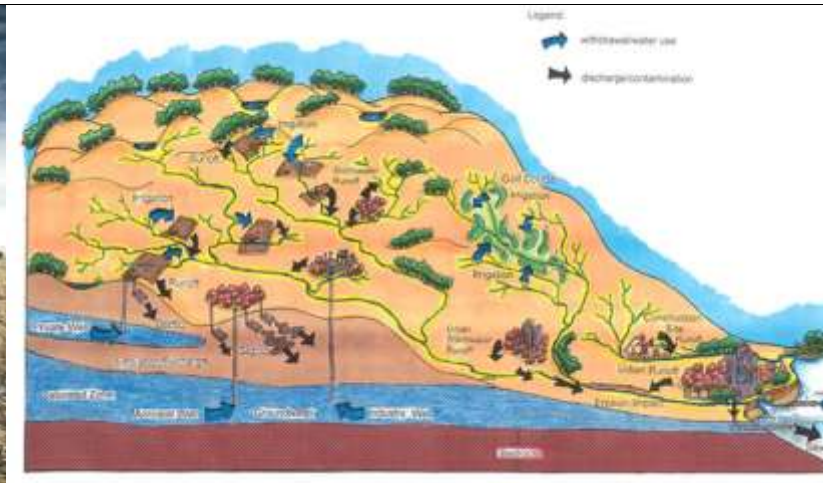
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF WATER IRRIGATION AND ENERGY

# Rural Water Supply Operation and Maintenance Manual



# Module - G

## A Trainer's Manual for Rural Water Safety Plan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| **MODULES** | **RURAL WATER SUPPLY POINT SOURCES MANAUL** |
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| MODULE – A | FACILITATOR'S GUIDELINE |
| MODULE – B | DESCRIPTION OF POINT WATER SOURCES AND TECHNOLOGIES |
| MODULE – C | TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS FOR POINT WATER SOURCES |
| MODULE – D | COMMUNITY BASED SCHEME AND FINANCIAL MANAGEMENT |
| MODULE – F | MONITORING AND EVALUATION OF RURAL WATER SUPPLY SCHEME |
| **MODULE – G** | **WATER SAFETY PLAN FOR RURAL WATER SUPPLY** |
| MODULE – H | PREPARATION OF ACTION PLAN AND IMPLEMENTATION OF O&M |

# Definitions:

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| **A hazard** | It is a biological, chemical or physical agent that has the potential to cause harm. |
| **A hazardous event** | It is an event or situation that can introduce a hazard to the water supply system. |
| **A sanitary survey** | is an on-site inspection of water supply to identify actual and potential sources of hazards such as physical structure, operation of the system, and external environmental factors, are being evaluated and select appropriate remedial actions to improve or protect the water supply |
| **Climate resilient water safety plans** | is an approach which based on assessment of climate risks to the water supply systems and management through identification of activities to better understand climate risks, plan to address climate impacts and implement adaptation measures to reduce the consequences of climate change to the water supply system from catchment to the point of consumption taking in to account service level including quantity, quality, reliability, cost and accessibility. |
| **Climate** | Climate is average weather and occurs over long time frames (e.g. 30 years) |
| **Control measures** | are activities or processes to prevent or reduce a hazardous event/hazard. The WSPs process involves consideration of both existing control measures and new/proposed control measure (or improvements). |
| **Critical limit** | is cutoff point that signifies when a control measure has failed or is working ineffectively and therefore emergency action is required |
| **Operational monitoring** | Routine monitoring of control measures along the water supply chain to confirm ongoing effectiveness. Carried out by the water supplier and involves defining **critical limits** for relevant parameters and **corrective actions** to take when critical limits are breached. |
| **Risk** | is the likelihood that a hazardous event/hazard will occur combined with the severity of the consequences. |
| **Validation** | refers to reviewing evidence to determine whether or not the existing control measures can effectively control the hazardous event/hazard. This must be done prior to risk assessment so that the risk assessment considers how well controlled the hazardous event/hazard is currently. |
| **Verification** | Monitoring to confirm the effectiveness of the WSPs as a whole and involving three elements: 1) compliance monitoring (generally by health authorities to confirm final water compliance with drinking water quality standards); 2) consumer satisfaction monitoring; and 3) internal/external WSPs auditing. |
| **Water safety plan (WSPs)** | A comprehensive risk assessment and risk management approach that encompasses all steps in the water supply, from catchment to consumer |
| **Weather** | is what is happening in the atmosphere at any given time is considered “weather” (including e.g. wind speed and direction, precipitation, barometric pressure, temperature, and relative humidity) |

# MODULE - G: RURAL WATER SAFETY PLAN

# Table of Contents



## List of Tables

## List of Figures



## List of Annexes

# 1. MODULE – G: WATER SAFTY PLAN

## 1.1 Session Outline

This Training manual comprise of:

Session – A1: Introduction to WSP

Session – A2: Assemble a team

Session – A3: Describe the Water Supply System

Session – A4: Identify the hazards and assess the risks

Session – A5: Determine and Validate the Control Measures

Session – A6: Define Monitoring of Control Measures

Session – A7: Verify the effectiveness of the WSP

Session – A8: Prepare Management Procedures

Session – A9: Develop Support Programs

Session – A10: Plan and carry out WSP review

Session – A11: Revise WSP following an incident

## 1.2 Manual to be referred

This training module is extracted from operation and maintenance Part-G of the manual. Please refer it whenever necessary.

## 1.3 Session – G1: Introduction to Water Safety Plan

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| **MODULE – D:** | **RURAL WATER SAFETY PLAN** |
| **SESSION – G1** | **INTRODUCTION TO WATER SAFETY PLAN** |
| **1.3.1. Introduction** | A **Water Safety Plan** (WSP) is the most effective way of ensuring that a water supply is safe and reliable for human consumption and that it meets the health and demand based standards and other regulatory requirements.<br><br>It is based on a comprehensive **risk assessment** and **risk management** approach to all the steps in a **water supply chain** from **catchment** to **consumer.**<br><br>As it is well known, the water sources are in one way another contaminated and depleted due to climate change and interference of human being (various development activities in the catchment areas). In order to mitigate the hazards and risk associated with these factors, various stakeholders and community need to be involved and work by integration. So, this module will learn that identification of stakeholders, identification hazards and risks, looking for mitigation measures by providing control system and so on will be elaborated. |
| **1.3.2. Objective** | At the end of this session, the participants are:<br><br>☞ Aware on how WSP team is assembled,<br><br>☞ Indentified hazards and assessed the risk through the catchment to the end users,<br><br>☞ Understand how to put control measures and monitor the implementation of WSP,<br><br>☞ Understand how to prepare management system and follow up,<br><br>☞ What would be expected as a support from various government offices |
| **Outputs** | Participants understood the team assembly, planning, implementing and managing of waster safety plan to enhance the quality as well as the quantity of water sources. |
| **Timing** | 1 and ½ hours |
| **Target Group** | Regional Water Bureau, Zone and Woreda Water Offices, WASHCOs |
| **Session Guide** | |
| **1.3.3. Step 1: Background** | Water safety plans provide a reliable framework for communities to strengthen their capacities and capabilities with a focus on cost-effective management of their water supplies.<br><br>The present guidance document puts water safety planning in the context of |

| MODULE – D: | RURAL WATER SAFETY PLAN |
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rural community water supplies and provides a step-by-step approach for those charged with dealing with the everyday realities of maintaining a reliable, safe supply.

It addresses members of rural communities themselves, in addition to those supporting them in their endeavours to bring safe and clean water collectively to millions of people.

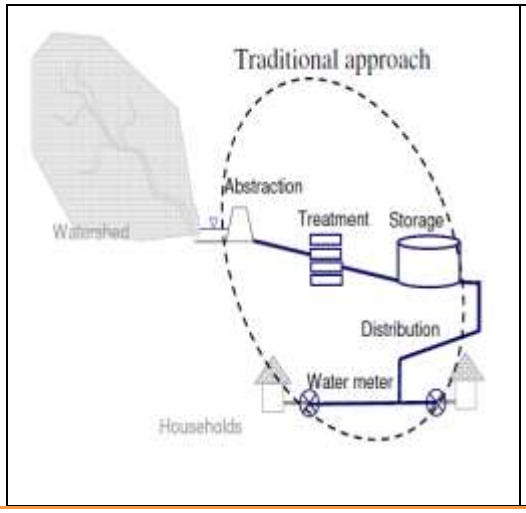
## Challenges in meeting minimum standard for providing of clean water supply:

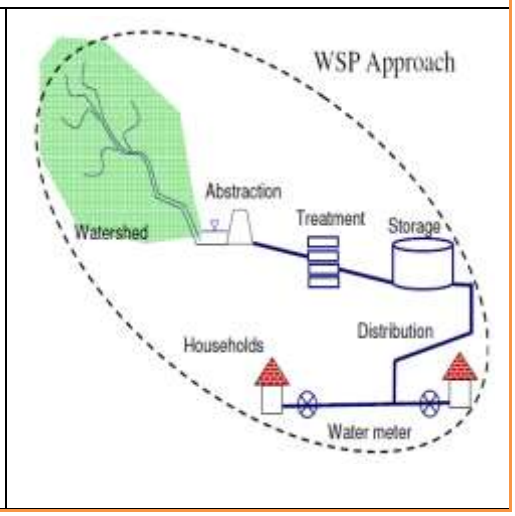
- Heavy rainfall eroded the soil in the catchment area and improper farming practices,
- Temporal and time variation of rainfall causes the deficiency of water quantity to satisfy the demand of the community.
- Deforestation of trees to have more farm land as a result of population pressure,
- Application of fertilizer in the farmlands that could be washed and percolated to deep and contaminate the ground water.
- Poor sanitation – Poor access to sanitation may result in the contamination of the water source and may also lead to the potential cross contamination of spring and HDW
- Animal dung around water sources affect the quality of water

This manual is designed to engage, empower and guide communities in the development and implementation of water safety plans (WSPs) for their water supply systems.

It provides guidance on how to apply effective and achievable management actions in order to improve the safety and quality of supplied water.

## ☞ Traditional and Water Safety Plan Approaches:



| MODULE – D: | RURAL WATER SAFETY PLAN |
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Traditionally, the water utilities have only focused from the point of abstraction to the water meter while Woreda or WASHCOs only focused at point sources that excluded the remote catchments'

But, the WSP approach includes an evaluation of the water supply system from the water source to the point of consumption.

First we concentrate on the management of the surface water and/or ground water source;

Second, we optimize the operations to eliminate and deactivate the hazards that affect water quality and quality.

Finally, we work to prevent the recontamination and deficiency of the treated water during distribution, storage, and handling at the household level.

### 1.3.4. Purpose of WSP

Water Safety Plans aim to:

- seek to prevent contamination of water from the source to the point of consumption;
- to treat the water to reduce or remove contamination that could be present to the extent necessary to meet the water quality targets;
- To prevent re-contamination during storage, distribution and handling of drinking-water.
- Give consumers greater involvement and control over maintaining water quality.
- To ensure the reliability of water supply to satisfy the demand requirement of the consumers.

### 1.3.5. Why should WSPs be applied to community water supplies?

By following the WSP approach, community members identify and prioritize health risks and, where necessary, take steps, over time, to improve the safety of the water supply using available resources.

Implementing a WSP will improve day to- day risk management and operation of the water supply and will ultimately lead to consistently safer water.

The WSP process encourages a team-based approach, improving cooperation and engagement with stakeholders and technical experts.

Community water suppliers may find it difficult to immediately meet community, Woreda or national water quality targets or objectives, particularly when resources are limited.

| MODULE – D: | RURAL WATER SAFETY PLAN |
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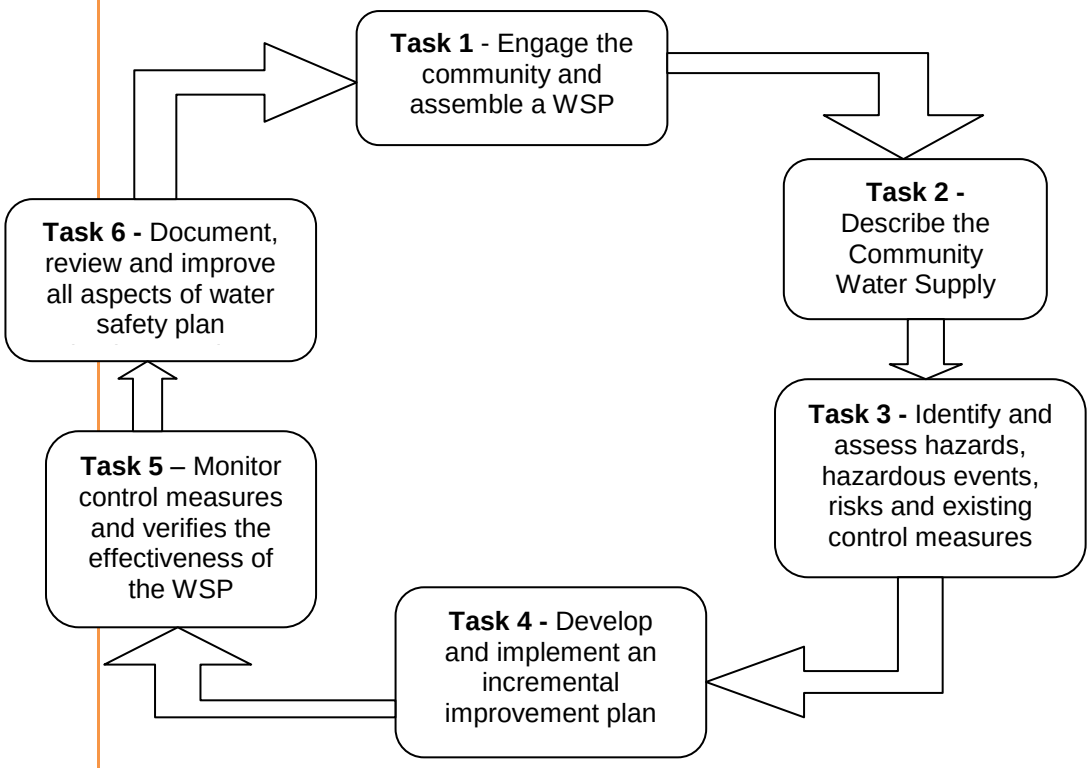
The WSP philosophy recognizes that even small, readily achievable improvements are better than none and encourages the adoption of a prioritized, "incremental improvement plan".

