is also important for the public that the water when consume, is aesthetically acceptable and pleasing.

It is universally understood that the water supplied through the use of conventional treatment processes is safe to be use for drinking purposes. If a treated water supply system is located within the vicinity of a village, then they are encouraged to connect to the treated water supply provided.

However, such systems are not available to all the villages in the rural areas. Therefore, alternative water supply systems were provided and used by these communities.

In addition, the provisions of water supply systems are more focused on the aspects of water quantity to be supplied, not the suitability of water quality aspects involved. Normally, any monitoring of the quality of water supplied cannot be carried out thoroughly and the management of these water supplies are not given due attention.

Currently, safety management practices of a water supply system has relied on the testing of drinking water either as it leaves the treatment works or at selected points, either within the distribution system or at consumer taps.

As it is, the results of such monitoring are received too little and too late to do any preventive action. Improving the management of water safety, adopting appropriate quality assurance procedures is increasingly in the priority agenda. Therefore, a method of managing water supply is needed in line with the increasing importance of security of supply of water used.

1.1 What is Water Safety Plan

To ensure the safety of drinking water supplied through the use of these systems, a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer, in other word, a Water Safety Plan (WSP), is necessary in order to minimize any danger to the end users.

A **Water Safety Plan** is a plan to ensure the safety of drinking water through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.

Conventional practices of monitoring water quality rely on output as a means for quality assurance. Such practices are not timely enough to prevent consumption of contaminated water and do not give sufficient information to identify the source of contamination (when, why, and where it occurred).

Water safety plans stand in contrast to conventional approaches. They introduce pro-active risk management that contributes to timely detection of contamination to prevent illness and rectify the problem through monitoring of critical points at the water source, treatment, distribution to the consumer, and end storage.

These plans identify credible risks in the water supply system from the source to consumer, prioritize those risks, and put in place controls to mitigate them. They also include processes to monitor and validate the effectiveness of management control systems and the quality of the water produced.

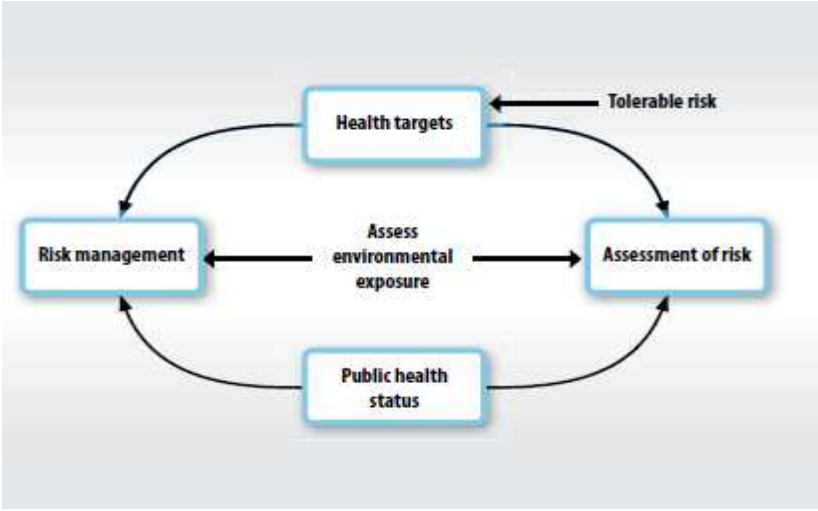

Figure 1.1: Simplified harmonized risk-based water cycle management framework showing health-based targets

1.2 Water Safety Plan and WHO

The World Health Organization (WHO) has promoted water quality assurance through water safety plans since the early 2000s and formally recommended them in the Third Edition of Guidelines for Drinking Quality published in 2004. This is because water safety plans work.

In fact, the World Health Organization (WHO) currently considers WSP as the most effective way to ensure the safety of drinking water supply to the public. WSP will ensure the implementation of water supply is safe to use and meet the standards of the regulations relating to human health.

Their use should ensure that water is safe for human consumption and that it meets regulatory water standards relating to human health. Comprehensive, systematic risk assessment and risk management where detailed assessment and prioritization of hazards and associate risk form the backbone of these plans.

In addition, appropriate monitoring and control measures need to be put in place to reduce any incidences of risks to an acceptable level. Hazards and risks should be identified, with appropriate steps towards minimizing these risks are then investigated.

However, it is well understood that such goals cannot be achieve on the back of a single entity, agency or sector. It requires a coordinated approach and involvement from all relevant stakeholders, at all institutional levels and the rural communities involved to achieve the desired outcomes.

This guideline is prepared with a aim to provide practical guidance to the key stakeholders, project managers, workers and consumers at different levels, in promoting and guiding specific good practices for planning and implementation of WSP approach within the broad guideline of the water security plan in place within this country.

All examples mentioned in this guideline refer to the current situation and conditions that are applicable in Malaysia.

2.0 Rural WSP - Initial Effort

In January 2010, Malaysia was asked by the WHO, Western Pacific Regional Office to undertake the task of preparing a manual on Rural Water Supply Water Safety Plan (WSP). Malaysia has also been asked to produce a guide on conducting training for the implementation of WSP in rural water supply.

To prepare for the task, MOH conducted a course on 'WSP for Drinking Water Supply Systems' from the 11th to 15th April 2010 in Ipoh, Malaysia. With the assistance of WHO, with participants ranging from water supply companies, water regulatory and environmental health officers from MOH were introduced to the concepts of WSP and ways to set up and implement them.

BAKAS, as one of the main programmes that provides alternative rural water supply in the country, are tasked to prepare the necessary guiding documents for the implementation of WSP for rural water supply systems in Malaysia.

In addition, WHO has also asked the MOH to produce materials on WSP such as banners, brochures and guidebooks for use in the preparation, use and maintenance of small communities' water supply systems. Since there are three types of water supply systems are used by the MOH in BAKAS program, the MOH decided to conduct three pilot projects which represent the types of water systems in preparation to produce the materials.

Each WSP model was then tested at several locations in each of the pilot project to ascertain the suitability of each module in the context and the local area. These pilot projects are implemented during the period August 2010 until March 2011, depending on the type of projects. Experience from the implementation of pilot projects are collected and documented in March, 2011. Based on these experiences and lessons, a first draft edition was produced.

It is hoped that with the exposure during the session held in Ipoh last year and other WSP events held since, the government, water supply companies and other stakeholders such as non-governmental organizations will be able to contribute to the implementation and plans to expand the use of water safety plans in the country indefinitely.

3.0 Forming a WSP for Rural Water Supply Systems

As previously mentioned, MOH has been providing water supply through the use of alternative systems to villages or rural areas that don't enjoy the benefits of treated water. These villages are not provided with treated water, therefore, it is still our responsibility to make sure that there are as little risk and harm as possible to those who use and drink this water.

Through preparing and implementing a WSP, we will be able to monitor the quality of water being supplied to the villagers and able to take pre-emptive measures in the event of any problems or risks occurring throughout the entire water supply system.

However, they are several key challenges that need to be addressed in order to fully understand the situation at hand and properly utilize any WSP prepared for the above purpose. These challenges are;

a) The variety of available database concerning the current status of rural water systems and their management due to the involvement of various departments and agencies has made the legitimacy of each or as an overall database rather questionable. This is due to the different interpretation adopted by each agency on what rural water supply is actually defined. No definite figure can be confidently said as representing the actual situation on the ground.

b) Little or no coordination and understanding between relevant stakeholders especially in the planning and provisioning of rural water systems to the rural communities.

c) Lack of understanding by stakeholders in which when discussing issues related to water supply, most do not see their connection to issues relating to sanitation. Both areas have to be handled simultaneously because they are interconnected.

d) Difference in culture, social habits and lack of knowledge and understanding inhibits the participation of villagers in the implementation of the safety plans.

e) The lack of human and equipment resources needed is to effectively monitor the progress and effectiveness of the plans implemented.

3.1 Successful Implementation of WSP

Therefore, to ensure the successful implementation of a WSP, an understanding on certain aspects between all stakeholders on the following matters is a must. They are;

a) Permanent drinking water security in the respective rural area must be ensured.

b) The critical role of the community involved in ensuring drinking water security.

c) The water supplied for drinking and cooking should be as of high quality as possible, comparable to that of the potable water standards in order to reduce disease burden and improve quality of life. Ultimately, the aim is to integrate it with the standing Drinking Water Quality Surveillance Programme.

d) Maintenance cost of all water supply systems should have an inbuilt component where the bulk of the monitoring and management responsibility rest with the village communities and financial needs are cross subsidize by the relevant agencies especially for hardcore poor groups.

e) Shifting gradually towards quality rather than quantity, in line with having drinking water security, based on the need of the community, for every member in the community.

f) Each and every house in a community is entitled to the same amount and quality of water provided by the system.

g) To enable the community to plan, implement and manage their own water supply systems.

The aim of a WSP is very straightforward which is to *consistently ensure the safety and acceptability of a drinking water supply.*

There are 11 steps that need to be taken in preparing and implementing any WSP. They are:

a) Assemble the team to prepare the water safety plan;

b) Identifying and describing the water supply system;

c) Identify hazards and risks to a water supply system;

d) Assess and prioritize the hazards;

e) Determine and improving control measures to manage these hazards;

f) Set up action plans in case of a crisis or emergency;

g) Establish other support programmes or measures, and

h) Continuous verification, record keeping or documentation.

5.0 Module 1 - Assembling the team to prepare the Water Safety Plan

The process of development, implementation and maintenance of a rural WSP is a very big undertaking and therefore there is a need for a proper Lead Implementing Agency, usually whose associated with the water supply programme, but requires support and involvement from a number of partner and regulatory organizations. Clear support from all stakeholders particularly of user's group is imperative for successfully putting WSP for rural water safety programme into practice.

As mentioned before, MOH Malaysia has taken up the lead in promoting the use of WSP in managing water supply around the country. For rural water supply, MOH has taken the initiative to prepare this necessary guiding document and other related materials on the preparation of WSP, in particular with regards to rural water supply projects under the BAKAS programme.