The improvement schedule laid out in a well-documented WSP should support community requests for resources to implement further water supply improvements. With a clear community WSP in hand, government and other financial supporters may be more inclined to consider supportive funding for corrective work and upgrading.

### 1.3.6. How can a WSP be developed and implemented in a community water supply?



## MODULE – D: RURAL WATER SAFETY PLAN

**Table 1-1: Summary of tasks involved in developing and implementing a WSP for community-managed supplies**

| Task No. | Description of Tasks | Key Questions | Key Outcomes |
|---|---|---|---|
| Task - 1 | Engage the community and assemble a WSP team | Who needs to be, should be and wants to be involved? | ▪ A community empowered through interest and ownership in the management of its water supply<br>▪ Support from Water and health staff in the concerned administrative unit (e.g. Woreda, kebeles) and/or from experienced NGOs<br>▪ Linkage to prevailing government policies, water quality standards, laws and local by-laws |
| Task - 2 | Describe the community water supply | Have we accurately captured the details of our water supply system? | Proper documentation of the community water supply (with drawings, maps, photos, water quality records and relevant management and institutional records) |
| Task - 3 | Identify and assess hazards, hazardous events, risks and existing control measures | How serious is the risk of a hazard causing harm? | ▪ Improved knowledge of hazards and hazardous events and associated risks to public health in the system<br>▪ Improved understanding of how the risks are currently being addressed (what control measures are in place and whether they are suitable and effective) and what risks may need further control. |
| Task - 4 | Develop and implement an incremental improvement plan | How do we get to where we want to be? | ▪ Scoping of opportunities to improve drinking-water quality (by new or modified control measures)<br>▪ Priority actions identified to improve management and safety of the supply, including proposed timelines and needed resources<br>▪ Engagement of the community in implementation of the improvements |
| Task - 5 | Monitor control measures and verify the effectiveness of the WSP | Are the control measures and the plan working? | ▪ Operational monitoring and inspections demonstrating that control measures continue to work effectively<br>▪ Verification that the WSP is appropriate and working effectively to provide safe drinking-water |

| **MODULE – D:** | **RURAL WATER SAFETY PLAN** |
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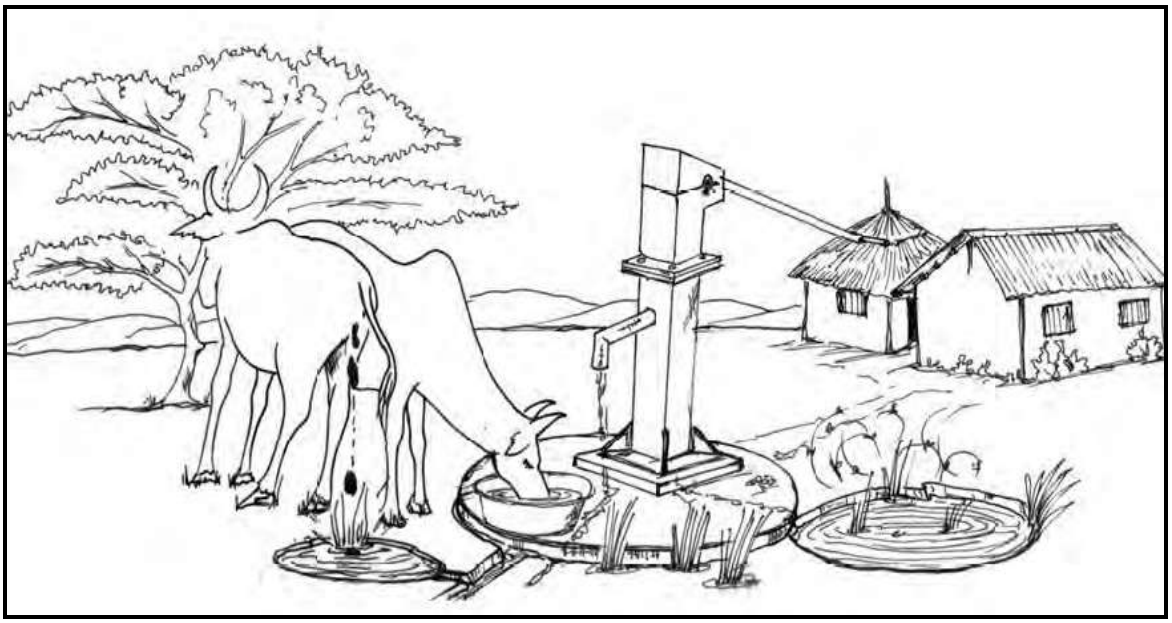
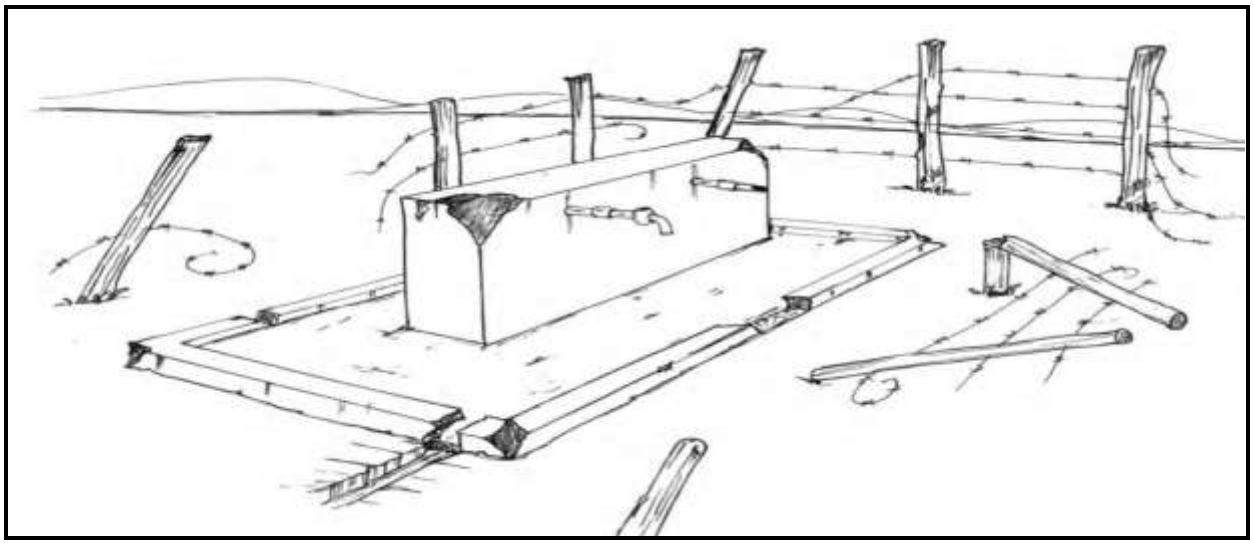
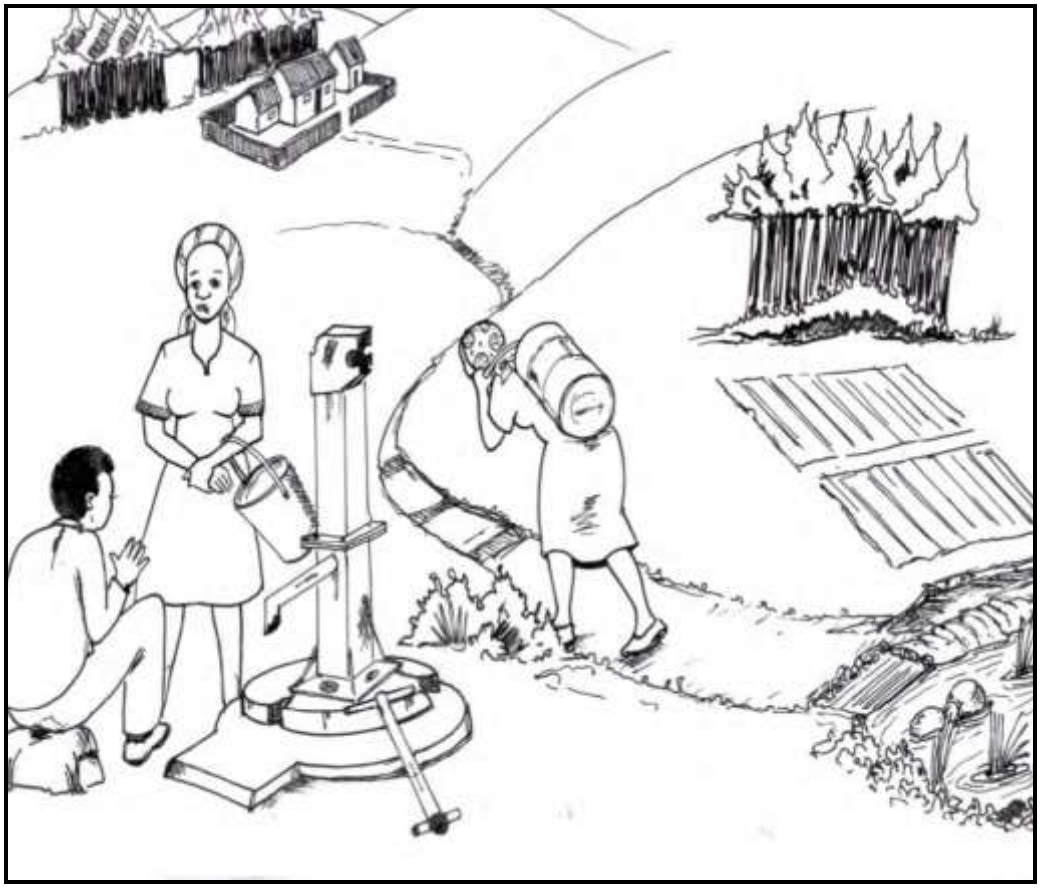
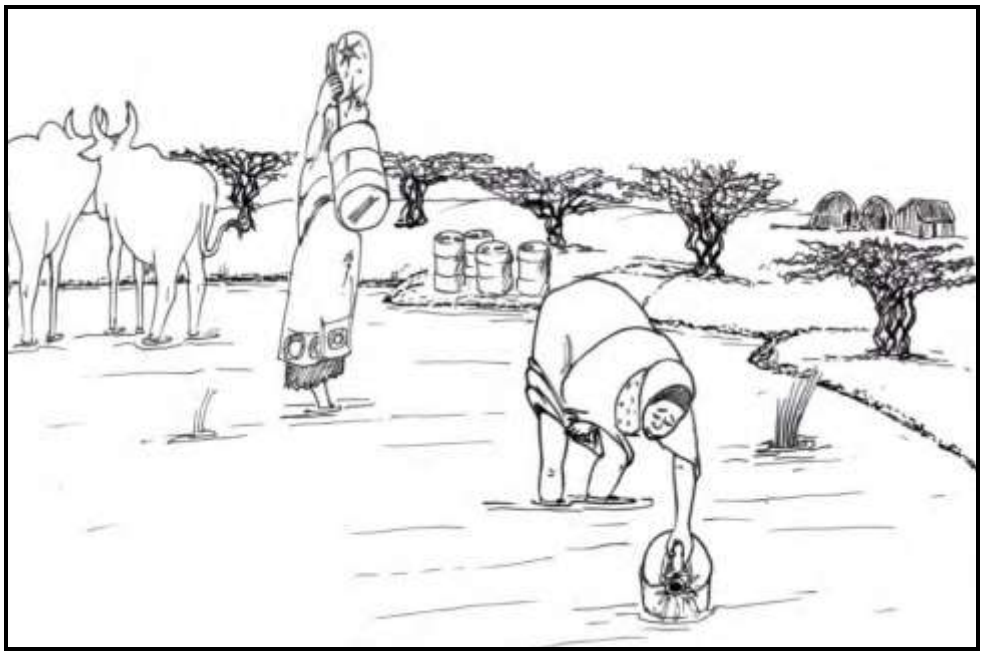
| | <table><tr><td>Task - 6</td><td>Document, review and improve all aspects of WSP implementation</td><td>What do we need to do to ensure that our WSP works well and to improve it continuously?</td><td>▪ Well-established management procedures for normal, incident and emergency situations shared with the WSP team and those responsible for managing the community water supply<br>▪ Supporting activities established to embed the WSP approach into water supply operations (e.g. training and education)<br>▪ Establishment of processes to review the WSP periodically, ensuring that the WSP remains up to date and effective, resulting in incremental improvements to water safety</td></tr></table> |
| **Review questions** | Have you understood the difference between traditional approach and water safety plan approach? How the two treat the water quality and quantity and ensure the safe water supply to the community. |
| **Session Attachments** | Attachment 1: Tools to provoke discussion |
| **Attachment 1:** | Non-functionality of rural water supply Schemes (NWI_2011) and Diagrams for discussion on aspects of operation, maintenance and sustainability |









## Real Situation in Tigray Region

## 1.4 Session – G2: Task – 1: Engage the Community and Assemble a WSP team

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| **MODULE – A:** | **RURAL WATER SAFETY PLAN** |
| **SESSION – A2** | **TASK – 1 : ENGAGE THE COMMUNITY AND ASSESMBLE A WSP TEAM** |
| **Introduction** | The first session recommends the formation of a water safety plan team. It requires collaboration from a variety of professionals: water supply system operators, lab personnel-chemists and microbiologists, engineers, environmental health scientists, health professionals, public relations-media and regulatory agency personnel.<br><br>In many of the communities where the WWO works the Water Safety Plan team includes community members because it is the community that has responsibility for managing their own water supply; or, community members have responsibility for the transport, storage, and disinfection of their own water supply. |
| **Objective** | At the end of this session, the participants are able to:<br><br>☞ Assemble a WSP team from the community as well as other professionals |
| **Outputs** | ☞ Established a water safety plan team |
| **Timing** | 1 hour |
| **Target Group** | Regional Water, Agriculture, Health Bureau and their descendants at Zone and Worda Offices, WASHCOs |
| **Methodology** | Lecture and exercise |
| **Session Guide** | |
| **Step – 1: Engaging the community and assembling the WSP team** | ☞ **Engaging the community and assembling a WSP team are an essential means to:**<br><br>▪ Identify the community's aspirations and needs in respect of their water supply, through an inclusive process that considers gender as well as elderly and vulnerable community members;<br><br>▪ Balance water supply needs against competing community-level priorities, such as housing and education;<br><br>▪ tap into local knowledge and experience in the identification, assessment and management of risks;<br><br>▪ identify resources within the community that can be called upon when needed;<br><br>▪ initiate a dialogue between the community and other stakeholders (government, NGOs, water service delivery and public health agencies) on the benefits and requirements of a well-functioning water supply and the joint |

| MODULE – A: | RURAL WATER SAFETY PLAN |
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| | preparation of a WSP;<br>▪ Raise awareness of the role that community members can play in protecting and improving their water supply.<br>A successful WSP will have involved the community throughout the entire process and, ideally, is led at the community level. |
| **Step 2: How do it!** | **a) *Engage the community***<br>Buy-in from decision-makers for the WSP process is needed to obtain support for changes in the operation, maintenance and management of the community water supply and to ensure that sufficient resources are available.<br>The community as a whole can be engaged in a number of ways:<br>■ It is generally more efficient and effective to identify suitable members of the community to represent the community's interests as part of a WSP team.<br>■ Other methods of engagement include, for example, public meetings, participatory techniques (e.g. participatory rural appraisal, mapping, transect walk, pocket chart) and subgroup (corner) meetings by service areas or interest groups (women, the poor, farmers).<br>■ A visit to a nearby community that has successfully applied a WSP is a good way to trigger interest in the approach.<br>***b) Assemble a WSP team***<br>The WSP team will be responsible for developing, implementing and maintaining the WSP. The team is also needed to help the community to understand and accept the WSP approach. When choosing WSP team members, it is best to consult community leaders, such as elders, WASHCOs or other persons who know the community well. Ideally, team members will have varying backgrounds. People who have one or more of the following characteristics should be considered for team membership:<br>■ Is familiar with, and uses from the water supply;<br>■ is responsible for the day-to-day operations of the water supply or has helped during construction or earlier repairs;<br>■ has the authority to make decisions about spending money, training, recruiting staff and/or making changes to the water supply;<br>■ has the knowledge and capacity to identify and characterize potential risks to the water supply from the catchment to the consumer;<br>■ is responsible for or has the capacity to help manage and prevent those risks; |

| MODULE – A: | RURAL WATER SAFETY PLAN |
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- Is influential and interested, at both the community level and at least one administrative level up, in representing water quality concerns and investment needs at the Woreda level or higher.

✓ It helps to include people with knowledge of the catchment area (e.g. land owners and users) and of the history of the water supply in the community (e.g. community elders),

✓ Those with the greatest interest in safe water (often women) and those who can influence how the water supply is managed (e.g. community leaders and opinion leaders).

✓ Health staff and agriculture office should also be considered as members or resource persons.

✓ NGOs, local consultancy firms (WSGs and CFTs) can provide assistance in identifying hazards and prioritizing risks and, during subsequent implementation of the WSP, may facilitate support and assistance, financial or in-kind, monitoring of services and water quality, surveillance and independent oversight, technical advice and guidance, training and education to build understanding and expertise.

### *c) Document team membership*

Once the WSP team is identified, participants' names and roles should be documented and shared with all team members and the community.

**Tips:**

- It may not be possible to bring together the entire team right at the beginning.

  *Part of the WSP process is to identify gaps in the community's knowledge and expertise and to work together to fill those gaps.*

  *New members can easily be added later in the process, or persons with specific expertise (e.g. a public health officer or a teacher) may need to be invited for a few sessions only.*

- The WSP team should plan to meet regularly to develop, implement and review the WSP.

  *It is likely that more meetings will be needed during the initial stages of WSP development. As WSP implementation progresses and the team become more familiar with the WSP approach, fewer meetings may be required.*

- Community engagement should not be limited to the start of the process.

  *It is beneficial to try to engage community members throughout the WSP process and mobilize them for each of the main tasks.*

  *It is important to focus particularly on women, as they are often responsible for water collection and family health, and schoolchildren, who can study aspects of the system (e.g. types of animals and crops in the catchment).*

| MODULE – A: | RURAL WATER SAFETY PLAN |
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| | ▪ An annual water week (or day) festival focusing on water safety, water quality, sanitation and hygiene, organized in the community, is a good way to raise interest and may make it possible to generate the resources for improvements.<br><br>*For example, the WSP team could consider planning an event around already established community events or around World Water Day (22 March) and linking it with any activities being planned in the region by other stakeholders, including government and NGOs.*<br><br>▪ In new schemes, it should be easier to incorporate the WSP approach in the community mobilization and planning phase.<br><br>▪ In existing schemes, a fresh effort may be needed to raise interest and generate a community drive for developing and implementing a WSP.<br><br>▪ Regional Water Bureaus, Zone and Woreda Water, Health and Agriculture Offices and NGOs should be engaged from the beginning, as they may be interested in and able to provide support for developing and implementing a WSP.<br><br>▪ The WSP team may wish to explore partnership arrangements for peer-to-peer support.<br><br>Partnerships could be formed between two neighboring communities to facilitate knowledge exchange for community-managed supplies that are both initiating a WSP or where a community experienced with the WSP approach would help the other community in setting up the WSP process. Partnerships could also be formed between a larger organized supply and a community-managed supply, where the larger supply would support the community-managed supply.<br><br>**Outputs:**<br><br>A team of individuals representing the community's interests:<br>▪ with knowledge of the water supply system and how to identify and prioritize potential risks to the community water supply, including health, social, environmental, development and physical planning considerations<br>▪ with interest in promoting sustained access to safe drinking-water<br>▪ who can help mitigate risks |
| **Review** | What has been missed in engaging community and assemble WSP team? |
| **Session Attachments** | None |

## 1.5 Session – A3: Task - 2 Describe the Community Water Supply

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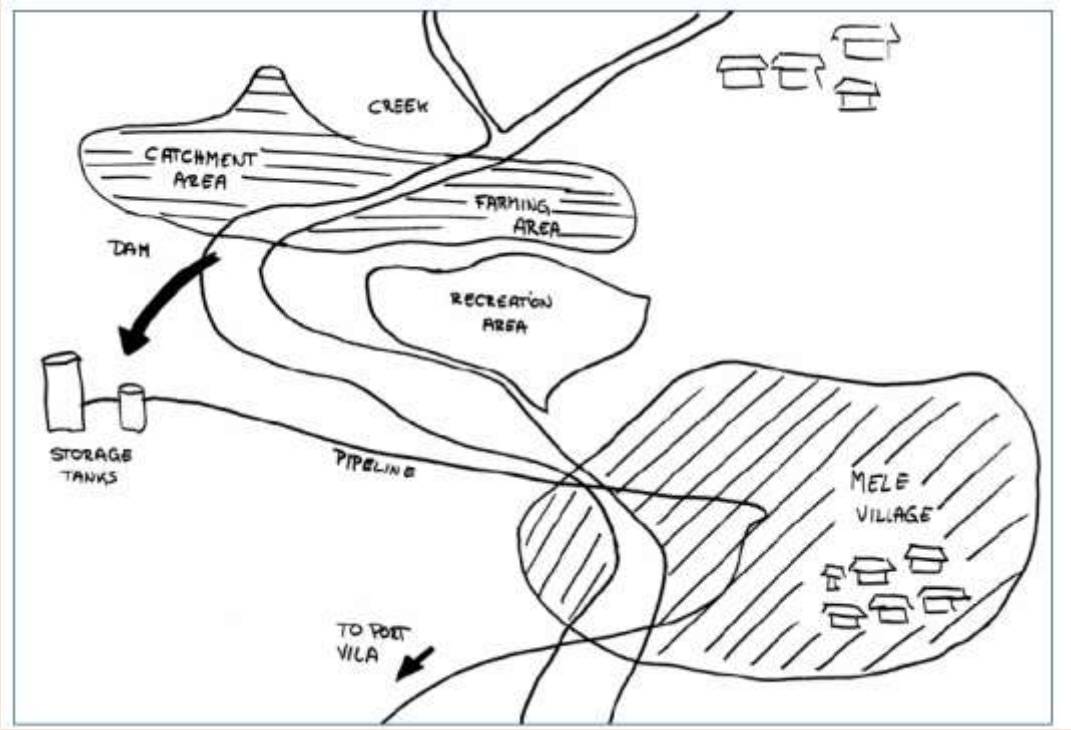
| **MODULE – G** | **WATER SAFETY PLAN** |
| **SESSION – G3** | **DESCRIBE THE COMMUNITY WATER SUPPLY SYSTEM** |
| **Appropriate Facilitator Background** | Community Trainer with experience in community water projects; Technician with the relevant practical and technical background from Woreda Water Offices |
| **Introduction** | This session describes the water supply system from its water source to the point of consumers. |
| **Objectives** | At the end of the session , participants are able to:<br>▪ Understand the various components of the water supply system, which is important to identify hazards and assessment of risks. |
| **Outputs** | An Operation and Maintenance Plan which includes:<br>▪ Participants carried out mapping of the water supply system; |
| **Timing** | 1 hour |
| **Target Group** | ▪ Regional Water, health and Agriculture Bureaus,<br>▪ Zone and Woreda line offices<br>▪ WASHCOs. |
| **Methodology** | ▪ Presentation and discussion<br>▪ Site walks around the system components<br>▪ Practical demonstrations and exercises |
| **Session Guide** | |
| **Step – 1: Water Supply System** | The WSP development process provides a framework to give the community a better understanding of the health concerns related to their water supply and empower it to act through ownership over its water supply. A complete map and description of the water supply system are a precious source of information that will help the WSP team and the community members identify hazards and their potential impacts on water safety. |


**Step 2: How do identify the water supply system**

### a) Draw a map

The first task of the WSP team will be to understand what is in place. An easy way to do this is to make a map/flow diagram of the water supply, including relevant elements of the catchment area and the community served. A great deal of information can be recorded and presented in a drawing. Such mapping of the community water supply from catchment to consumer is an essential part of the water supply description.

**Figure 1-1: Example of drawing a map**




Maps should be sufficiently detailed to easily identify hazards and risks to the water supply. Therefore, when a community water supply is made up of a number of connected components, it may be helpful to develop an overview map of the entire community supply as well as detailed maps/ schematics of each water supply component.

### *b) Gather supporting information*

General information also needs to be gathered and recorded to describe the water supply and its management, including the various sources in use.

The type of information collected should include, but is not limited to:

- relevant water quality standards;
- known or suspected changes in source water quality relating to weather or other

conditions;

- details relating to the land uses in the catchment;
- details relating to the treatment, distribution and storage of the water;
- who uses the water supply and for what purpose;
- the person(s) currently responsible for operating the system and what education and training they received;
- what financial and human resources are available for managing and operating the supply;
- management procedures (e.g. operations, maintenance, inspection), if they exist;
- the legal ownership of land used and other properties in the catchment;
- Details on existing sanitation facilities, including their location.