Considering drinking water a public good, importance has been given for involvement of the community to develop its own village water security plan taking into consideration, the present water availability, reliability and its different usage and equity.

To ensure this, different types of bodies are to be formed at various levels. In Malaysia, for most villages, there is already in place a Village Safety and Development Committee (VSDC), which handles any matters concerning the wellbeing of any particular village. However it is recommended that a separate subcommittee, within the one stated above, which handles all aspects regarding water supply safety and sanitation (Village Water Supply and Sanitation Committee or VWSSC) is preferable.

A similar set up should also be implemented at the district level (District Water Safety and Sanitation Committee or DWSSC) and at state level (State Water Supply and Sanitation Mission or SWSSC) should be constituted to prepare broad and specific policy and programme implementation framework as to facilitate each levels roles more effectively.

In addition, both state and district levels will also be able to expand their scope not only to cover rural water supplies but those involving piped (treated) water supplies.

Table 1 is an example that shows who is supposed to be involved in the implementation of a WSP in a rural setting. Table 2 shows the roles and responsibility of those involved in implementing WSP.

As an example, the findings from the pilot projects done in Malaysia list out the possible committee members and their functions as list out in the following tables.

Table 1: Proposed membership of the **Village Water Supply and Sanitation**: -

a) The Village Head

b) Committee Chairman

c) Some representative population

d) Representative from the District Health Department (such as the Public Health Assistant or Assistant Environmental Health Officer as technical advisor)

e) Representatives of other interested parties or stakeholders, such as the District Office (local government), Forestry Department, or TNB (electrical power provider).

Table 2 - Module 1 (Example) : Formation of WSP Implementation Team for Rural Areas (for Malaysia)

i. Identify and form the implementation team from individuals and management team (stakeholders) who are responsible for the implementation of WSP at the village or community level in the rural areas.
ii. Define the roles and responsibilities of the individuals and management team (stakeholders) responsible in the implementation of the WSP.

Level	Management team and members	Roles and responsibilities
Village (Community)	Village Development and Security Committee • Chairman • Chairman Water Supply Committee • Villagers	• Responsible for all matters including the WSP, maintenance and appropriate action pertaining to the village water supply • Responsible to appoint the Village Water Supply Committee • Act as liaison with relevant agencies
	Local Health Office • Public Health Assistant (PHA)	• Carry out monitoring/maintenance of water supply system • Report any damages to the water supply system and illegal connections thereto • Provide technical advice • Give health education talk • Carry out water sampling • Act as a resource for information • To be present in community activities and provide cooperation in 'self-help' activities of the people
	Representatives of other interested parties or stakeholders, such as the District Office (local government), Forestry Department, or TNB (electrical power provider).	• Monitor the implementation of the WSP in the village (at every stages). • Provide all aspects of technical advice to the villagers.

Table 3a: The proposed membership of the Water Supply and Sanitation Committee at the District level: -

a) Regional Office
- District Officer

b) Regional Health Offices
- Assistant Environmental Health Officer (BAKAS)
- Public Health Assistants (BAKAS)

c) The Department of Aboriginal Affairs

d) The Department of Education

e) Department of Forestry

f) representatives of other stakeholders such as District Councils, Public Water Supplier or electrical power provider.

Table 3b: The proposed membership of the State Water Supply and Sanitation Committee: -

a) State
- Secretary General of the State

b) Regional Office

b) Office of Health Affairs
- Director
- Public Health Engineer

c) The Department of Aboriginal Affairs

d) Drainage and Irrigation Department

e) The Department of Environment

f) Department of Forestry

g) representatives of other stakeholders such as District Councils, Public Water Supplier, or electrical power provider.

In general, the use of this module connects all the parties concerned in the implementation of WSP and to provide a duty which all the collective or team responsible for understanding the water supply system is monitored and to identify and prevent hazards that could affect water quality and water supply safety .

6.0 Module 2 - Identifying and describing the water supply system

After a team or committee of the Water Safety Plan (WSP) was established in the village, the first task for the WSP team is to get the full picture of the water supply system in the village.

If there is no documentation available on the system before, it is important for the VWSSC to carry out a field investigation to identify system. This is to ensure that all necessary information is collected to assist in producing a better water quality and management plan and to make sure any risks can be managed more effectively. It is good to have a carefully planned and precise WSP so that it can use as an effective quality assurance tool as to ensure clean water supply reach the end users.

If there is already an existing plan to ensure the water supply safety for the village, it is advisable that the VWSSC continue to use it or adapt the plan into a proper WSP as stated in this handbook.

One of the essential requirements of the assessment process, the water supply system is an understanding of each stage of the supply process, covering the entire system from source to tap at the end of the supply. In addition, the VWSSC can also take the opportunity to identify where the system is exposed to hazardous events, and important control measures are related. This matter will be discussed further in Module 3.

Typically, the water supply system is divided into three, as shown in Figure 1

Catchment/ Source of Supply

Distribution Pipes/ Reticulation

User's Homes

FIGURE 1

Information and detailed explanation of the monitored water supplies should include:

- Sources of water used, including water runoff (surface runoff) and / or water reuse;
- How water is stored or treated, including the methods used;
- Whether any additions are made on the use of water;
- How water is distributed to consumers and
- Are there any special requirements that need to be noticed in the quality of water supplied, such as the need to meet the standards of existing supplies or supplies that are used to meet a set of standards or targets are different.

If a different set of standards are used, these requirements should be explained and documented to ensure that any changes to the quality of water used to be closely monitored.

Detailed explanation of the water supply system is needed as supporting information for the next process, namely risk assessment of water supply systems and processes used.

The tables below provide the description of each component for each supply system done in the pilot project.

Table 4 - Module 2 (Example): Identify and Describe the Type of Water Supply

i. Identify and describe the type of water supply and its components (including other possible components).
ii. Lists the possible activities that occur on the components that contribute to pollution and health risks (depending on the location)

Water Type: **Gravity Feed Systems / Wells / Rainwater Catchment System**

Types of System *	Catchment	Treatment Methods	Storage and Distribution
(List down each system)	**Component Definition & Component Inventory**		
Gravity Feed System or GFS	Has components such as dams and distribution pipes  	No treatment systems	Has components such as storage tanks and distribution pipes to homes
Gravity Feed System or GFS with treatment	Having additional components such as filters	Has the treatment components such as filtration or disinfection (chlorination)	Has components such as storage tanks and distribution pipes to homes

Types of System *	Catchment	Treatment Methods	Storage and Distribution
(List down each system)	**Component Definition & Component Inventory**		
	 		
Sanitary Well	Underground Water	No treatment systems	Either consisting of a hand pump, mechanical pumps or other types of pumps, apron, distribution pipes and pipe tap to the house.
Sanitary wells with connections to the home (without storage tank)	Underground Water	No treatment systems	Either consisting of a hand pump, mechanical pumps or other types of pumps, apron, distribution pipes and pipe tap to the house.
Sanitary wells with connections to the home (with storage tank)	Underground Water	No treatment systems	Either consisting of a hand pump, mechanical pumps or other types of pumps, apron, distribution pipes and pipe tap to the house.

Types of System *	Catchment	Treatment Methods	Storage and Distribution
(List down each system)	**Component Definition & Component Inventory**		
Sanitary wells with connections to the home (with storage tank and treatment system)	Underground Water	Filter Media, chlorine feeder, ultraviolet.	Either consisting of a hand pump, mechanical pumps or other types of pumps, apron, distribution pipes and pipe tap to the house.
Rainwater Catchment System	Concrete Tank: Roofing framework, Roofing (zinc), Steel Bars, HDPE pipe, Main House Gutter, Down Spout, End Stopper, Joiner, Elbow joint, Down Pipe, Down Spout Joiner, Gutter Bracket, Cement, valve and gate valve. HDPE Tank: Roofing framework, Roofing (zinc), HDPE tanks, HDPE pipes, Main house gutter, Down Spout, End Stopper, Joiner, Elbow joint, Down Pipe, Down Spout Joiner, Gutter Bracket, Cement, valve and gate valve.	No treatment systems	Has components such as storage tanks and distribution pipes to homes
Rainwater Catchment System with treatment system	Concrete Tank: Roofing framework, Roofing (zinc), Steel Bars, HDPE pipe, Main House Gutter, Down Spout, End Stopper, Joiner, Elbow joint, Down Pipe, Down Spout Joiner, Gutter Bracket, Cement, valve and gate valve.	Filter Media, chlorine feeder, ultraviolet or a sedimentation tank	Has components such as storage tanks and distribution pipes to homes

Types of System *	Catchment	Treatment Methods	Storage and Distribution
(List down each system)	**Component Definition & Component Inventory**		
	HDPE Tank: Roofing framework, Roofing (zinc), HDPE tanks, HDPE pipes, Main house gutter, Down Spout, End Stopper, Joiner, Elbow joint, Down Pipe, Down Spout Joiner, Gutter Bracket, Cement, valve and gate valve.		

7.0 Module 3 - Identifying hazards and risks

The threat of contamination to the water supply system can come and occur from anywhere, from the catchment area up to the home of the user. Thus, effective risk management requires the identification of all potential threats that can harm consumers, including the knowing sources of threats, the incidents that may pose threats and risk assessment of each threat level.

Hazards to the water supply system may come from a source or agent of biological, chemical, physical or radiological in nature that contains the potential to endanger the health of consumers.

Hazardous event is an event or situation that could cause a hazard above (what can happen and how it happened).

Risk is measured by the probability of an event occurring and the dangers of exposure to threats which resulted in a period of time to these people.

Accordingly, the WSP implementation team should consider all aspects that may pose any danger to the water supply system, the dangers be of a biological, physical, chemical or radiological in nature. WSP implementation team should assess from the start of system, at the source, through the distribution pipes and finally at the connections of the house of the user.

WSP implementation team should list all sources or activities that may contribute to a hazard that can be used to make water unsafe to drink and take into account the surrounding circumstances and historical events that have occurred in the area.