### *c) Check the map and water supply description*

It is important for the WSP team to physically check the description of the water supply system through a walk or site inspection (e.g. by following the "flow of water" through the water supply system). Taking photos and reviewing related documentation can also be useful. The water supply map and description should be updated based on this check. This activity could also be conducted as part of ''a'' (drawing a map).

### *d) Discuss and identify community water supply objectives*

The following questions can help in developing holistic community water supply objectives:

- What do we want and need from our water supply?
- What are our current water supply and sanitation systems, and how are they operated?
- What problems are there with the water supply?
- Who is involved, and who should be involved, in ensuring that we have the water we need and want?
- What else, other than the water supply, is needed for a healthy and sustainable community?
- What other water supply aspects should/can be considered (e.g. other activities for which water is needed, such as fruit and vegetable gardening, growing rice seedlings for transplanting, domestic livestock)?

It is important to discuss the benefits of safe drinking-water and good hygiene with the community and the linkages among water supply, sanitation and hygiene. Hygiene education and health promotion activities, received via other community members, from public health staff, by mass media or while in school, should be reinforced.

With understanding comes an appreciation of the value of hygienic behaviors on health, opening the door to sustained behavior change.

**Table 1-2: Examples of factors to be considered when describing the major components of Rural piped water supply system**

| Catchment/abstraction | Treatment | Storage and distribution | User installations |
|---|---|---|---|
| **Catchment:**<br>▪ What are the characteristics of the water source(s) (e.g. quantity and quality)?<br>▪ Are there seasonal or weather variations? What is their impact on the quality and quantity of the water source(s)?<br>▪ Where is the catchment and recharge area?<br>▪ What are the catchment characteristics, including details on land use (e.g. household, sanitation, industry, agriculture, wildlife)? | ▪ What water treatment processes are in place, and how are they configured?<br>▪ What chemicals and materials are used for treatment? What are the availability and quality of the chemicals? How are they stored?<br>▪ Is the water disinfected? If so, what methods and disinfectants are used? Is there sufficient disinfectant (e.g. chlorine) contact time for proper disinfection?<br>▪ Is water quality monitored? How? How often? Where?<br>▪ Are treatment plant operators trained?<br>▪ Are there minimum competency standards, and do operators meet such standards? | ▪ Are the storage tanks protected (e.g. rainproof with gutters)?<br>▪ Are there screens on ventilation and overflows to prevent vermin and animal entry?<br>▪ Is there adequate protection/security on storage tanks with locked gates and hatches?<br>▪ Are there separate inlets and outlets at varying heights on opposite sides of tanks to promote good mixing?<br>▪ What construction materials are used in the infrastructure, and how old is the infrastructure?<br>▪ Does the distribution operate constantly or intermittently?<br>▪ Is there secondary disinfection, and, if so, are chlorine residuals in critical points in the system monitored and recorded?<br>▪ What is the average pressure in the system, and does it vary? What is the flow rate at the tank inlet and tap points in the system?<br>▪ Is water quality monitored?<br>▪ How? How often? Where? | ▪ What are the current water uses (e.g. drinking, preparation of food, personal hygiene, clothes washing, domestic livestock, vegetable farming) and future needs (quantity and quality)?<br>▪ What are the numbers and type of users, including commercial users (e.g. homes, hotels, institutions, workshops, small industry)?<br>▪ Are there any vulnerable groups or special needs within the population, including the infirm or sick and aged? Are there health station and schools?<br>▪ Do households treat and store water? By what means?<br>▪ How is water collected and transported?<br>▪ Are the water points and house connections inspected, and is water quality tested? How? How often?<br>▪ Is water quality monitored at water points and at households? By whom? How often? What education/training has been given to the community about its water supply?<br>▪ How is wastewater handled?<br>▪ Is there backflow prevention?<br>▪ What material is used for domestic pipe work, and how old is it?<br>▪ Are consumers aware of regulatory requirements for drinking-water quality (e.g. drinking-water standards)? |
| **Abstraction (for spring boxes, wells, boreholes, streams, etc.):**<br>▪ Where is the abstraction point located, and how does it operate?<br>▪ What human activities take place near the abstraction point?<br>▪ What types of sanitation facilities are in the community (or is open defecation being practiced)? Where are these sanitation facilities located?<br>▪ What is their distance from the abstraction point?<br>▪ What is the abstraction infrastructure made of, and how old is it?<br>▪ What is the capacity/flow of abstraction?<br>▪ Are there protection measures around the abstraction area (e.g. fencing, grating)? | | | |

**Review Questions**

1. Why is needed to describe the water system components?

| | |
|---|---|
| | 2. Do you understand the function of each water supply system?<br><br>3. What WSP is required for different water supply component? |
| **Session Attachments** | N/A |

## 1.6 Session – G4: Identifying Hazard, Hazardous Event, Risks and Existing Control Measures

| | |
|---|---|
| **MODULE – G** | **RURAL WATER SAFETY PLAN** |
| **SESSION – G4** | **IDENTIFY HAZARD, HAZAROUS EVENTS, RISK AND EXISTING CONTROL MEASURES** |
| **Introduction** | In this session the system has to be described in detail, which will help facilitators identify and describe how hazards and hazardous events affect the functionality of the water supply system. After identifying the hazards, the consequence of those hazards need to be assessed. Such issues will be address in this training session. |
| **Objective** | At the end of the session, the participants will be able to:<br>▪ Identify the potential hazards at different components of the system<br>▪ Understand the situation of introduce the hazard events.<br>▪ Identify the risks an its control measures |
| **Outputs** | The participants gained knowledge on the hazards and how to mitigate it to meet standard water quality and replenish of the quantity. |
| **Timing** | Session should take approximately 3 hr |
| **Target Group** | Regional Water, Health and Agriculture Bureaus and descendant at Zone and Wored level, and WASHCOs |
| **Methodology** | This is intended to be a **PRACTICAL** session. The components will be taught by demonstration on the system itself. The flip chart can be used to illustrate details if necessary.<br><br>Reinforce the learning by allowing participants to identify components and describe their functions to each other. |
| **Session Guide** | |
| **Step 1: Introduction** | The process of hazard identification involves identifying actual and potential dangers and their causes. Hazard identification should be based on community knowledge (including historical information), recurring local events (e.g. heavy runoff or floods during heavy rainfall periods or thaw), checklists included in water supply guidelines or developed by Woreda water and health offices, sanitary inspections and expert advice.<br><br>Ask the participants if they would like to explain what is happening to the quality of drinking water in their area? Is water quality monitoring and surveillance carried out? Did you conduct WQ before developing the water sources? If so how were the results? Did you carry out WQ test later on after implementation and service? What were the result compare with the WQ prior to developing the water source?<br><br>This session will explain and define the adequacy of supply indicators [quantity, quality, coverage, continuity, and cost] and the importance of these concepts for a water safety plan.) |

**Step 2: What are the most common hazards?**

When people fall ill not long after drinking the water from the water supply system, it may indicate that drinking-water has been contaminated with microbial pathogens or, much less commonly, poisoned with chemicals from industrial or agricultural accidents.

## How to do it

### a) Look for signs of hazards and hazardous events

When identifying hazards and hazardous events, the WSP team should first look for signs that may signal issues caused by contaminated water supplies. Some common signs are presented in Table 1-3.

**Hazards:** A biological, chemical, physical or radiological agent that can cause harm to public health. If people use empty pesticide containers to collect drinking-water, the pesticide residues that are likely to contaminate the water pose a clear health hazard.

**Hazardous event:** An incident or situation that introduces or amplifies a hazard to, or fails to remove a hazard from, the water supply. Heavy rainfall is a hazardous event that may create pathways for microbial pathogens in excreta (the hazard) to enter the source water, distribution system or storage tank.

**Risk:** The likelihood of a hazard causing harm to exposed populations in a specific time frame and the magnitude and/ or consequences of that harm. The practice of open defecation creates a risk associated with microbial pathogens in human excreta, especially during rainfall, as runoff containing human excreta is likely to contaminate drinking-water sources with disease-causing organisms.

**Table 1-3: Sign of chronic health based issued caused by contaminated water supply**

| Potential Signs | Possible Hazards | Contamination sources/Hazardous events |
|---|---|---|
| **Acute water-related health issues** | | |
| Diarrhea and dysentery (including occasional outbreaks of cholera and typhoid fever) and other waterborne infections such as hepatitis are widespread within the community, particularly affecting the young, old and health compromised | Microbial pathogens | Open defecation or nearby sanitation facilities cause faecal matter to enter the source water<br>or the system<br>Source contamination from agriculture (use of manure) or wildlife<br>Dirty water with suspended particles such as silt, clay or organic matter, often from flood<br>waters or following rainstorms |
| **Chronic water-related health issues** | | |
| Mottling and staining of teeth in | High fluoride levels | Naturally occurring in some groundwater |

| | | |
|---|---|---|
| young children and teenagers, brittle bones and crippling | | |
| Pigmentation changes (melanosis) and thickening of the skin (hyperkeratosis), increased rates of cancers | High arsenic levels | Naturally occurring in some groundwater |
| Skin irritation (skin rash, hives, itchy eyes and throat), tingling around the mouth and fingertips, slurred speech; animals who drink the water may die | Algae and algal toxins | High nutrient levels in warm and stagnant surface water (ponds, tanks), resulting in algal blooms, which may release toxins |
| **Aesthetic issues** | | |
| High corrosion rates of metals in contact with water | High metal concentrations; may pose health concern in some cases (e.g. lead) | Soft, acidic water (e.g. rainwater) in contact with unprotected metal pipes and fittings |
| Stains on fixtures or laundry, colored water with metallic taste | High metal concentrations<br>▪ copper (green/blue-colored water or stains); may pose health concern<br>▪ iron (brown/red-coloured water)<br>▪ manganese (black/dark brown stains) | May result from corroding pipes in the distribution system; in borehole supplies, it may be naturally occurring in groundwater with elevated iron and manganese levels or from “overturning” of reservoirs |
| Unpleasantly salty taste | High sodium chloride levels; may pose health concerns to those on sodium restricted diets | Naturally occurring in some groundwater, may be from seawater (coastal areas) or caused by runoff of road salt (cold climates) or evaporation residue in irrigated areas (hot climates) |
| Brown-coloured water without particles | High levels of natural organic matter; could result in high levels of disinfection by-products if water is chlorinated | Naturally occurring in some surface waters from lakes or rivers with submerged vegetation |
| Soap does not lather, white scale builds up on pots or kettles when water is heated | High hardness (calcium and magnesium); not harmful to health, but may make the water difficult to treat and use | Usually from limestone and chalk aquifers |

## b) Identify hazards and hazardous events

The WSP team should identify hazards and hazardous events for each stage of the drinking-water supply by asking the questions:

## What can go wrong? How, When, Where and Why?

- For each component identified in the water supply map, the WSP team should identify the relevant hazards and hazardous events. Some are obvious, and others need reflection and on-site checking. Their occurrence and control depend on many factors, including:
  - type of source water (surface water, groundwater, rainwater);
  - how the water is distributed (piped, carried, storage, materials used, distance and time);
  - location (hillside, flood-prone area, near roads or developed areas);
  - social situation (public or private taps, personal hygiene practices, waste and wastewater disposal, supply also used for animal watering or crop irrigation);
  - energy supply and mechanicals (availability, reliability and location of fuel and electricity, maintenance and spare parts);
  - hours of supply (intermittent, permanent or only dry season);
  - Availability of chemicals and funds for treatment and distribution.
- The WSP team should consider not only the obvious hazards and hazardous events associated with the water supply, but also the potential for them to occur or be compounded through:
  - lack of understanding of the water supply system and how to operate it;
  - operational failures, as a result of power shutdown or disruption;
  - various shortcomings associated with faulty infrastructure;
  - treatment failures, including equipment breakdown or operator error;
  - accidental contamination;
  - natural hazardous events, including heavy rainfall, thaw, landslides, floods or droughts;
  - Human-made disasters, resulting from neglect or sabotage.

**Table 1-4: Examples of hazards and hazardous events organized by different components of a drinking-water supply**

| Catchment/abstraction | Treatment | Storage and distribution | User installations |
|---|---|---|---|
| **Acute health risk due to disease-causing microorganisms in drinking-water** | | | |
| Rainstorm events and heavy rainfall causing high pollution load (due to runoff)<br>Septic tanks in catchment and raw sewage causing faecal matter to enter water source<br>Swimming, boating, fishing or other human activities possibly introducing faecal material<br>Wastewater or urban stormwater discharge/local flooding<br>Intensive animal farming around shallow groundwater wells<br>Cracked spring box, well or borehole infrastructures, allowing ingress of faecally contaminated runoff or leachate<br>Direct access of animals to abstraction infrastructures<br>Latrines nearby water abstraction, introducing contamination | Microbial pathogen loading exceeds treatment removal capacity (e.g. chlorine concentration and contact time insufficient)<br>Failure of disinfection system<br>Short-circuiting within tanks, (e.g. some water to be treated passes too quickly through the treatment tank as a result of flaws in tank design, such as to the inlet/outlet) | Access to service reservoir by humans or animals, including insects and birds (e.g. lack of screen at air vents)<br>Ingress of contaminated runoff through service reservoir inspection covers<br>Inflow of contaminated roof drainage to service reservoir<br>Poor cleaning of pipes and tanks<br>Contamination of collected water because of the use of containers or jerry cans without a screw cap and poor hygienic practices associated with containers<br>Pipe breakage due to old pipes or road crossing<br>Contamination from broken sewerage pipes<br>Low pressure or intermittent operation causing influx of contaminants<br>Insufficient residual chlorine | Contamination of domestic water because of poor hygienic practices associated wit storage containers (e.g. storage in wide-mouthe uncovered containers o hand dipping of cups)<br>Rainwater system without functioning first flush discharge device or filter<br>No place to hang the bucket to keep it clean when using an open we<br>Cross-connections with non-drinking-water systems in the home<br>Insufficient residual chlorine |
| **Acute health risk due to short-term exposure to hazardous chemicals in drinking-water** | | | |
| Excessive or inappropriate use or inappropriate disposal of pesticides, insecticides, herbicides, etc. in agriculture<br>Wastewater discharges containing high concentrations of industrial chemicals (e.g. cyanide spilt to sewer)<br>Chemical spills or industrial accidents<br>Algal blooms in reservoir (toxins) | Overdosing and contamination with chemicals (e.g. fluoride, alum)<br>No treatment for specific chemicals or toxins, or exceeding the treatment limit | Cross-connections from chemical storage | Backflow from a household or institution (hospital, workshop, garage or small factory including chemical storage) |
| **Chronic health risk due to medium- or long-term exposure to hazardous chemicals in drinking-water** | | | |
| Naturally occurring fluoride or arsenic in groundwater<br>Pesticide and fertilizer use (e.g. in plantations, agriculture and horticulture)<br>Leaching from waste upstream of community water sources (e.g. solid wastes, mining wastes, contaminated landfills)<br>Frequent urban stormwater discharge (runoff of high concentrations of heavy metals and hydrocarbons)<br>Leakage/waste of hydrocarbons and other chemicals from commercial sites or fuel stations<br>Improper disposal of chlorinated solvents used for degreasing, resulting in high concentrations in groundwater | Overdosing and contamination with chemicals (e.g. fluoride, chlorate from poorly stored hypochlorite) | Corrosion of materials used (copper, lead) | Corrosion of materials used in domestic plumbing (copper, lead)<br>Continued use of a domestic filter, when the filter medium is exhausted (arsenic, fluoride)<br>Cross-connections with non-drinking-water systems in the home |
| **Aesthetic issues** | | | |
| Soil erosion and runoff (high turbidity)<br>Stratification, overturning of reservoirs (high iron, manganese levels)<br>Heavy rainfall or thaw (high turbidity, colour) | Treatment malfunctions (e.g. high chlorine, alum levels) (taste, odour, colour, high turbidity) | Material corrosion (high iron levels)<br>Stagnant water in pipes or tanks due to poor design and operation (e.g. dead ends, low points) (taste, odour, colour)<br>Increase or reversal of flow, causing | Material corrosion on internal galvanized pipe work (high iron levels)<br>Stagnant water in internal system |

## c) Assess risk associated with hazards and hazardous events

- ☞ The WSP team can undertake risk assessments in a number of ways. Approaches vary in accuracy, complexity and effort. For WSP team members, this exercise is often a gradual learning curve of growing understanding and appreciation of the risks. Generally, it is better for the team to start with less complicated risk assessments and progress to more precise approaches as more information, skills and resources become available.

This section covers two approaches that could be considered:

- descriptive risk assessment and
- Risk ranking.

- ☞ If possible, the WSP team should have an engineer, environmentalist, a public health inspector or a similar expert from respective Regions or NGO help with the hazard identification and risk assessment. They may not be needed for the whole process, but as they have broader experience, they may come up with issues that the team missed.

### *i) Descriptive risk assessment*

The simplest risk assessment method is descriptive risk assessment. In this approach, the hazards and hazardous events are prioritized based on the team's judgment.

For each hazard and hazardous event, the WSP team should consider the significance of each risk (see Table 3.5), reflecting on and recording how likely it is that the event will occur in the community and how serious it might be, along with a consideration of the effectiveness of any existing control measures that are in place to mitigate those risks.

- ☞ The WSP team should discuss and compare each listing until it agrees on which issues are of greater or lesser importance.
- ☞ The team should then write down the issues in order of importance and double-check the entire list to make sure that it makes sense.
- ☞ At the end of this process, the team has a list of issues to be addressed, with those of greatest concern at the top.
- ☞ Revisiting the initial listing made in this risk assessment may be helpful, as team members may have learned more about their "real life" risks in the process and may wish to adjust some of their assessments.

Undertaking a risk assessment is often a matter of knowing the system, combined with common sense.

For example, broken platforms or allowing clothes washing to be done on the well apron can increase the potential for contamination of the well water with soap or faecal matter. In community water supply schemes, many improvements can be made by consumers clearing and cleaning the sources

and water points on a regular basis. It is a worthwhile effort that can be done with little money.

**Table 1-5: Example definitions of descriptors for use in descriptive risk assessment**

| Descriptor | Meaning | Notes |
|---|---|---|
| Significant | Clearly a priority | Actions need to be taken to minimize the risk. Possible options (short-, medium- and long-term options) should be documented (as part of the improvement plan developed in the next task) and implemented based on community priorities and available resources. |
| Medium | Medium priority | Currently no impact on drinking-water safety, but requires attention in operation and/or possible improvements in the medium and long term to continue minimizing risks. |
| Insignificant | Clearly not a priority | Actions may be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of the WSP review process. |
| Uncertain | Clarification required | Further data collection or studies are required to better understand the significance of the risk. Some actions can be taken in the meantime as deemed necessary to reduce risk based on existing information, community priorities and available resources. |

☞ When the WSP team has insufficient information or knowledge available and thus is uncertain in assessing whether or not a risk is significant, risks should be clearly flagged for further investigation. Further study may need to be conducted, or views from experts may need to be sought. It is not uncommon that further information needs to be gathered for the risk assessment.

### *ii) Risk ranking*

The second risk assessment approach is a more formal, two-step process. This method can be applied if the community has some higher-level support (e.g. water quality unit of the Woreda water Office or health inspector) or additional resources in the community. Whereas the previous method focuses primarily on listing and ranking the hazardous events, in this method, the WSP team tries to assess the likelihood of the hazardous event actually occurring and the consequence or severity of the impact of the event to the community.

1. As a first step, the WSP team should draw up definitions for the likelihood (e.g. what is meant by unlikely, possible and likely) and consequence (e.g. what is meant by minor impact, moderate impact and major impact) categories (see Table 1.6). This should be conducted to facilitate consistency in assessments for all parts of the

water supply system and over time.

**Table 1-6: Example likelihood and severity definitions for the risk ranking approach**

Box: 2 **Definitions of likelihood of hazardous event to happen and consequences**

| Likelihood level | Assigned score | Description |
|---|---|---|
| Unlikely | 1 | Could occur at some time but has not been observed; may occur only in exceptional circumstances |
| Possible | 2 | Might occur at some time; has been observed occasionally |
| Likely | 3 | Will probably occur in most circumstances; has been observed regularly |
| Consequence level | Assigned score | Description |
| No/minor impact | 1 | Minor or negligible water quality impact (e.g. aesthetic impact, not health related) for a small percentage of customers; some manageable disruptions to operation; rise in complaints not significant |
| Moderate impact | 2 | Minor water quality impact (e.g. aesthetic impact, not health related) for a large percentage of customers; clear rise in complaints; community annoyance; minor breach of regulatory requirement |
| Major impact | 3 | Major water quality impact; illness in community associated with the water supply; large number of complaints; significant level of customer concern; significant breach of regulatory requirement |

***Source: Adapted from WHO SCWS WSP manual***

☞ The WSP team should then compare the listings for all hazardous events and their relative likelihood and consequences to make sure that they have been categorized appropriately. Each event is then mapped in a matrix (see Table 1.7) to get a risk ranking.

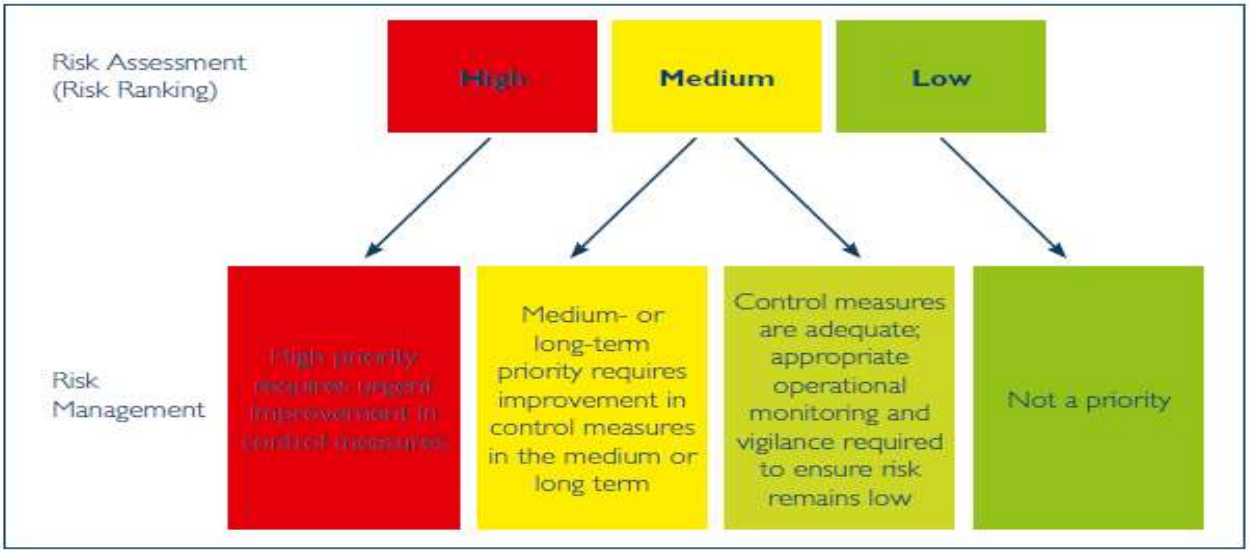
**Table 1-7: Example risk matrix for the risk ranking approach**

| | | **Severity/consequences** | | |
|---|---|---|---|---|
| | | **No/minor impact** | **Moderate impact** | **Major impact** |
| **Likelihood** | Likely | Medium | High | High |
| | Possible | Low | Medium | High |
| | Unlikely | Low | Low | Medium |

☞ To support the risk ranking, the WSP team should define what is meant by significant (e.g. high and medium) risks so that these can easily be distinguished from less significant risks (see Table 1-8).

**Table 1-8: Example risk ranking definitions to prioritize actions**

| Risk ranking | Meaning | Description |
|---|---|---|
| High | Clearly a priority: requires urgent attention | Actions need to be taken to minimize the risk. Possible options should be documented (as part of the improvement plan developed in the next task) and implemented based on community priorities and available resources. |
| Medium | Medium- or long-term priority: requires attention | Actions may need to be taken to minimize the risk. Possible options should be documented (as part of the improvement plan developed in the next task) and implemented based on community priorities and available resources.<br>**Or** where the likelihood of a hazard occurring is low because effective control measures are in place but the consequences are major (e.g. microbial risks), special attention should be given to maintaining the control measures and their appropriate operational monitoring to ensure that the likelihood remains low. |
| Low | Clearly not a priority | Actions may need to be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of the WSP review process.<br>**Or** control measures are effective, and attention should be given to ensure that the risk remains low |



## d) Identify and assess existing control measures

- ☞ The WSP needs to identify any existing control measures or barriers that are already in place and that address potential hazards and hazardous events.
- ☞ Control measures can be technical (e.g. disinfection), infrastructural (e.g. fencing), behavioral (e.g. pesticide use) or related to planning (e.g. land use).
- ☞ It is very important to assess whether these existing barriers are effective at eliminating or reducing the identified risks; it should not be taken for granted that they are working properly.
- ☞ If control measures are ineffective or are not currently in place for an identified significant risk, this should be noted and suggestions for improvement listed.
- ☞ See Task - 4 for additional information on control measures.

> Control measures (also referred to as barriers or mitigation measures): Activities and processes that can be used to prevent, eliminate or significantly reduce the occurrence of a water safety hazard.

- ☞ At the end of this process, the WSP team will have a list of hazards and corresponding hazardous events to be addressed and a ranking of their priority.
- ☞ An example of how this list could be compiled using the risk ranking approach is shown in Annex-A

**Review**

- What are the main hazards can you imagine in your area?
- Have you introduced the hazardous events?
- What control measures have you ever adapted?