The tables below list out the possible activities and hazardous events that might occur in the respective water supply systems and health risk to the consumers.

Table 5 - Module 3 (Example): Assessment of Water Supply System

i. To list and explain any sources or activities that may cause harm incidents in which the water is not safe to drink by taking into account the history and current situation (depending on the location)

Component	Activity/Hazardous event	Danger (Hazard)
Catchment	Logging activities cause landslides, decay, and the increase of sludge in the catchment area.	Turbidity of water will increase and enhance bacterial activity.
	Industrial activities that use the machinery causing soil erosion and oil spills.	Chemical contamination.
	Camping activities/recreation by the public to contribute to garbage lying around in the vicinity of the dam. The presence of litter can also cause the outlet pipe is blocked.	Water will be polluted by the rubbish that can lead to bacterial contamination, chemical and physical. It will also disrupt the flow of water outlets in the dam, causing water shortages in the distribution.
	Agricultural and farming activities will use pesticides and fertilizers. Surface runoff will carry pesticides and fertilizers into the water.	Water will be contaminated by pesticides (pesticide) and steel. It would be detrimental to the health of consumers of water.
	Farming activities will lead to pollution of excrement, food waste and dead farm animals into the water source	Water supply will experience physical and bacteriological contamination.
	Landslide / earthquake / soil erosion	Increase the turbidity, the addition of chemicals in water, sludge increased, damage the dam structure.
	Fallen leaves and branches from the surrounding vegetation into the water will undergo a process of decay.	Increased BOD and COD and reducing water quality.

Component	Activity/Hazardous event	Danger (Hazard)
	Possible stool/wild animal carcasses contamination into the raw water source. Illegal settlements in the vicinity of the dam will contribute to the waste disposal/waste water directly into the raw water source. Flooding or drought (seasonal changes) effects where the rainfall will increase during the rainy season and decreased during the dry season.	The presence of E.coli bacteria, Leptospira, and other waterborne diseases. Water supply will be polluted by the rubbish that can lead to bacterial contamination, chemical and physical. It may also increase the risk of waterborne diseases. Turbidity and water quality is affected. Less / no water supply to consumers.
Treatment	The use of excessive doses of chemicals such as chlorine Power failure in the treatment system (pumps do not work) Possibility of sabotage committed by certain individuals, such as inserting harmful substances into the tank The use of method or material of lower quality which is not appropriate for treatment of water supply The increase in population from time to time, causing increased water supply needs.	Affect water quality, unpleasant odor and corrosive to pipes There is no clean water to consumers The safety of water users may be affected due to drinking water that is contaminated with hazardous substances. Water quality affected due to inappropriate treatment methods Lack of clean water supply
Storage and Distribution	Burst pipes	Cross contamination into the water supply

Component	Activity/Hazardous event	Danger (Hazard)
	The distance between the water source to users' homes will result in the loss head column and low water pressure. Incidence of low pressure in the distribution pipes causes 'Backflow' or 'back siphonage' can occur and pollute the water supply. The use of method or material of lower quality which is not appropriate for storage and distribution of water supply	Consumers are not getting adequate supplies of clean water. Water supply contaminated by harmful bacteria Water quality affected such as from leaching of the pipes.

8.0 Module 4 - Assessing and prioritizing hazards

Risk assessment and risk management, from catchment to the consumer homes is a key element in determining the direction of the Water Safety Plan.

This is done by identifying risks and evaluating them one by one, and reflecting them in a systematic management of necessary regulatory and the corrective actions to ensure the safety of water used.

The first stage of risk assessment is to identify and understand the type of water supply systems is used. This was explained in the previous module.

The second stage involves the identification and recording of any source of hazard or hazardous event that could affect the safety of water supplies. And finally, all of these hazards must be assessed in terms of levels risks they represent to the water users or the public.

Assessment of each hazard identified is made through the determination of risk factors generated through the calculation of probability of a risk occurring, from the lowest levels, for example, there is little or no possibility for a hazard or a hazardous event to occur, to the highest level of probability, say, that the event is most likely or will happen.

It is then multiplied by a factor of how serious danger of an incident that can occur on the health and safety of consumers in which it is measured, for example, no serious or significant as the lowest level to the most serious/ dangerous for the highest level.

Using risk assessment factors are explained more by using the Risk Determination Matrix in Figure 2 and Table 6 below: -

Risk Determination Matrix		Hazard level (b)				
		Insignificant (1) Not Detectable	Minor (2) Requirement Compliance	Moderate (3) Compliance Aesthetic	Major (4) Compliance with laws	Catastrophic (5) Public Health Compliance
Probability of Occurence (a)	Almost Certain (5) Daily	5	10	15	20	25
	Likely (4) Weekly	4	8	12	16	20
	Moderate (3) Monthly	3	6	9	12	15
	Unlikely (2) Yearly	2	4	6	8	10
	Rare (1) Every Decade	1	2	3	4	5

Figure 2: Risk Determination Matrix

The tables below list out the assessment of each possible hazardous event that might occur in the respective water supply systems and control measures to minimize the risks associated. All information below are examples gathered through the pilot project mentioned earlier.

Table 6 - Module 4 (Example): Identify Control Measures

i. Identify priority risks (depending on the location)
ii. State the preventive measures to prevent and/or rehabilitate or improve or avoid sources of pollution from occurring.

A. GRAVITY FEED SYSTEM

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Among the hazardous activities/events that may occur	Hazard due to the hazardous activities/ events	Possibility of hazardous activities/events will occur	Risk Level of hazardous activities/events will occur		Control measures that must be carried out	Other control measures that can be carried out
The presence of logging activities that causes landslides, decaying particles and increase in sedimentation in the catchment area.	Increase water turbidity and bacteriological presence. Disruption to the catchment ecosystem.	Unlikely (2)	Catastrophic (5)	2 x 5 = 10	Licensing of logging activities by the relevant authorities. Law enforcement by relevant authorities. Gazettment of forest reserve and catchment area. Signboard to indicate forest reserve areas.	To place signboards at strategic locations to warn against encroachment. Signage or gazetting of water catchment areas.

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Industrial activities using heavy vehicles causing soil erosion and oil spill.	Occurrence of chemical contamination	Moderate (3)	Moderate (3)	3 x 3 = 9	Licensing of logging activities by the relevant authorities. Gazettment of forest reserve and catchment area.	Out of bound signboards and warning against encroachment.
Picnic or recreational spots for the general public that contributed to indiscriminate disposal of refuse around the dam area. The refuse will flow into the water course that clogged the intake pipe and the presence of animals as well.	The water source containing refuse and debris will contribute to bacteriological, chemical and physical contamination. The bigger solid wastes will clogged the intake pipe which will reduce the water flow in the distribution system.	Moderate (3)	Moderate (3)	3 x 3 = 9	Report illegal activities to the police.	Out of bound signboards and warning against encroachment.

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Land use activities • Livestock rearing in the catchment area will result in the presence of animal wastes and faeces. • Agricultural and farming activities tend to use substantial amount of pesticides and fertilizers. Water surface run-off will transport these pesticides and fertilizers into the water sources.	Occurrence of contamination and increase in bacteria load in the water supply. The water will be polluted with pesticides and fertilizers that will have a detrimental health effect to the consumers.	Moderate (3)	Major (4)	3 x 4 = 12	Licensing and control of livestock rearing, agricultural activities and estates by the relevant authorities.	Enforcement activities in the catchment area.

Hazardous event	Hazard	Risk Priority For category of probability occurrence (a)	Risk Priority For category of risk level (b)	Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
Severe seasonal/ weather condition such as drought and flooding	Heavy concentration in water and high water turbidity.	Moderate (3)	Minor (2)	3 x 2 = 6	The use of filter media Sampling by the Health Department each day during disasters (floods) or (2) twice a year	Encourage activities that promote "water retention" to the soil such as tree planting.
Fallen leaves and branches from the surrounding vegetation into the water will undergo a process of decay.	Can lead to bacterial, chemical or physical contamination. Disruption to the outlet flow of water from the dam, causing water shortages in the distribution.	Almost Certain (5)	Major (4)	5 x 4 = 20	None	Installing nets on the water surface at dams to catch falling debris Install a 'double-screening' before the water reached the users.
Encroachment wild animals in the dam/ wild animal carcasses into the	The water supply will experience physical and micro biological	Likely (4)	Catastrophic (5)	5 x 4 = 20	None	Fencing around the catchment area.

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
raw water source.	Contamination. The lack of smell and taste Increased BOD and COD and reducing water quality. The presence of the bacteria E. coli, Leptospira, odor and water-borne diseases.					
Very strong pressure in the pipe-line system that causes leakage and pipe bursts.	Cross contamination in the pipe system by pathogens and pests.	Moderate (3)	Major (4)	3 x 4 = 12	Sampling by the Ministry of Health at least two (2) times a year. Determine the quality of materials/supplies through auditing.	Periodic monitoring by the community and the water supply committee.
Increasing population will	Cross contamination in	Moderate (3)	Major (4)	3 x 4 = 12	No monitoring done	Monitoring done by the local community

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Increase water usage. And illegal connections will disrupt water supply.	the pipe system by pathogens and pests.					
Presence of mining or quarry that alters the soil structure.	Increase water turbidity, chemical contamination.	Unlikely (2)	Moderate (3)	2 x 3 = 6	Mining license from relevant authorities.	Enforcement
Water treatment is poorly achieved due to over-dosing (chlorine).	Result in excessive chlorine smell, oxidizes the pipe-line system as well as affects the health of consumers.	Moderate (3)	Moderate (3)	3 x 3 = 9	Sampling by the Ministry of Health at least two (2) times a year.	Automatic chlorine dosing in the distribution tank. Additional allocation, personnel and equipments. Provide technical training to the committee.

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Chlorination has not met the desired or required contact time.	Bacteriological contamination in the water.	Moderate (3)	Major (4)	3 x 4 = 12	Sampling by the Ministry of Health at least two (2) times a year.	Periodic sampling with the preparation of an annual schedule that must be carried out.
Failure in design of the GFS will result in occurrence of head loss and backflow of water.	Cross contamination in the pipe system by pathogens and pests.	Unlikely (2)	Major (4)	2 x 4 = 8	No monitoring done	Every project to be carried out systematically according to guidelines.
Storage of water by consumers is not sanitary.	Re-contamination occurs from chemicals, bacteria and physical materials.	Likely(4)	Major (4)	4 x 4 = 16	Health education to all household members by instilling sanitary practices through a change or modification in behavior.	Health education to all household members by instilling sanitary practices through a change or modification in behavior.
The use of iron pipes in the distribution which results in the oxidation of pipes.	The use of old pipes will cause the water to be contaminated with chemicals.	Unlikely(2)	Major (4)	2 x 4 = 8	To use poly pipes to replace the iron pipes.	To determine the standard of materials to be use. To upgrade the old systems through an increase in allocation.

B. SANITARY WELL

Hazardous event	Hazard	Risk Priority		Risk Level	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)	(a)x(b)		
Among the hazardous activities/events that may occur	Hazard due to the hazardous activities/ events	Possibility of hazardous activities/events will occur	Risk Level of hazardous activities/events will occur		Control measures that must be carried out	Other control measures that can be carried out
The house located too close to the sanitary well	Overflow of waste water into the sanitary well can lead to contamination with bacteria and chemicals such as ammonia, nitrate, nitrite, etc.	Likely (4)	Moderate (3)	4 x 3 = 12	Well top closed, install pumps, construct apron and drainage, and ensure that the distance of the nearest house is not less than 50 meters	Development of new homes should require approval from local authorities Development of new well should require approval from relevant authorities, including on technical matters. Reassessment should be made to existing homes and well by a technical department, and to recommend improvement

Hazardous event	Hazard	Risk Priority For category of probability occurrence (a)	 For category of risk level (b)	Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
						measures where necessary. The houses must be equipped with waste water disposal system is good.
Construction and use of unsanitary toilets near a well	Toilets built near the sanitary well may be contaminated with bacteria.	Likely(4)	Moderate (3)	4 x 3 = 12	Distance of toilets must be over 50 meters, and it has to be covered.	(As above) Regular de-sludging
Wastewater from the septic tanks seep into the sanitary well	Due to ineffective treatment not enough retention time; damaged tank, causing high BOD and COD content and assist the breeding of pathogens.	Likely (4)	Minor (2)	4 x 2 = 8	Distance of septic tank, and outlet pipes must be more than 50 meters away, covered, and desludge regularly.	Construction of septic tanks in rural areas must get approval from relevant authorities (eg District Office) Reassessment should be performed on the septic tank by a

Hazardous event	Hazard	Risk Priority For category of probability occurrence (a)	 For category of risk level (b)	Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
						technical department, and to recommend technical improvements if needed.
Commercial activities such as sundry shops, eateries and auto vehicle workshops too close to the sanitary wells.	Businesses such as car workshop oil pumping station, sawmill, a brick factory, batik factories, etc., will produce waste such as benzene, solvents, lubricants and others.	Moderate (3)	Minor (4)	3 x 2= 6	Monitor sanitary wells Business and the workshop examined by the relevant authorities such as local authorities, DOE, DOSH (technical and licenses).	Monitor and enforce local laws on businesses without licenses More frequent water sampling of affected areas
Indiscriminate disposal of solid waste.	Water leachate seep into sanitary wells.	Moderate (3)	Minor (3)	3 x 3 = 9	To have a suitable and effective solid waste management system.	Developing a centralized system of garbage disposal in rural areas Using the 3R

Hazardous event	Hazard	Risk Priority For category of probability occurrence (a)	 For category of risk level (b)	Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
						concept (Reduce, Reuse, Recycle) Improving health promotion activities
Agricultural activities near the sanitary well	The use of pesticides or herbicides that are not monitored will lead to contamination of ground water, etc.	Moderate (3)	Major (4)	3 x 4 = 12	Well top closed, install pumps, construct apron and drainage, and ensure that the distance of the nearest house is not less than 50 meters	Taking water samples periodically Increase enforcement activities Construct a suitable drainage system and create a buffer zone. Increase health promotion activities.
Severe seasonal/ weather condition such as drought and flooding	Exposed to reduced or excessive amounts of water, high water turbidity.	Moderate (3)	Moderate(3)	3 x 3 = 9	Sampling by the Health Department each day during disasters (floods) or (2) twice a year.	Running penklorinan Storage tank. Provide additional, members and equipment.

Hazardous event	Hazard	Risk Priority		Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
		For category of probability occurrence (a)	For category of risk level (b)			
	Pollution (physical, chemical) or contamination (bacteriological), such as cholera, typhus, leptospirosis, oil, arsenic, ammonia, turbidity, odor, etc.					Provide technical training to the committee. Sampling should be conducted periodically

C. Rainwater Catchment System

Hazardous event	Danger (Hazard)	Priority Risk		Risk Level (a)x(b)	Existing control measures	Proposed additional control measures
		For category of probability occurrence	For category of risk level			
Among the hazardous activities/events that may occur	Hazard due to the hazardous activities/ events	Possibility of hazardous activities/events will occur	Risk Level of hazardous activities/events will occur		Control measures that must be carried out	Other control measures that can be carried out
Drought	Scarcity of water. Foreign matters, dusts and dusty water storage tanks.	Moderate (3)	Major (4)	3 x 4 = 12	Periodic cleaning of tanks and roofing is necessary.	Cleaning to use appropriate equipments. Cloud seeding to induce rain
Acid Rain	Acidic water will damage the system components like roofing, pipes and tanks.	Unlikely (2)	Major (4)	2 x 4 = 8	Release water by flushing when it is raining.	To use corrosion resistant materials for roofing, pipes and water tanks.
Dirty and rusty roofing	The drinking water will cause water-borne diseases.	Moderate (3)	Major (4)	3 x 4 = 12	Replacement of rusty parts.	To use anti corrosion materials for roofing, pipes and water tanks.
Animal wastes or rotting dead animals or human activities.	The presence of pathogens which affects the water quality.	Likely (4)	Moderate (3)	4 x 3 = 12	Periodic cleaning as and when necessary.	Auto-cleaning to use appropriate equipments.

Hazardous event	Danger (Hazard)	Priority Risk			Existing control measures	Proposed additional control measures
		For category of probability occurrence	For category of risk level	Risk Level (a)x(b)		
Clogged gutter	Water turbidity and risk of pathogenic bacteria.	Moderate (3)	Minor (2)	3 x 2 = 6	Periodic inspection of gutters and carry out cleaning and repair as and when necessary.	Cleaning the surrounding of leaves and tree branches. Screening
The filter media is clogged and damaged due to absence of maintenance.	High turbidity due to problem of water quality.	Moderate (3)	Minor (2)	3x2 = 6	Periodic inspection of filter and do replacement when necessary.	Use durable filter that is easy to service.
Moss-grown and dirty sedimentation tank.	High turbidity due to problem of water quality.	Moderate (3)	Minor (2)	3 x 2 = 6	Periodic inspection and flushing of water tanks.	None
Mossy and dirty storage tank.	Water becomes turbid and smelly.	Moderate (3)	Minor (2)	3 x 2 = 6	Periodic inspection and flushing of water tanks.	None

Hazardous event	Danger (Hazard)	Priority Risk			Existing control measures	Proposed additional control measures
		For category of probability occurrence	For category of risk level	Risk Level (a)x(b)		
Sediments in the tanks	Turbidity and quality of water is affected.	Moderate (3)	Minor (2)	3 x 2 = 6	Periodic inspection and flushing of water tanks.	
Tank has no cover or damage.	Entry of dangerous foreign matters	Rare (1)	Minor (2)	1 x 2 = 2	Periodic inspection and replace cover when necessary.	Cover is made of quality material.
Prolong storage of water.	Turbidity and quality of water is affected.	Moderate (3)	Minor (2)	3 x 2 = 6	Periodic inspection and flushing of water tanks.	
Stability of water tank site.	Unstable water structure tank is a safety risk.	Rare (1)	Minor (2)	1 x 2 = 2	Periodic inspection and carry out the necessary improvement.	Use strong permanent site. Comprehensive training on construction technology.

9.0 Module 5 – Determining and Improving Control Measures

When identifying and assessing risks that presents danger to a water supply system, the team which implements WSP must execute and document the control measures, whether they are already in place or new ones in which it can mitigate the risks involved to the villages concerned.

After categorizing the risks involved, the Committee should consider measures to effectively control all of the risks faced. In order to reduce the risk of each hazard events, control measures for each event needed to be in place or introduced.

There are different types of control measures. Depending on the type of control needed, this can be carry out, possibly through conducting site visits or taking actions according to specifications set by the manufacturer, or by taking water samples through a systematic and periodic monitoring program. Depending on the determination of the level of risk as discussed earlier, the effectiveness of these control measures is then measured by the targeted reduction has been achieved by the performed actions.

Existing control measures for any hazards or dangerous occurrence must be identified. If no control measures are determined to a hazardous or dangerous incident, it should be clearly documented for follow-up.

If the effectiveness of control measures is not known at the time of the initial determination process was carried out, the WSP implementation team should take the assumption that no existing control measures are effective to complete a hazard to water supplies used. Therefore, the implementation team should conduct a study or research to identify the measures deemed appropriate.

Normally, in most cases, control measures involve the periodic monitoring activities based on observation or conducting test on samples taken from the site, such as on turbidity, the presence of microbial or chemical tests as well as the structural integrity of the supply system.

After identifying the control measures needed to be carried out, the WSP implementation team should also determine the scope of the measures to be

taken. Typically, the scopes of controls include every component or sub-components of water supply systems that are being monitored.

In addition, when determining the control measures, questions on the implementation or maintenance of the system should be taken into consideration to ensure that any regulatory action taken will be fully effective.