**Session Attachments**

Attachment 1: See Annex - A

## 1.7 Session – A5: Task – 4: Develop and Implement an Incremental Improvement Plan

| | |
|---|---|
| **MODULE – G** | **RURAL WATER SAFETY PLAN** |
| **SESSION – G5** | **DEVELOP AND IMPLEMENT AN INCREMENTAL IMPROVEMENT PLAN** |
| **Introduction** | The team should review its available resources and the community's needs against the information from the risk assessment (Task 3) to identify which water safety improvements should be implemented with priority and which can be deferred for the medium or long term. When considering work to reduce or eliminate a risk, positive spin-offs, such as the opportunity to make the service more reliable or extending the service area, should be looked at. Comparing costs against all the benefits may generate more interest in supporting the planned work. The incremental improvement plan will be a powerful tool to ensure that limited funds, from both within and outside the community, will be used most effectively. |
| **Objective** | At the end of the session, the participants will be able to:<br>▪ Develop improvement plan to reduce the hazards<br>▪ Implement the developed plan and monitor its effectiveness in regular period<br>▪ Recommend the mitigation measure to reduce risks |
| **Outputs** | Awareness created to develop and implement mitigation improvement plan |
| **Timing** | 2 hours |
| **Target Group** | Regional Water, Health and Agriculture Bureaus and their descendant Zone and Woreda offices, WASHCOs |
| **Methodology** | Lecture, Exercise and field practicing |
| **Materials** | ▪ Flip chart<br>▪ Charts<br>▪ Matrix table |
| **Session Guide** | |
| **Step 1: How do develop and implement Improvement Plan?** | **a) Review options to control identified risks**<br><br>In developing and implementing an incremental improvement plan, the WSP team must first review the significant risks determined to require additional control and, for each of these risks, list possible measures that could be put in place to address it.<br><br>The aim of control measures includes, but is not limited to:<br>▪ eliminating or reducing contaminants in the source water, thus preventing them from entering the water supply;<br>▪ removing particles and chemicals from the water or killing or inactivating pathogens (i.e. using control measures through treatment, if necessary);<br>▪ preventing contamination during drinking-water storage, distribution and handling, |

**Table 1-9: Example control measures organized by different components of water supply**

See Annex – B of Table 1.9 Control Measures which is referred under this session.

## b) Select control measures, and develop an incremental improvement plan to implement them

- Based on the control measures identified in (a), an improvement plan should be developed.
- It is not always feasible for a small community to address every possible significant risk and put in place all possible control measures that have been identified at once.
- Limiting factors will include desirable time frames and available resources. Therefore, control measures to be implemented in the short, medium and long term should be identified. In developing this incremental improvement plan, the WSP team should consider:
  - the level of risk associated with each hazard and hazardous event;
  - control measures to address the risk (i.e. what and how);
  - the person(s) responsible for carrying out the control measure (i.e. who);
  - timelines for the control measure (i.e. when);
  - financial resources needed (i.e. cost);
  - Training requirements for operating the control measure.
- Some improvements or control measures will be ready for immediate implementation at little or no cost. Others will need to be addressed over time and may require a substantial budget and additional external resources. It is better not to try to do everything at once, but to use the WSP approach to make a plan with feasible and realistic time frames (e.g. for three to five years), prioritizing improvements.
- The WSP team should estimate the costs and labor time associated with each improvement to provide information for decision-making. Economies that may be achieved from combining certain improvements should also be estimated.
- Available resources will need to be balanced against the risk assigned to the hazard and hazardous event. The incremental improvement plan needs to be realistic and appropriate to the community's limited resources. There are often a number of ways to deal with multiple risks. The WSP team will need to consider the various benefits and costs of all the options, as well as intermediate or temporary solutions until resources become available for the preferred permanent solution.
- Communities will need to decide how they will raise the funds needed for the implementation of the improvements. The incremental improvement plan will be an excellent prospectus to attract government and other interested local or external supporters to come forward and assist.

- Funds should be raised as part of the regular district budgeting process. Often some matching funds from the community need to be arranged. These can be raised through water tariff and/or financial support from NGOs or wealthy community members. Community action for maintenance of the water supply also offers great opportunities for communication and information sharing and facilitates ownership of the WSP by the community.

- An incremental approach allows for improvements to be made over time to achieve water quality targets or objectives. The improvement plan should be documented and shared with all those responsible for the improvement measures. A sample completed form is shown in Table 1-11.

**Table 1-10: Example of an improvement plan**

| Hazardous events | Plan | | Do | | |
|---|---|---|---|---|---|
| | What | How | Who | When | Cost |
| Cattle and sheep can access the well and the immediate area around it, which could result in animal faecal matter entering the water supply | Exclude cattle and sheep from the abstraction area | Repair fencing around the catchment area | Ato X to arrange with Woreda council work team | Repairs to be carried out January 2014 | 500 ETB materials |
| Access to water storage tank could result in bird/animal waste entering treated water | Eliminate potential for contamination at water storage tanks | Repair leaking covers, implement an annual inspection programme (to include all system tanks) and develop a suitable sanitary inspection form | W/zo Y to develop sanitary inspection form and to carry out inspections; Ator Z to make repairs | Repairs to be carried out March 2014; Begin developing Sanitary inspection forms by March 2014, complete by July 2014; first annual inspection in January 2015 | 200 ETB materials |
| Contamination of treated water in household storage containers due to poor hygiene (e.g. hand dipping of cups) | Control potential for contamination at the household level | Develop and implement a consumer education programme (to include pamphlet distribution and information sessions at primary and secondary schools) | W/zt A to develop and distribute pamphlets; Ato Y to present at schools | Begin developing pamphlets August 2014, complete by December 2014 Pamphlet distribution and school presentations to begin in January 2015 | 150 ETB materials |

Note that it is essential to monitor the identified control measures to ensure that they are operating as required. How to do this is discussed further in Task 5.

**Review**

- What did you understand by mean control measures?
- What considerations have been taken when assigning control measures?

**Session Attachments**

See Annex – B for Control Measures Matrix

## 1.8 Session – G6: Monitor Control Measures and Verify the Effectiveness of the WSP

| | |
|---|---|
| **MODULE – G** | **RURAL WATER SAFETY PLAN** |
| **SESSION – G6** | **MONITOR CONTROL MEASURES AND VERIFY THE EFFECTIVNESS OF THE WSP** |
| **Appropriate Facilitator Background** | Water and health experts knowledge is required to offer this training |
| **Introduction** | Session - 6 is stage in the water safety plan when the team makes decisions about the operational monitoring system. The water safety plan team will need to make decisions that will describe the implementation of operational monitoring activities, such as:<br>▪ What is going to be monitored?<br>▪ How will it be monitored?<br>▪ The moment and the frequency of monitoring<br>▪ Where it will be monitored<br>▪ Who will conduct the monitoring<br>▪ Who will receive the results of the monitoring system.<br>Verification of the effectiveness (Compliance monitoring) of the water safety plan includes three main activities:<br>▪ Compliance monitoring: Is the drinking water that is delivered to consumers safe?<br>▪ Internal and external auditing of operational activities, and<br>▪ Consumer satisfaction. |
| **Objective** | At the end of the session, the participants will be able to:<br>▪ Understand the issues to be monitored based on the identified hazards and the control measures,<br>▪ Creating awareness on the roles and responsibilities of various stakeholders involves in monitoring activities<br>▪ Aware on the frequency of monitoring and result analysis<br>▪ Create know how of the compliance of delivered water that makes satisfaction of the consumer in terms of quality and quantity.<br>▪ Recognize how poor maintenance of a handpump can reduce water yield |
| **Outputs** | Understood the monitoring and verification system |

| | |
|---|---|
| **Timing** | 6 hrs |
| **Target Group** | Regional Water, Health and Agriculture Bureaus & their descendants of Zone & Woreda, and WASHCOs. |
| **Appropriate Venue** | Lecture room and field |
| **Methodology** | Lecture and group work |
| **Materials** | ▪ Checklist<br>▪ Laboratory results |
| **Session Guide** | |
| **Step 1: Monitoring System... How do It?** | The purpose of Task 5 is to confirm that the community water supply is operating as expected and that the WSP is protecting drinking-water safety and public health.<br><br>**Operational monitoring:** Planned, ongoing observations using checklists for visual on-site inspection and simple water quality measurements to assess whether a community water supply is operating normally—that is, whether the control measures to prevent, remove or reduce contaminants are operating effectively (as planned). Operational monitoring of control measures enables timely detection of operational and water quality problems so that action can be taken prior to the supply of unsafe drinking-water.<br><br>**Verification monitoring:** Verification monitoring confirms that water quality targets or objectives are being achieved and maintained and that the system as a whole is operating safely and the WSP is functioning effectively. It is typically based on compliance monitoring, internal and external auditing of the adequacy of the WSP and adherence to operational activities, and checking consumer satisfaction. In auditing, sanitary inspection formats are often a useful tool for confirming that measures put in place effectively control previously identified risks. The results of verification monitoring are typically included in district, regional or national water supply surveillance programmes.<br><br>**How to do it**<br><br>**c) Establish a monitoring programme**<br><br>While there are a number of differences between operational monitoring and verification monitoring, they are all simply checks to ensure that the water is safe and the WSP is working effectively. Monitoring programmes should aim to prevent problems and to correct faults in a timely manner. Monitoring should address both preventive (detecting risks so that action may be taken before problems occur) and remedial objectives (identifying problems so that corrective actions can be taken promptly).<br><br>***i) Operational monitoring***<br><br>Quick and easy measurements and observations are best. Examples include |

observing features during onsite inspections (e.g. the integrity of a fence or wellhead, practices during water collection) and water quality testing for simple indicator parameters (e.g. chlorine residual, turbidity, conductivity). Specific operational monitoring parameters that are appropriate to the local water supply and the control measures being applied should be selected. Related to water quality testing, as a minimum, the following parameters that affect drinking-water quality should be monitored by the operator with support from an external agency if the operator does not have the capacity to monitor water quality: chlorine residual and pH (if chlorination is practiced) and turbidity. Operational monitoring is usually done by the person(s) responsible for the day-to-day operation of the community water supply.

For each of the monitoring parameters, the operational limits—limits that will trigger corrective actions— need to be established. Corrective actions aim to bring the control measure back to operating properly— that is, within the set limits. For instance, if the fence around the abstraction area is to be checked weekly, as described in the management procedure, the operational limit is reached when the fence has been damaged. Clearly, that exceedance will initiate corrective action: repair. Similarly, when free chlorine residual at a water points falls below a predetermined limit (e.g. 0.2 mg/l), the chlorine dosing will need to be checked and adjusted. Monitoring and corrective actions form the control loop that ensures that unsafe drinking-water is not supplied. Where possible, corrective actions should be specific and prepared and tested ahead of the event to ensure that they can be put in place quickly.

An example of an operational monitoring programme is shown in Table 1-12.

**Table 1-11: Example of an operational monitoring programme**

| Control measure | Monitoring | | Operational limit | Corrective action | |
|---|---|---|---|---|---|
| ■ Wells are fenced to prevent animal access within 30 metres, and ground is sloped away from wells. | What: | Sanitary integrity of the well and fence | Integrity of fence or well is compromised per information collected from relevant inspection form | What: | Repair fence and/or well. Inform land/animal users/owners as appropriate. |
| | How: | Visual inspection by using inspection form XYZ. Completed form given to WSP team leader for storage and to review trends. | | How: | Contact community mechanic and/or plumber and request repair.<br>Call for ad hoc community meeting |
| | When: | Monthly | | When: | As soon as identified |
| | Where: | On-site at well area. | | | |
| | Who: | Community caretaker | | Who: | Community caretaker with mechanic and/or plumber. |
| Backup Generator ensures uninterrupted disinfection during power outages. | What: | Operational reliability of generators | Dysfunction of generator. | What: | Repair generator |
| | How: | Test runs | | How: | Contact community electrician and request checking and repair |
| | When: | Quarterly | | When: | As soon as identified |
| | Where: | Generator house | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Who: | Community technician | | Who: | Community technician with electrician |
| Chlorine dosing is flow-paced to ensure consistent dosing. | What: | Free chlorine concentration | Free chlorine concentration is less than 0.2 or greater than 1.5 mg/l. | What: | Take manual water sample and analyze to confirm online chlorine value. If chlorine concentrations confirmed to be correct, follow chlorine non compliance procedure. Otherwise, check disinfection unit and online analyzer for faults and adjust/repair accordingly. If repair of disinfection unit is not possible, use backup device. |
| | How: | Online chlorine analyzer | | How: | Water sampling, testing and analysis according to relevant standard operating procedures. Chlorine non-compliance procedure according to relevant standard operating procedure. Contact community technician and request checking and repair of disinfection unit and online analyzer. Check and repair according to manufacturer's manuals. |
| | When: | Continuously | | When: | As soon as identified |
| | Where: | Clear water tank outlet | | | |
| | Who: | Community caretaker for maintenance and calibration of analyzer | | Who: | Community caretaker with technician (for repair of online chlorine analyzer) and local public health officer (for chlorine non-compliance procedure) |
| Cover on water storage tank and vermin screening over vent piping. | What: | Integrity of covers and screens | Integrity of covers or screens is Compromised per information collected from relevant inspection form. | What | Repair/replace cover and/or screen |
| | How: | Visual inspection by using inspection form ABC. Completed form given to WSP team leader for storage and to review trends | | How: | Contact community technician and request repair |
| | When: | Quarterly | | When: | As soon as identified |
| | Where: | On-site at storage tank area | | | |
| | Who: | Community caretaker | | Who: | Community caretaker with technician |

## ▪ *Verification monitoring*

Verification involves three activities undertaken together to provide evidence that the WSP is working effectively:

1. Compliance monitoring;
2. Internal and external auditing;
3. Checking consumer satisfaction.

### *i) Compliance monitoring*

Compliance monitoring is typically based on water quality testing for faecal indicator organisms and hazardous chemicals. Typically, the results are checked against established national water quality standards. Compliance monitoring is usually carried out by someone not involved in the day-to-day operation of the water supply, such as a designated and appropriately trained community member or a public health officer/inspector.