Among the questions that need to be addressed when determining whether the control measures are appropriate:

- What should be monitored? What will be monitored?;
- How monitoring will be carried out? How will it be monitored?;
- When monitoring is done? When will it be monitored?;
- Where the monitoring should be conducted? Where will it be monitored?;
- Who will conduct the monitoring? Who will do the monitoring?

Once the answers to these five questions were found, implementation team must determine the critical conditions (critical limits) to be used as a guide to gauge the effectiveness of the control measures are implemented. The selection of the critical conditions depends on the following items:

- Are all hazardous and dangerous incidents have been consider in the monitoring process to ensure that even small risks can be controlled? Is there any standard or set of parameters to guide the monitoring to be carried out?
- What are the standards or parameters selected to be used as a scale for the proposed control measures?
- Can corrective actions be performed when/after violations are detected?

However, when there were deviations from the set critical conditions, it will require corrective action and the nearest Health Office have to be inform.

Corrective actions, together with the monitoring process, form a circle of control measures to ensure the safety of drinking water is used. Please refer to the preparation of the control measures set out as a guide in Table 7: Module 5a as provided below.

To ensure that control measures has been implemented properly and provide a positive impact on security of water supply used, aspects of a review or an audit should be conducted on these measures, to validate the measures taken.

The validation process is to determine whether the system is operating according to the assumptions made by the executive team during the implementation of previous WSP modules beforehand. This process typically involves re-checking the validity of all findings during the steps taken from the previous module. Please refer to Table 8: Module 5b as an example. It uses the control measures that have been identified for all hazards and dangerous occurrences to the water supply systems gathered from the pilot projects mentioned earlier and that which also have been discussed in the previous modules.

Table 7: Module 5a (Example) - To Establish Periodic Investigations, Monitoring and Maintenance Schedule.

A. GRAVITY FEED SYSTEM

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Protection of catchment area	Gazettement of catchment area.	What	Gazettement of catchment area as water catchment area.	e.Coli - 0 MPN (bacteria) Turbidity (10 NTU) (These parameters are chosen as they are much easier to detect compared to other parameters)	What	Determine the maximum level of water turbidity. Carry out water sampling for turbidity test.
		How	Continuous monitoring in the catchment area to prevent and ensure that there is no encroachment.		How	Inform the relevant agencies like Forest Department, etc.
		When	Every three (3) Months		When	Immediately upon detection
		Where	Catchment area that has been gazetted.			
		Who	WSP implementation team, home owners, users.		Who	WSP implementation team, home owners, users.

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Monitoring of Dam Structure	Reduced water flow/ low water pressure	What	Carry out maintenance of the dam.	Content of sediments in the dam (Level of sediments should not exceed 0.3 m from the outlet pipe level) To use water pressure equipment	What	Content level of sediments in the dam.
		How	Inspection of the dam		How	'Desludging'
		When	i. After heavy rain ii. Drop in water supply		When	Immediately upon detection
		Where	At the Dam			
		Who	WSP implementation team, home owners, users.		Who	WSP implementation team, home owners, users.
Water treatment tank (if chlorine is used as disinfectant)	Water tank	What	Contain the presence of chlorine (>2ppm) No damage/leakage to the tank	Presence of e.Coli in the water distribution line Water will be less/below the designated level	What	To ascertain that the chlorine level is adequate in the distribution tank. To check sign of damage or leakage to the tank.
		How	Carry out water quality testing		How	Adjustment of chlorine dosage in the tank when e.Coli is detected in the

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
			In-situ inspection/ observation.			pipe distribution. Carry out any maintenance and renovation of damages immediately.
		When	Once a week and in the event of crisis or emergency.		When	Immediately upon detection
		Where	Water treatment tank			
		Who	WSP implementation team, home owners and users.		Who	Implementing agency, WSP implementation team, home owners, and users.
Distribution network	Necessary measures that need to be taken to ensure minimal loss of water in the distribution pipe. Consumers receive safe water from the distribution system.	What	Presence of leakage and unstable pressure in the distribution pipe.	Low water pressure (public complaint) Presence of e.Coli in the distribution pipe	What	Ensure that there is no leakage and inspection of the pipe connections.
		How	Carry out inspection of the pipe distribution through observation. Carry out water quality testing in the field.		How	Monitoring of materials which may cause the leakage. Carry out any maintenance and

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
						renovation to the pipes that are a problem.
		When	Every three (3) months to check the pipe network Every six (6) months for water quality test.		When	Immediately upon detection.
		Where	Distribution network			
		Who	WSP implementation team, home owners and users.		Who	WSP implementation team, home owners and users.

B.SANITARY WELL

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Control of well surroundings	Water Quality	**What**	Monitoring of physical, chemical and bacterial parameters	Comply with water quality standards	**What**	Improve the water supply system by providing treatment
		How	Visual inspection, sampling and testing for water quality		**How**	Through health education Treatment method such as Aeration, Sand filtering or disinfection
		When	Every 6 months and during the crisis (drought in the long run)		**When**	When detected
		Where	At the well and distribution pipes			
		Who	WSP implementation team, home owners and users		**Who**	WSP implementation team, home owners and users
Ensure the water tank used is in good condition	The condition and cleanliness of the tank	**What**	Whether there is leakage, which affect the condition and cleanliness of the tank		**What**	Maintenance of the tank
		How	Visual inspection		**How**	Cleaning, maintaining or

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
						repairing (when necessary) the tank.
		When	Monthly		**When**	When detected
		Where	At the tank			
		Who	WSP implementation team, home owners and users		**Who**	WSP implementation team, home owners and users
Chlorination during flood	Adequate chlorine dosing to eliminate pathogens.	**What**	Residual chlorine	Residual chlorine in water is around 0.2ppm.	**What**	Residual chlorine violation occurs even though chlorination has been done.
		How	Water sample collection and analysis.		**How**	To investigate the chlorine dosage used and if the violation persisted, the Flood Relief Committee has to be informed to provide alternative water supply.
		When	During and after flood		**When**	When detected

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
		Where	Wells affected in the flooded area.			
		Who	WSP implementation team, home owners and users		**Who**	WSP implementation team, home owners and users
Ensure that the pump works well	Pump is running smoothly	**What**	When the pump is clogged or damaged pump	Pump malfunction	**What**	Repair or replace damaged pump
		How	Visual inspection by lifting the pump out of the tube wells Pump maintenance		**How**	Repair the damaged pumps. If cannot be repaired, should be replaced with a new pump
		When	Monthly basis for examining the ability of the pump Pump cleaning every three (3) months		**When**	When pump is not operational
		Where	Individual pump			
		Who	WSP implementation team, home owners and users		**Who**	WSP implementation team, home owners and users

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Ensure there are no problems with the water mains and distribution pipes are.	No disruption of water supply	**What**	Leakage or damage to the distribution pipeline Illegal connection Clean surrounding	There are still leakage in the pipeline	**What**	Repair or replacement of affected pipes
		How	Visual inspection Repair or replacement of pipes		**How**	Repair or replacement of affected pipes
		When	Monthly		**When**	When there are still leakage in the pipeline
		Where	Water mains and distribution pipe			
		Who	WSP implementation team, home owners and users		**Who**	WSP implementation team, home owners and users
Ensure continuous electrical supply (for use of pumps, etc)	No disruption to the electrical supply	**What**	Check electrical supply		**What**	Perform repairs to the electrical wires and components affected
		How	Visual inspection		**How**	Inform relevant authorities

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
		When	When there is electrical power disruption		**When**	When there is still electrical power
		Where	Electrical power source			
		Who	WSP implementation team, home owners and users		**Who**	Local electrical provider, WSP implementation team, home owners and users

C. Rainwater Collection System

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Periodic cleaning of tanks and roofing is necessary.	Condition of tank structure, gutter, roofing and fittings.	**What**	Ensure the cleaning of all dirt and sediments.	**Repairs needed to roofing, gutters and tanks.**	**What**	Prevent foreign matters and wastes from entering into the water tanks.
		How	Visual Inspection		**How**	Education of consumer.
		When	Periodically and during heavy rain.		**When**	On-going
		Where	Roofing, gutters and tank		**Who**	WSP team, House owner
		Who	WSP Team, House owner, Consumer.			
Release water by flushing when it is raining, at the sedimentation tank and drain pipe.	Water quality	**What**	Water acidity should not be less than 6.0pH.	**Ensure the water pH is not less than 5.5pH.**	**What**	Release water or add lime soda.
		How	Test with the pH meter		**How**	Education of consumer.
		When	When pH test on rain water is less than 6.0.		**When**	On-going
		Where	Tank and drain pipe.		**Who**	WSP team, House owner.
		Who	WSP Team, House owner, Consumer.			

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Replacement of rusty parts.	Quality of roofing construction materials	**What**	Ensure that the materials do not get rusty.	**Roofing is rusty**	**What**	Anti rust materials.
		How	Visual inspection		**How**	Knowledge on anti rust construction materials.
		When	All the time		**When**	On-going
		Where	Roofing		**Who**	WSP team, House owner.
		Who	WSP Team, House owner, Consumer.			
Periodic cleaning of tank as and when necessary.	Condition of the structure of the tank.	**What**	Ensure the cleaning of all dirt and sediments.	**Moss and sedimentation build up in the tank.**	**What**	Prevent foreign matters and wastes from entering into the water tanks.
		How	Inspection		**How**	Education of consumer.
		When	Periodically and during heavy rain.		**When**	On-going
		Where	Sedimentation tank		**Who**	WSP team, House owner.
		Who	WSP Team, House owner, Consumer.			

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Periodic inspection of gutters and carry out cleaning and repairs.	Structural condition of the gutter	**What** **How** **When** **Where** **Who**	Ensure the cleaning of all dirt and sediments. Inspection Periodically and during heavy rain. Gutter WSP Team, House owner, Consumer.	**Dirt, foreign matters, waste in the gutters.** **Damages along the structure of the gutter.**	**What** **How** **When** **Who**	Prevent the gutter from clogging. Education of consumer and maintenance. On-going WSP team, House owner.
Periodic inspection of filter and do replacement when necessary.	Condition of the filter media.	**What** **How** **When** **Where** **Who**	Ensure the cleaning of the filter of sediments and replace when necessary. Inspection and cleaning Periodically and during heavy rain. Filter WSP Team, House owner, Consumer.	**Damaged filter**	**What** **How** **When** **Who**	Prevent the filter materials from damage Education of consumer and maintenance. On-going WSP team, House owner.

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
Periodic inspection and flushing of water tanks.	Condition of the storage tank structure	**What**	Ensure the cleaning of sediments in the storage tank.	**Mossy and dirty storage tank.**	**What**	Prevent the presence of sediments and carry out the necessary cleaning.
		How	Inspection and cleaning		**How**	Education of consumer and maintenance.
		When	During downpour		**When**	On-going
		Where	Storage tank			
		Who	WSP Team, House owner, Consumer.		**Who**	WSP team, House owner.

Table 8 - Module 5b (Example): To Establish a Verification Schedule over the Monitoring and Maintenance Activities
(Follow up action to Module 5a, how to ensure that the Module is monitored, investigated or verified)

Control Measures	Scope of Monitoring	Verification process on the Monitoring and Maintenance Activities		Proposed Follow up Action	
Catchment Area Monitoring or Implementation Audit.	Raw water turbidity and E. coli monitoring record.	What	Record of E. coli and turbidity parameters results, follow-up action to agencies concerned.	What	Remedial measures on violations detected.
		How	1. Check the relevant record. 2. Carry out inspection by observation.	How	1. Send reminder letter to comply with guidelines. 2. District or State Action Committee Meeting 3. Carry out follow up visit.
		When	Once a year/when complaint is received.	When	Promptly
		Where	Committee office		
		Who	WSP Committee at District/State/National	Who	WSP Committee at District/State/National
Water Tank Treatment Monitoring or Maintenance Audit. (If treatment system is available).	Record of monitoring E. coli parameter and tank maintenance.	What	Record of E. coli parameter result and tank maintenance record.	What	Remedial measures on violations detected.

Control Measures	Scope of Monitoring	Verification process on the Monitoring and Maintenance Activities		Proposed Follow up Action	
		How	1. Check E. coli parameter record. 2. Check tank maintenance record (Repair/replace)	How	1. Send reminder letter to comply with guidelines. 2. District or State Action Committee Meeting. 3. Carry out follow up visit.
		When	Quarterly/when there is complaint	When	Immediately/when there is no compliance in the project implementation.
		Where	Committee office/record keeping place		
		Who	WSP Committee at District/State/National	Who	WSP Committee at District/State/National
Pipe Distribution Monitoring or Maintenance Audit.	Record of monitoring E. coli parameter and distribution system maintenance.	What	Record of E. coli parameter result and tank maintenance record.	What	Remedial measures on violations detected.
		How	1. Check E. coli parameter record. 2. Check pipe distribution maintenance record (Repair/replace)	How	1. Send reminder letter to comply with guidelines. 2. District or State Action Committee Meeting. 3. Carry out follow up visit.
		When	Quarterly/when there is complaint	When	Promptly

Control Measures	Scope of Monitoring	Verification process on the Monitoring and Maintenance Activities		Proposed Follow up Action	
		Where	Committee office/record keeping place		
		Who	WSP Committee at District/State/National	Who	WSP Committee at District/State/National

B. SANITARY WELL

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Proposed Follow up Action	
Audit on wells condition and surrounding	Condition of well and surrounding Records on Water Samples Analysis	**What**	Records of water quality parameters such as e.Coli, Iron and Manganese chemistry. Condition of well and surrounding	**What**	Ensure the efficiency of chlorination.
		How	Checking records of water quality and maintenance records. Taking a water sample confirmation. Visual Inspection	**How**	Carry out study/thorough investigation.
		When	Twice a year	**When**	When non-compliance of residual chlorine level is detected.
		Where	At the well and surroundings The Committee office /records storage		
		Who	WSP Committee at District/State/National	**Who**	WSP Committee at District/State/National

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Proposed Follow up Action	
Chlorination during flood	Adequate chlorine dosing to kill pathogens and chlorination record.	**What**	Ensure that the residual chlorine is between 0.5ppm-2ppm and done according to schedule.	**What**	Ensure the efficiency of chlorination.
		How	Carry out monitoring and verification checks on chlorination and sampling records of affected wells randomly.	**How**	Carry out study/thorough investigation.
		When	During and after flood.	**When**	When non-compliance of residual chlorine level is detected.
		Where	Wells affected in the flooded area and at the office.		
		Who	WSP Committee at District/State/National	**Who**	WSP Committee at District/State/National

C. RAINWATER COLLECTION SYSTEM

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
Periodic cleaning of tanks and roofing when necessary.	Condition of tank structure, gutter, roofing and fittings.	**What**	Inspection of cleaning efficiency.	**What**	Assessment of cleanliness status.
		How	Observation Audit and cleanliness inspection. Documentation and verification of maintenance works, pictures and other reports. Frequency of meeting with the WSP committee and/or Health Bureau.	**How**	Have periodic renovation and improvement action meeting.
		When	Annually	**When**	Annually
		Where	Roofing, gutter and tanks		
		Who	WSP Committee at District/State/National	**Who**	WSP Committee at District/State/National
Release water by flushing when it is raining, at the tank and drain pipe.	Acidity of water quality	**What**	Check the inspection document on water pH.	**What**	Ensure that the water pH inspection document conform to standard.
		How	Verify the inspection format on water pH.	**How**	Check the monitoring and inspection documents.

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
			Random sampling test. Documentation and verification of inspection works. - check list, pictures and report. Frequency of meeting with the WSP committee and/or Health Bureau.		Periodic meeting with the local community and its committee. Practical training on cleaning or cleanliness procedures. Technical visit from the higher management. Written report to the Department of Environment.
		When	Every 6 months	**When**	Annually
		Where	Tanks and drain pipes		
		Who	WSP Committee at District/State/National	**Who**	WSP Committee at District/State/National
Replacement of rusty parts.	Quality of roofing construction materials.	**What**	Record of replacement materials.	**What**	Ensure the availability of inspection record document.
		How	Verification of inspection format. Frequency of meeting with the WSP committee and/or Health Bureau.	**How**	Check the monitoring and inspection documents. Periodic meeting with the local community and its committee.
		When	Every 6 months		
		Where	Roofing		Practical training on use of materials at the site.

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
		Who	District level committee, WSP members or Health Bureau committee or Health Office.	**When** **Who**	Technical visit from the higher management. Annually WSP Committee at District/State/National
Periodic cleaning of sedimentation tank when necessary.	Condition of the sedimentation tank structure.	**What** **How** **When** **Where** **Who**	Inspection of cleaning efficiency. Observation Audit and cleanliness inspection. Documentation and verification of inspection works. – check list, pictures and report. Frequency of meeting with the WSP committee and/or Health Bureau. Every 6 months Sedimentation tank District level committee, WSP members or Health Bureau committee or Health Office.	**What** **How** **When** **Who**	Ensure document inspection. Check the monitoring and inspection documents. Periodic meeting with the local community and its committee. Practical training on cleaning or cleanliness procedures. Technical visit from the higher management. Annually WSP Committee at District/State/National

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
Periodic inspection of gutter and carry out cleaning.	Condition of gutter structure.	**What**	Inspection of cleaning efficiency.	**What**	Ensure document inspection.
		How	Observation Audit and cleanliness inspection. Documentation and verification of inspection works. – check list, pictures and report. Frequency of meeting with the WSP committee and/or Health Bureau.	**How**	Check the monitoring and inspection documents. Periodic meeting with the local community and its committee. Practical training on cleaning or cleanliness procedures. Technical visit from the higher management.
		When	Every 6 months	**When**	Annually
		Where	Gutter		
		Who	District level committee, WSP members or Health Bureau committee or Health Office.	**Who**	WSP Committee at District/State/National
Periodic inspection of filter and replace when necessary.	Condition of filter material	**What**	Parts functional efficiency inspection	**What**	Ensure document inspection.
		How	Observation Audit and *parts functionality* inspection. Documentation and verification of inspection works. – check list, pictures and report.	**How**	Check the monitoring and inspection documents. Periodic meeting with the local community and its committee.

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
			Frequency of meeting with the WSP committee and/or Health Bureau.		Practical training on cleaning or cleanliness procedures.
		When	Every 6 months		Technical visit from the higher management.
		Where	Filter	**When**	Annually
		Who	District level committee, WSP members or Health Bureau committee or Health Office.	**Who**	WSP Committee at District/State/National
Periodic tank inspection and carry out flushing.	Condition of storage tank structure.	**What**	Inspection of cleaning efficiency.	**What**	Ensure document inspection.
		How	Observation Audit and cleanliness inspection.	**How**	Check the monitoring and inspection documents.
			Documentation and verification of inspection works. – check list, pictures and report.		Periodic meeting with the local community and its committee.
			Frequency of meeting with the WSP committee and/or Health Bureau.		Practical training on cleaning or cleanliness procedures.
		When	Every 6 months		Technical visit from the higher management.
		Where	Storage tank		

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
		Who	District level committee, WSP members or Health Bureau committee or Health Office	**When** **Who**	Annually WSP Committee at District/State/National
Periodic inspection and replace the cover.	Condition of cover structure.	**What** **How** **When** **Where** **Who**	Parts functional efficiency inspection Observation Audit and *parts functionality.* Documentation and verification of inspection works. – check list, pictures and report. Frequency of meeting with the WSP committee and/or Health Bureau. Every 6 months Tank cover District level committee, WSP members or Health Bureau committee or Health Office.	**What** **How** **When** **Who**	Ensure document inspection. Check the monitoring and inspection documents. Periodic meeting with the local community and its committee. Practical training on cleaning or cleanliness procedures. Technical visit from the higher management. Annually WSP Committee at District/State/National
Periodic inspection and carry out repairs to the tank site structure.	Condition of tank site structure.	**What**	Parts functional efficiency inspection record.	**What**	Ensure document inspection.