***ii) Internal and external auditing***

Audits help maintain the quality of implementation of a WSP. Audits should involve external review by an independent qualified third party. The external review team may include government officials or the regulatory authority or water quality experts from neighboring larger utilities. The audit may also involve internal review by people with responsibilities for the operation or oversight of the water supply.

Auditors may identify additional opportunities for improvement, such as areas where planned improvements are impractical, procedures are not being properly followed, resources are insufficient or training or motivational support is required for staff.

It is essential for the auditors to have detailed knowledge of the delivery of drinking-water and to verify information in person through site visits, through interviews with community members responsible for operation of the water supply and by observing the procedures in place. Records may not always be factually correct, and, in some cases, equipment that would appear to be working on paper may not be working in practice.

***iii) Checking consumer satisfaction***

Consumer use of, and satisfaction with, the water supply is an important indicator of whether the water supply is operating effectively. Consumer complaints about taste, colour or odour should raise concern that the drinking-water may not be safe. On the other hand, water that tastes or smells strange or does not look “clean” may not be accepted by the community, even though it is perfectly safe. This may lead consumers to use other, less safe water.

## d) Record and share results

All operational monitoring and verification data should be documented, filed and shared with relevant stakeholders. There may be legal or other requirements to submit reports to public health or regulatory officials. The WSP team should check to see who needs to receive this information. If there is no mandatory reporting, the WSP team should consider who would benefit from receiving these reports.

## e) Frequently assess results

Water quality monitoring and sanitary inspection data should be regularly reviewed to confirm that control measures continue to work and allow for adjustments to stay within operational limits. For instance, the output of a slow sand filter will decline over time when clogging of the filter increases. This information tells the operator when he or she may have to take the filter out of operation for cleaning, at which time the operator will simultaneously have to provide for extra water storage to tide consumers over the cleaning break and inform them to use water sparingly for a few days. Monitoring and audit programmes should aim to prevent problems and to correct faults in a timely manner.

| | |
|---|---|
| | Over time, this documentation will be helpful, as results are analyzed, to explain historical performance and occurrences and to show what risks occur with what frequency. This information will help to improve the continued implementation of the WSP, especially to justify investments. |
| **Review** | ▪ What do you understand in monitoring of control measures?<br>▪ What do you understand verification of monitoring? |
| **Session Attachments** | N/A |

## 1.9 Session – A7: Task – 6: Document, Review and Improve Aspects of WSP Implementation

| | |
|---|---|
| **MODULE – A** | **RURAL WATER SAFETY PLAN** |
| **SESSION – A7** | **TADK – 6 DOCUMENT, REVIEW AND IMPROVE ASPECTS OF WSP IMPLEMENTATION** |
| **Appropriate Facilitator Background** | Water and health experts knowledge is required to offer this training |
| **Introduction** | The purpose of Task - 6 is to document the status and the level of operation and management of the water supply system and to ensure that the WSP approach is embedded in operations and that the WSP remains up to date and effective. |
| **Objective** | At the end of the session, the participants will be able to:<br>▪ Understand the level operation and management of WSP |
| **Outputs** | Understood the operation and management system of WSP |
| **Timing** | 4 hrs |
| **Target Group** | Regional Water, Health and Agriculture Bureaus & their descendants of Zone & Woreda, and WASHCOs. |
| **Appropriate Venue** | Lecture room and field |
| **Methodology** | Lecture and group work |
| **Materials** | ▪ Checklist |
| **Session Guide** | |
| **Step 1: Operation and Management of WSP... How Do It?** | **a) Document management procedures**<br>▪ Good information on the status of and procedures for running the water supply is essential for effective management and planning. The development of the WSP will have yielded a lot of information, for example, on the origin of the system, its design and construction, or ownership details of the schemes. It is very important to retain copies of the documentation and to know where the original files are to be found (e.g. at the Woreda water office).<br>▪ All systems require instructions on how to operate. Management procedures (e.g. standard operating procedures) and manuals should be available for individual technical components of the system, such as for a hand pump or diesel generator. Some procedures also need to be tailor-made to reflect the actual situation. It is important to have relevant information available and properly stored.<br>Documenting operating, maintenance and inspection procedures is important |

because it:

- helps build confidence that operators and backup support know what to do and when;
- supports consistent and effective performance of tasks;
- captures knowledge and experience that may otherwise be lost when community members have moved;
- helps reinforce the importance of the role of the community in the water supply system;
- helps in training and competency development of new community operators;
- Forms a basis for continuous improvement.

In addition to the technical information needed to run the system, management procedures should be developed outlining the tasks to be undertaken in managing all aspects of the water supply, including during emergency situations.

The WSP is an important source of information for drafting these management procedures. The WSP team also needs to ensure that the different roles and responsibilities (**i.e. who does what, when, where, how and why)** for water safety are clearly understood by everyone involved. An efficient, regular review and updating cycle is important.

Also, procedures for routine monitoring and inspection activities and their collected results (see Task 5) are obviously also important management information and need to be documented.

☞ As a minimum, the WSP team should document management procedures for the items included in Table 1-13.

**Table 1-12: Examples of management procedures to be documented for a community water supply system**

<table>
<tr><th>Catchment/abstraction</th><th>Treatment</th><th>Storage and distribution</th><th>User installations</th></tr>
<tr><td rowspan="2">Land use zoning and management plans.<br>Procedures and forms to monitor/ inspect activities in the catchment area (e.g. agricultural practices, such as fertilizer application).<br>Maintenance, cleaning and inspection schedules and procedures for abstraction infrastructure.<br>Schedules and procedures to monitor raw water quality.<br>Procedures for notifying source water users (including downstream</td><td>Operation and Maintenance schedules and procedures for all aspects of the treatment cycle of the system (e.g. aeration, filtration, chlorination).<br>It may be useful to post these procedures on the wall of the treatment plant for easy access.<br>Operational monitoring procedures to confirm the effectiveness of treatment processes (e.g. for turbidity and chlorine levels).</td><td>Maintenance, cleaning and inspection schedules and procedures for storage tanks and pipelines.<br>Procedures for (factories filling) bottled water and filling stations of tankers conveying drinking-water, if relevant.</td><td>Public information and education plans.<br>Procedures for notifying customers (e.g. boil water alert).<br>Procedures for responding to and investigating consumer complaints about taste or odour</td></tr>
<tr><td colspan="3">Schedules and procedures to monitor drinking-water quality (compliance monitoring).</td></tr>
</table>

| | |
|---|---|
| users) during incidents or accidents in the catchment/source water(s). | |

Additional information to be recorded, collected and stored for easy retrieval includes the following:

- accurate and accessible system information (e.g. location of abstraction points and distribution system, including tanks, valves, pumps, washouts, etc., construction materials used, age of infrastructure);
- operational roles and responsibilities;
- contact details for operators and caretakers (with mobile phone numbers if available);
- contact details for water equipment suppliers;
- training programmes for operators, contractors and water committee members;
- design standards for infrastructure;
- relevant plumbing codes and standards and enforcement procedures;
- compliance monitoring results; copies of results shared with public health and water supply regulatory authority (as required by regulation);
- audits, inspections and security check programmes;
- programme for reviewing/revising documentation;
- annual reports/financial statements;
- Documentation on periodic review and revision/amendment of the WSP.

### b) Participate in supporting activities

Supporting activities are important in ensuring water safety, even though they may not affect water quality directly. They incorporate the principles of good management that underpin the WSP. Codes of good operating, management and hygienic practices are essential elements in this respect. These are often standard operating procedures or system operating rules.

Water suppliers or their associations will ordinarily have supporting activities in place as part of their normal operations. For most, the implementation of supporting activities will involve collating existing operational and management practices, initial and periodic review and updating to continually improve practices, promoting good practices to encourage their use and auditing practices to check that they are being used, including taking corrective actions, where necessary.

## Supporting programmes can include, but are not limited to:

- training programmes for personnel involved in the water supply;
- tools for managing the actions of staff, such as quality assurance systems;
- education of community members whose activities may influence water quality;

- communication protocols to ensure that there is a clear and defined pathway for communicating information;
- mechanisms for tracking consumer complaints and actions taken to respond to complaints;
- calibration of monitoring equipment;
- Record keeping.

Where supporting activities do not exist, small community water supplies can make an effort to establish and implement their own programme support activities, including training and educating appropriate staff and community members, potentially by collaborating with government officials, local or regional NGOs, associations of water user committees, local training institutions and other small communities. The WSP team should contact these organizations for help and guidance in identifying suitable supporting activities.

Regardless of how sophisticated national and regional policies and programmes may be, experts from these organizations should, at a minimum, be available and willing to provide assistance and guidance, even if only on an advisory or ad hoc basis. Experts could include inspectors, public health professionals, water quality experts and water resource specialists. Ideally, these experts would be able to bring to the team's attention, and help leverage, tools such as grant schemes and inspection forms.

### c) Regularly review the WSP

Periodically, the team should meet to review the WSP and to learn from experiences and new procedures. The WSP should also be reviewed whenever there are significant changes in or around the community water supply, including recent land use changes. The review process is essential to overall implementation and provides the basis from which future assessments can be made. Periodic reviews are particularly important in small community water supplies where capacity is limited and where the objective is to make incremental improvements over time to achieve national, state and community-based water quality targets or objectives.

To review the plan, the team should return to Task 1 (Engage the community and assemble a WSP team) and work through it again. The team should then move through the other tasks again in order. As the team is not starting from scratch, and assuming that the initial process was well documented, the tasks should be easier and take less time to complete.

### During the review, it may be helpful to:

- Review and include any new activities or changes in the catchment area, abstraction, treatment, storage, distribution and consumer components of the water supply, as applicable. This includes reviewing and updating the water supply description and map/schematics as needed. New hazards and associated risks should be incorporated, and previously identified risks should be updated with additional or new information. The original layout plan shown to the right, for example, will need to be updated to incorporate any new activities or changes that have occurred in the water supply since the WSP was first

developed.

- Review the improvement schedule. This will need to be updated as improvements are completed. New information or resources may mean changing the order of priority for the improvements.
- Review the roles and responsibilities and standard operating procedures. Have the roles and responsibilities of management or staff changed since the last review? Have there been personnel changes since the last review? Have there been any changes in system operation, maintenance, inspection and monitoring processes and procedures?
- Review available water quality data and any completed sanitary inspection forms. Are control measures working as planned? Does the risk assessment need to be updated based on these results?

The WSP should additionally be reviewed following an emergency an incident, or a near-miss. During this review, the team should consider the following questions:

- What was the cause of the problem?
- How the problem was first identified or recognized?
- What were the essential actions required, and were these carried out?
- What communication problems arose, and how were they addressed?
- What were the immediate and longer-term consequences?
- How well did the emergency procedures function?
- Have these hazardous events highlighted any weaknesses in the WSP, and how can the team (or the local government) prevent a recurrence of the problem causing the emergency?
- Has the WSP been updated to reflect the lessons learnt to avoid a similar problem in the future?