Control Measures	Scope of Monitoring	Process on the Monitoring and Maintenance		Proposed Follow up Action	
		How	Observation Audit and *structure safety inspection.* Documentation and verification of inspection works. – check list, pictures and report. Frequency of meeting with the WSP committee and/or Health Bureau.	**How**	Check the monitoring and inspection documents. Periodic meeting with the local community and its committee. Practical training on cleaning or cleanliness procedures. Technical visit from the higher management.
		When	Every 6 months	**When**	Annually
		Where	Tank site structure		
		Who	District level committee, WSP members or Health Bureau committee or Health Office.	**Who**	WSP Committee at District/State/National

9.0 Module 6 - Crisis Management Plan

No matter how comprehensive a water safety plan is, there is every possibility that unexpected hazardous events may occur and no corrective action or maintenance is prescribed in the plans to handle them.

In these circumstances, the WSP implementation team has to be prepared by taking inventory of all possible unexpected hazards. Although these events may be unpredictable and any specific action and detailed corrective actions might not be prepared beforehand, it is reasonable for the WSP team to provide a suitable crisis management plan which is generic to handle the incident involved.

Water safety plan essentially doesn't have definite and clear operational limits, which when or if something unexpected happens, it will not necessarily trigger immediate corrective action. Instead, a water safety plan should include a set of protocols for the assessment of the situation and when necessary, the declaration of a situation that requires activation of crisis management plans based on that assessment.

This will include what criteria or level of incident should be considered a crisis as well as what steps are needed to resolve the crisis and determination of responsibilities of the parties involved. Criteria for selection and determination of the crisis should include the following:

- time taken for the crisis to affect a water supply ;
- the population affected, and
- the nature of a suspected hazard.

A Crisis management plan success depends on the evaluation, experience and skills of WSP implementation team managing the used water supply system.

A Crisis Management Plan shall include all major disasters (such as earthquakes, floods) accident, damage and human actions (strikes, sabotage). A Crisis Management Plan should clearly define the responsibilities of each party in the coordination of the actions to be taken, communication plans to

inform water users to be vigilant, and to prepare the actions for the provision of alternative supplies.

A Crisis Management Plan should also take into account the opinions and contributions given by all the parties concerned. Therefore, negotiations and meetings with all parties involved are one important step in the preparation of the plan.

A Crisis Management Plan should be consistent with any emergency and crisis management plan baseline, in which if there are already plans in place with the relevant parties, be it at whether national or local level, all of these plans should be taken into consideration to form a cohesive and all encompassing plan. The main areas that should be in the Crisis Management Plan include:

- response actions, including the need of increased surveillance;
- the responsibility and jurisdiction at every level, whether it involves internal and external matters to the WSP;
- plans for emergency water supply;
- communication protocols and strategies, including notification procedures (Internal, regulatory bodies, media and public), and
- mechanisms to ensure the continued health of the community.

A crisis management plan is divided into two, namely: -

a) The **incident management plan** involving the management of crisis events on which the effects on the health of consumers is only temporary. Typically, the solution to the crisis events can be implemented immediately and in a short period of WSP implementation team and the interested parties in the village or area concerned.

b) **Emergency management plan** involving the management of crisis events which affect the health of consumers is more significant and require drastic solutions by WSP implementation team and the interested parties involved.

The following tables will demonstrate the points mention above:

Table 9 - Module 6a (Example) : Crisis Management Plan (Incident Plan)

A. GRAVITY FEED SYSTEM

Component	Incident Plan				
	Hazardous event	**Plan of Action**	**Additional Action**	**Time Frame**	**Responsible**
Catchment Area	Microbiological contamination as a result of livestock rearing, animal sewage, decaying process, etc.	Inform the community about the incident. Investigate and stop source or operation. Carry out sampling to determine the types of bacteria contaminating the water. Carry out corrective action like chlorination, and so forth.	Advice consumers to boil water before drinking. Give health education and distribute pamphlets pertaining to drinking water safety and health. Increase monitoring and enforcement by the responsible authorities.	With immediate effect	WSP Committee/Health Bureau/DHO/Relevant Agencies
	Chemical contamination from activities like plantations, machineries, pesticides use and so forth.	Inform the community about the incident. Investigate and stop source or operation. Carry out sampling to determine the types of	Give health education and distribute pamphlets pertaining to drinking water safety and health. Increase monitoring and enforcement by the responsible authorities.	With immediate effect	WSP Committee/Health Bureau/DHO/Relevant Agencies

Component	Hazardous event	Incident Plan			
		Plan of Action	**Additional Action**	**Time Frame**	**Responsible**
		bacteria contaminating the water. Carry out corrective action like pH stabilization and disinfection/cleaning of contaminated area.			
	Physical contamination due to land erosion, sedimentation and so forth.	Inform the community about the incident. Water sampling to determine the level of turbidity, TDS, TSS and so forth. Carry out corrective measures like purifying the water (alum) water screening and filtration.	Advice consumers to boil water before drinking. Give health education and distribute pamphlets pertaining to drinking water safety and health. Increase monitoring and enforcement by the responsible authorities. Inspect the treatment tank regularly.	With immediate effect	WSP Committee/Health Bureau/DHO/Relevant Agencies

Component	Hazardous event	Incident Plan			
		Plan of Action	**Additional Action**	**Time Frame**	**Responsible**
Distribution Pipes	Chemical contamination from activities like plantations, machineries, pesticides use and so forth	Inform the community about the incident. Investigate and stop source or operation. Carry out sampling to determine the types of bacteria contaminating the water. Carry out corrective action like pH stabilization and disinfection/cleaning of contaminated area.	Advice consumers to boil water before drinking. Give health education and distribute pamphlets pertaining to drinking water safety and health. Increase monitoring and enforcement by the responsible authorities Inspect the pipes regularly.	With immediate effect	WSP Committee/Health Bureau/DHO/Relevant Agencies
	Disruption in water supply system due to breakage to pipelines (might lead to contamination)	Inform the community about the incident. Investigate and stop source of leaking. Carry out sampling to determine the types of bacteria contaminating the water.	Advice consumers to boil water before drinking. Give health education and distribute pamphlets pertaining to drinking water safety and health. Increase monitoring and enforcement by the responsible authorities.	With immediate effect	WSP Committee/Health Bureau/DHO/Relevant Agencies

B. SANITARY WELL

Component	Hazardous event	Plan of Action	Additional Action	Time Frame	Responsible
Well	Damage to the pump of the sanitary well.	Repair or replace with new pump. Draw the water manually (bucket) for open well. For tube well, to ask for water supply from the water purveyor (tanker).	Advice consumers to boil water before drinking. Periodic monitoring of the pump condition. Ensure that the newly installed pump follows the specified conditions	Within 1-2 days	WSP Committee/Health Bureau/DHO/Relevant Agencies
	Leakage of tank	Replace with new tank Carry out bypass connection directly to the house	Ensure that the tank is in good condition	Within 1-2 days	WSP Committee/Health Bureau/DHO/Relevant Agencies
	Pipe clogging and leakage	Repair the leaking pipe	Upgrade/repair the whole or part of reticulation system if necessary	Within 1-2 days	WSP Committee/Health Bureau/DHO/Relevant Agencies

Component	Hazardous event	Plan of Action	Additional Action	Time Frame	Responsible
	Electricity supply blackout	Contact the relevant authority (electrical power provider) Draw the water manually (bucket) for open well. For tube well, to ask for water supply from the water purveyor (tanker).	Monitor the electricity voltage for capacity and capability.	Immediately (24 hours)	WSP Committee/Health Bureau/DHO/Relevant Agencies
	Soil collapse.	Inform the community about the incident. Investigate and stop source. Carry out sampling to determine water quality. Carry out corrective action and so forth.	Provide alternative sources of safe water Provide adequate water storage tank Cap major damage on wells.	Immediately (24 hours)	WSP Committee/Health Bureau/DHO/Relevant Agencies

Component	Hazardous event	Plan of Action	Additional Action	Time Frame	Responsible
	Water sewerage, septic tank water seeping into the well	Cleaning the area and minimize pollution Carry out scientific study/research if necessary Contact the relevant technical agencies. Visit the site with the relevant agency for further action	Advice consumers to boil water before drinking. Increase monitoring or surveillance	Immediately after getting the complaint	WSP Committee/Health Bureau/DHO/Relevant Agencies

C. RAINWATER COLLECTION SYSTEM

Component	Hazardous event	Plan of Action	Additional Action	Time Frame	Responsible
Area of Water collection (roofing including the gutter).	Microbe contamination/ water-borne diseases/sabotage	Carry out disinfection of the stored water. The villagers are required to boil their water. The villagers are given health education.	The Water Supply Company or water purveyor is to send lorry tankers to supply clean water. Repeat water sampling.	Promptly, within 24 hours.	WSP Committee/Health Bureau/DHO/Relevant Agencies
Storage Tank and Supporting Structure	Instability in the soil, unstable structure, etc might cause tank to tip over	Inform the community about the incident. Investigate source of problem. Carry out corrective action and so forth.	Provide alternative sources of safe water until problem is solved.	Promptly, within 24 hours.	WSP Committee/Health Bureau/DHO/Relevant Agencies

Table 10 - Module 6b (Example): Crisis Management Plan (Emergency)

A.GRAVITY FEED SYSTEM

Component	Activity/Dangerous Hazard	Emergency Plan			
		Plan of Action	Additional Action	Time Frame	Responsible
Catchment Area	Absence of water (dry) at the dam due to prolong drought and badly damaged dam (broken).	Set up a water crisis committee/operation room. Supply clean water by lorry tankers. Send drilling team to build tube wells as an alternative water supply source	Provide bottle or mineral water to the villagers. Carry out water sampling to the alternative sources Carry out medical examination and treatment to the population or carry out vaccination.	Promptly Promptly and continuously until the crisis is over. 3 days 24 Hours	WSP Committee at community/ District/State/National PKA Daerah/Water purveyor WSP Committee at community/ District/State/National WSP Committee at community/ District/State/National
Catchment Area/ treatment tank/ distribution network	Microbiological/chemical contamination that can result in mortality (pathogenic microbe).	Inform the public so that they do not use the water that is contaminated.		24 Hours	WSP Committee at community/ District/State/National

Component	Activity/Dangerous Hazard	Emergency Plan			
		Plan of Action	**Additional Action**	**Time Frame**	**Responsible**
	Example: Finding dead carcass at the dam.	Set up the Water Crisis Committee. Stop the supply of contaminated water to the population. Provide alternative water supply like water tankers. Carry out water sampling. Cleaning of the dam.		24 Hours Immediately Promptly and continuously until the crisis is over. 2 Days During the crisis period	WSP Committee at community/ District/State/National WSP Committee at community/ District/State/National District PHA/Water supply company WSP Committee at community/ District/State/National WSP Committee at community/ District/State

B. SANITARY WELL

Component	Activity/Dangerous Hazard	Emergency Plan			
		Plan of Action	Additional Action	Time Frame	Responsible
Well (Water source)	Incidental/Intentional exposure to hazardous materials	Stop the supply of contaminated water to the population. Provide alternative water supply like water tankers. Carry out water sampling. Thorough cleaning of the system.	Provide bottle or mineral water to the villagers. Carry out water sampling to the alternative sources Carry out medical examination and treatment to the population or carry out vaccination.	Immediately	WSP Committee at community/ District/State/National
Storage	The condition of tank not suitable due to etc. expose to harmful substances (dire microbiological/chemical contamination), structure of the tank	Carry out bypass connection directly to the houses. Provide alternative water storage	Ensure that remedial action taken on the tank Provide bottle or mineral water to the villagers. Carry out medical examination and treatment to the population or carry out vaccination.	Immediately	WSP Committee at community/ District/State/National

C. RAINWATER COLLECTION SYSTEM

Component	Activity/Dangerous Hazard	Emergency Plan			
		Plan of Action	Additional Action	Time Frame	Responsible
Area of Water collection (roofing including the gutter), Storage Tank and Supporting Structure.	Prolong severe drought. No rain. Natural disaster.	Set up the Water Crisis Committee. Provide alternative water supply like water tankers. Carry out water sampling.	Provide bottle or mineral water to the villagers. Cloud seeding Carry out medical examination and treatment to the population or carry out vaccination.	Promptly, within 24 hours until the disaster is over.	WSP Committee at community/ District/State/National
	Acidic water with pH below 6. Natural disaster	Set up the Water Crisis Committee. Provide alternative water supply like water tankers. Carry out water sampling.	Provide bottle or mineral water to the villagers. Cloud seeding Carry out medical examination and treatment to the population or carry out vaccination.	Promptly, within 24 hours until the disaster is over.	WSP Committee at community/ District/State/National

10.0 Module 7 - Supporting Programmes

The delivery of safe water together the implementation WSP involves managing people and processes. This is generally achieved with the help of all stakeholders, or relevant parties, through the implementation not only the plan itself but other supporting programmes or measures.

Supporting Programmes or measures are activities that indirectly support the implementation of a water safety plan. They are also essential for the proper operation of the control measures for a water safety plan. Supporting Programmes cover a range of activities including instrument calibration, preventive maintenance on the systems and hygienic and sanitation practices as well as legal aspects of the plan such as activities towards understanding the organisation's compliance obligations to the WSP.

It is essential that WSP Committees understand their liabilities and have these supporting programmes in place to deal with these issues as a guide and assess the programmes it currently has in place and any gaps that need to be addressed later. Examples of types of Supporting Programmes are provided below (Table 7-1).

Table 11 - Module 7 (Example): Supporting Programmes/Measures

Supportive programmes	Purpose	Interested Stakeholders (for Malaysia)
Cooperation with other agencies	i. Define the roles and responsibilities of every stakeholder. ii. Provide technical advice/expertise in project implementation. iii. Gazettement of water catchment concern. (Gravity Feed System) iv. Act as technical resource. v. Assist in controlling wild animals with regards to the	- Survey and Mapping Department Malaysia (SMDM) - Forestry Department (FDM), -Drainage and Irrigation Department (DID). - Local Authority - District Office - Aboriginal Affairs Department.

Supportive programmes	Purpose	Interested Stakeholders (for Malaysia)
	vi. water supply system. vii. Coordination between stakeholders in times of disasters viii. To get the local weather forecast.	- Wild Life Department - Water Governing Authority - Meteorological Department - Department of the Environment
Fund allocation	i. For construction, maintenance, renovation and incentives. ii. Provision of water testing instrument/ reagents/ Maintenance/ Repair of system iii. Allowance/ Training/ courses/meetings iv. Others	- Federal and State Government (which among others include Ministry of Rural and Regional Development and MOH) - Aboriginal Affairs Department - Local Politicians
Training	i. To provide technical training to the community and the WSP committee. Maintenance. ii. Training on water sampling technique. iii. Sanitary survey and Health Risk Assessment, Other issues related to poor water quality.	- MOH - Chemistry Department
Manpower/Personnel	i. To implement the WSP programme.	- WSP committee - community - Aboriginal Affairs Department - MOH

11.0 Documentation

In order to ensure that a water supply system is look after in accordance to the WSP, actions undertaken need to be captured effectively, with proper documentation. Management procedures such as system assessment, monitoring plans and communication procedures can be used as a verifying tool required in ensuring the safe operation of the WSP.

Documentation of all aspects of drinking-water quality management is essential. Records are a necessary element of the WSP as they can be reviewed (through internal and external audit) to identify whether the WSP is adequate and working according to plan. Documents should describe activities that are undertaken and how procedures are performed. They should also include detailed information on:

- Assessment of the drinking-water system (including flow diagrams and potential hazards and the outcome of validation);
- Control measures and operational monitoring and verification plan;
- Routine operation and management procedures;
- Incident and emergency response plans; and
- Supporting programmes/measures.

Documentation pertaining to the WSP should include the elements set out in the previous modules, from Module 1 (the setting up of the WSP committee) to Module 7 (setting up Support Programmes/Measures). The available tables feature in the modules discussed earlier can be use as a guide for a WSP committee to form its own set of documents.

When preparing the relevant documentation, it is preferable to get the information first hand. This is done not only through observations made on the system but also by interviewing those involved, especially the people who use the water supply itself. Try and capture the information as much as possible on their activity and their effects on the WSP rather than developing the documentation singularly without any outside feedback. This approach

will also help foster the feeling of ownership and eventual implementation of the procedures.

Tables – For Carrying Modules 1-7 Of The Plan.

WATER SAFETY PLAN FOR (Type of Supply) UNDER THE RURAL DRINKING WATER SUPPLY PROGRAMME

Module 1: Formation of WSP Implementation Team for Rural Areas

i. Identify and form the implementation team from individuals and management team (stakeholders) who are responsible for the implementation of WSP at the village or community level in the rural areas.
ii. Define the roles and responsibilities of the individuals and management team (stakeholders) responsible in the implementation of the WSP.

Level	Management team and members	Roles and responsibilities
Village (Community)		
District		

Level	Management team and members	Roles and responsibilities
State		
National		

Module 2: Identify and Describe the Type of Water Supply

i. Identify and describe the type of water supply including the various components (inclusive of all components therein)

Type of Water Supply: Gravity-feed System

Type of System* **List All Types of Systems**	**Catchment Area**	**Treatment**	**Storage and Distribution**
	Component Definition & Component Inventory		
Catchment			
Distribution			
User's/Consumer			

Schematic Diagram of the Water Supply System

Insert Schematic Diagram for the water system here

Module 3: Assessment of Water Supply System

i. Listing and stating all sources or activities that can contribute to the occurrence of hazards that will render the water unsafe for drinking and taking into consideration the history and prevailing conditions.

Component	Activity (Hazardous event)	Danger (Hazard)
Catchment area/ supply source		
Treatment (if there is any)		
Storage and distribution		

Module 4: Identify Control Measures

i. Identify priority risks
ii. State the preventive measures to prevent and/or rehabilitate or improve or avoid sources of pollution from occurring.

Hazardous event	Hazard	Priority Risk			Existing control measures	Proposed additional control measures
		For category of probability occurrence	For category of risk level	Risk Level		

Module 5a: To Establish Periodic Investigations, Monitoring and Maintenance Schedule.

Control Measures	Scope of Monitoring	Monitoring and Maintenance Process		Terms of Critical limit	Corrective Action	
		What			What	
		How			How	
		When			When	
		Where				
		Who			Who	

- What are going to be monitored?
- How will these be monitored?
- When will these be monitored?
- Where will these be monitored?
- Who will do the monitoring?

Module 5b: To Establish a Verification Schedule over the Monitoring and Maintenance Activities

(Follow up action to Module 5a, how to ensure that the Module is monitored, investigated or verified)

Control Measures	Scope of Monitoring	Verification process on the Monitoring and Maintenance Activities		Proposed Follow up Action	
		What		What	
		How		How	
		When		When	
		Where			
		Who		Who	

- What are going to be monitored?
- How will these be monitored?
- When will these be monitored?
- Where will these be monitored?
- Who will do the monitoring?

Module 6a: Crisis Management Plan (Incident Plan)

Component	Hazardous event	Incident Plan			
		Plan of Action	Additional Action	Time Frame	Responsibility

Module 6b: Crisis Management Plan (Emergency)

Component	Activity/Dangerous Hazard	Emergency Plan			
		Plan of Action	Additional Action	Time Frame	Responsibility

Module 7: Supportive Programmes

Supportive Programmes	Purpose	Interested Stakeholders
Cooperation with other agencies		
Fund allocation		
Training		
Manpower/Personnel		