**Tips:**

- Consider checking with local government, water supply associations and NGOs for continued training opportunities for operators, plumbers, pump drivers and community-based maintenance workers, to ensure upgrading of skills and timely replacement of staff.
- Various forms of mass media can be used to raise the effectiveness of communication on the WSP in all types of communities. Often posters with pictures and diagrams, discussions on the local radio and, of course, public meetings are useful to brief consumers. The WSP team should consider how to use information, education and communication formats and consumer relations in the most effective ways to ensure good interaction between the community and the operators or water user committee.
- Where a community has low literacy levels, pictures and diagrams can be used to communicate and document management procedures to all involved in operating and managing the community water supply.
- Following an emergency, an incident or a near-miss, risks should always be reassessed. The WSP team may need to modify the incremental

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| | improvement plan.<br>▪ The team may also want to review the process for developing and implementing the WSP. As mentioned previously, there is no one-size-fits-all approach to WSPs; hence, each community may need to try its approach and then review it to ensure that public health is being protected.<br>☞ Following the review, the WSP team should ensure that all documentation and contact lists are up to date and that all staff and operators are informed about the updated version. A new date for the next review process should also be scheduled. |
| **Review** | ▪ What do you understand in document, review and improvement plan? |
| **Session Attachments** | N/A |

# Annexes

## Annex A: Example of risk assessment and prioritization using the risk ranking approach

| Water supply system component | Possible hazard | Hazardous event | Control measures | Likelihood | Consequence | Risk ranking | Priority for action |
|---|---|---|---|---|---|---|---|
| Catchment/ abstraction | Microbial pathogens | Cattle and sheep can access the well and the immediate area around it, which could result in animal faecal matter entering the water supply. | Unprotected well: no control measures in place (e.g. no fence, no Well head protection works). | **Likely** *Justification:* Access of cattle and sheep frequently observed by community members; animal faeces are visible and can easily be washed into well after heavy rainfall. | **Major** *Justification:* Cattle and sheep faeces may contain a variety of pathogens, which may cause illness in the community. | High | **High priority** *Justification:* Hazardous event is likely to occur and has major consequences, and no control measures are in place. Short and Long-term measures are required. |
| Treatment | Microbial pathogens | Gravity-fed water supply continues to flow through the treatment works during power failures, but will not be disinfected. | Failsafe device fitted to the inlet of the treatment plant, which diverts the water if there is a power failure | **Unlikely** *Justification:* Device confirmed to be effective during power failure, tested quarterly to ensure effectiveness. | **Major** *Justification:* Untreated source water is known to contain a variety of pathogens that may cause illness in the community | Medium | **Attention required; low risk with appropriate operational monitoring** *Justification:* Exposure to microbial pathogens from the water supply is a major concern. Therefore, special attention should be given to maintaining the control measure with appropriate operational monitoring to ensure that the likelihood remains low |
| Treatment | Chlorine overdose | Chlorine dosing can result in chlorine over dose if control is lost at the treatment plant. | Chlorine dosing is flow-paced to ensure consistent dosing; online chlorine analysers | **Unlikely** *Justification:* Disinfection unit and online analyser confirmed to be effective | **Moderate** *Justification:* Chlorine overdose can cause taste and odour problems | Low | **No further action is needed; low risk with appropriate operational monitoring** *Justification:* Hazardous event is unlikely to occur and has moderate consequences, and existing control measures are adequate |
| Storage and distribution | Microbial pathogens | Access to water storage tank could result in bird or other animal waste entering treated water. | Cover on water storage tank and vermin screening over vent piping, although cover has | **Likely** *Justification:* Birds and other small animals have been previously found in the storage tank; animal faeces are visible | **Major** *Justification:* Bird and other animal faeces may contain a variety of pathogens that | High | **High priority** *Justification:* Hazardous event is likely to occur and has major consequences, and existing control measure (cover) is |

| Water supply system component | Possible hazard | Hazardous event | Control measures | Likelihood | Consequence | Risk ranking | Priority for action |
|---|---|---|---|---|---|---|---|
| | | | gaps. | around the storage tank cover. | may cause illness in the community | | inadequate. |
| Storage and distribution | Microbial pathogens/ chemicals | Low-pressure conditions (e.g. during mains breaks) can result in backflow from customer systems into the network | Backflow prevention devices are installed at all service connections | **Unlikely**<br>*Justification:* Backflow Prevention devices have been confirmed to be effective | **Major**<br>*Justification:*<br>Backflow from customer systems into the network can introduce a variety of pathogens, resulting in widespread distribution of contaminated water to the community, which may cause illness | Medium | **Attention required; low risk with appropriate operational monitoring**<br>*Justification:*<br>Exposure to microbial pathogens from the water supply is a major concern. Therefore, special attention should be given to maintaining the control measure with appropriate operational monitoring to ensure that the likelihood remains low |
| User installations | Microbial pathogens | Contamination of treated water in household storage containers as a result of poor hygiene (e.g. hand dipping of cups | None currently in place | **Possible**<br>*Justification:*<br>Meetings held with consumers indicate that household storage is practiced by some (not the majority of) consumers periodically | **Moderate**<br>*Justification:*<br>Consequence is for a small percentage of consumers, but could be health related | | **Medium- or long-term priority**<br>*Justification:*<br>Hazardous event may occur and has moderate consequences, and no control measures are in place |

# Annex B: Example of Control Measures

| Catchment/abstraction | Treatment | Storage and distribution | User installations |
|---|---|---|---|
| ▪ Establish drinking-water protection zones with land use restrictions (e.g. no or limited activities such as agriculture, horticulture, wildlife, swimming, boating, industrial discharge).<br>▪ Reduce use of herbicides, fertilizers and chemicals within catchments, and only use those that are approved.<br>▪ Train farmers on appropriate use of herbicides, fertilizers and chemicals in agriculture and horticulture.<br>▪ Establish natural "buffer strips" around reservoirs, rivers and streams to minimize erosion and runoff contamination.<br>▪ Prevent roaming of domestic animals near the source water (e.g. fence).<br>▪ Switch to alternative water source(s) when something goes wrong (e.g. occurrence of algal bloom in reservoir) or when a natural contaminant (e.g. fluoride) is difficult to remove).<br>▪ **For spring catchments:** Construct a safe collection chamber and a proper overflow with elbow or tee. | ▪ Remove microbial contamination through reliable treatment (e.g. filtration and disinfection), with adequate capacity.<br>▪ Apply proven and reliable treatment to bring chemical hazards of direct health concern (e.g. arsenic, fluoride) and those with an impact on taste, odour and appearance of drinking water (e.g. iron, manganese, turbidity and alkalinity) within acceptable limits.<br>▪ **Note:** if available, chemical removal processes should be certified for use by a relevant national authority. Even then, fine-tuning of treatment for chemical removal may require expert advice to ensure proper performance.<br>▪ Maximize removal of organic material prior to chlorine addition to limit disinfection by-product formation.<br>▪ Consider prohibiting treatment chemicals that result in taste and odour problems (but only if such actions do not compromise the | ▪ Human and vermin contact with water, particularly at service reservoirs and tanks, through, for example, good roofing of water storage, adequate security (e.g. fences, locks on gates and hatches), insect proof screens on vents and overflow pipes.<br>▪ Ensure that inlet and outlet<br>▪ pipes are at varying heights<br>▪ on opposite ends of service reservoir, and ensure good mixing.<br>▪ Regular cleaning, inspection and maintenance of storage tanks.<br>▪ Flush washouts in tanks and pipelines regularly.<br>▪ Use only materials and pipes approved for contact with drinking-water. | ▪ Remove illegal connections.<br>▪ Prevent cross connections<br>▪ And backflow into the system.<br>▪ Institutional and home installations are carried out by recognized or certified plumbers.<br>▪ Educate consumers about proper hygiene and safe water storage practices<br>▪ Inform consumers on point-of-use treatment options where applicable (e.g. boiling, filtration, Chlorination).<br>▪ Distribute educational materials about safe rainwater collection practices (e.g. first-flush systems, tank cleaning). |

| Catchment/abstraction | Treatment | Storage and distribution | User installations |
|---|---|---|---|
| ■ **For surface water abstraction:** Install and maintain screens and sediment traps.<br>■ For all abstraction points (e.g. spring boxes, wells, boreholes, streams):<br>○ Prohibit latrines and fix leaky septic tanks in the vicinity of the abstraction area. Regular cleaning, inspection and maintenance.<br>■ **For wells/boreholes:** Slope the ground away from wellheads to prevent contamination by runoff.<br>■ **For rainwater catchment:** Design with proper filter, first-flush mechanism and mosquito-safe tank.<br>■ In designed operational areas, consider fire breaks, designated roads and tracks (to abstraction areas), adequate drainage and waste facilities, containment and bounded areas (e.g. for chemical storage).<br>■ Arrange for legal right to source use and abstraction.<br>■ Enforce local by-laws on hygiene, sanitation and public health. | microbial safety of the water supply).<br>■ Ensure purity of chemicals added to water, including checking expiry dates.<br>■ Ensure proper storage and availability of chemicals (i.e. stocks do not run out).<br>■ Chlorinate to ensure residual chlorine in the distribution network, including in the service reservoir.<br>■ Backwash filters at regular intervals to avoid excessive pressure and particle breakthrough.<br>■ Prevent recycling of filter or backwash water.<br>■ Install duty and standby dosing pumps to prevent treatment disruption during equipment failure.<br>■ Shut off treatment plant and switch to alternative water source or treatment when something goes wrong.<br>■ Backup power supplies to maintain essential treatment functions during power outages.<br>■ Perform regular cleaning, inspection and maintenance of | ■ Check and replace unsuitable materials (e.g. lead-jointed or lead service pipes, bitumen lined mains).<br>■ Aggressive water (low pH) may force use of other construction materials and plumbing.<br>■ Maintain disinfectant residual throughout distribution system.<br>■ Maintain constant positive pressure in the distribution system to minimize opportunities for contaminant ingress.<br>■ Repair leaks to minimize opportunities for contaminant ingress.<br>■ Prevent backflow into the system.<br>■ Minimize dead ends in water pipes.<br>■ Enforce plumbing codes, standards and licensing | |

| Catchment/abstraction | Treatment | Storage and distribution | User installations |
|---|---|---|---|
| | treatment installations and infrastructures.<br>■ Ensure that treatment plant operators are trained and meet established minimum competency standards. | | |

# Annex C: Checklist for conducting a WSP

| No. | Descriptions | Yes | No. |
|---|---|---|---|
| 1 | Has a multi-disciplinary team of experts been assembled to carry out the water safety plan? | | |
| 2 | Has the team been informed of their duties and commitment? | | |
| 3 | Has the water treatment system been described?<br>(i.e. has each step in the system been considered for range and magnitude of hazards that may be present, and the ability of existing processes and infrastructure to manage actual or potential risks) | | |
| 4 | Following the description of the system above, has all the information been documented? | | |
| 5 | Has a flow diagram of the entire water supply system been constructed using the symbol chart? | | |
| 6 | Have existing, as well as potential., hazards in the system been identified | | |
| 7 | Have these hazards been prioritized using the hazard assessment matrix provided? | | |
| 8 | Are there any control measures in place to reduce/eliminate the hazards? | | |
| 9 | Is there a system in place to monitor the control measures? | | |
| 10 | Have corrective actions been identified for each control measure, especially if the control measure fails? | | |
| 11 | Are there procedures in place to verify that the WSP is working effectively and will meet the health-based targets? | | |
| 12 | Have supporting programmes been developed to ensure that health based targets will be met? | | |
| 13 | Have management procedures been prepared to respond to “normal” and “incident” conditions? | | |
| 14 | Has all the relevant information regarding the water supply system been documented?<br>(i.e. description and assessment of the system, plan for operational monitoring, plan for verification of drinking water system, management procedures, etc.) | | |
| 15 | Have communication procedures been established?<br>(i.e. general information on water quality through the media, annual reports and on the internet, procedures for promptly advising of any significant incidents, mechanisms to receive and actively address community complaints, etc.) | | |
| 16 | Has the WSP been reviewed at the following stages? | | |
| | Annually | | |
| | After an incident | | |
| | After any significant change to the water supply | | |
| | In response to finding a weakness in the plan | | |
| | Additional information regarding the system is received that might warrant a revised risk level for that system | | |

# Annex D: Risk Assessment Form

## Section A: Description of Water Supply Schemes

### Item - 1

| | | | | |
|---|---|---|---|---|
| **Name of Schemes** | | | | |
| **Type of Schemes:** | **HDW** ☐ **SW** ☐ **BH** ☐ **Spring** ☐ **Others** ☐ | | | |
| **Location** | Kebele: | | Village: | |
| | Woreda: | | Zone: | |
| | Region: | | | |
| **Year of Construction** | | | | |
| **Name of WaSHCOs** | | | | |
| **Name of Caretaker** | | | | |
| **GPS Coordinate** | | | | |
| | | | | |
| | | | | |

### Item - 2

**Diagram of the supply**

Provide a flow diagram showing the inter-relationships and various components of the supply source, treatment process and distribution system from the catchment to the consumer. The diagram should include:

- immediate catchment
- wider catchment
- collection point/s
- treatment processes used
- and major distribution pipe work (i.e. pumps, storage systems, pipelines)

### Item - 3

In the sections that follow, an evaluation of the system is conducted in order to determine if any hazards exist or if any hazardous events are likely to occur. The hazard assessment matrix shown in Table 1.3 above is a guide to scoring the existing risks that could make water unsafe (i.e. cause a deterioration in water quality) and should be referred to throughout the evaluation. rating of 0.8 x 70 = 56, which would be ranked higher than an event with a likelihood of 0.2 and a consequence of 2 and a risk rating of 0.2 x 2 = 0.4.

A higher score implies that a bigger risk of a hazardous event occurring exists and should therefore be prioritized. A risk profile is given below:

Risk Profile: LOW – 0-10

MEDIUM – 11-56

HIGH – 57-100

## Section B: EVALUATION OF CATCHMENT AND RAW WATER SOURCE

| | |
|---|---|
| Name of Catchment | |
| Name of Raw Water Supply Source | |
| Location of the Source | |

**(Mark with a cross where applicable)**

| **What Source of Water Is Used?** | HDW | SW | Deep Well | Spring | River | others |
|---|---|---|---|---|---|---|
| | | | | | | |

| | |
|---|---|
| **Name of caretaker** | |
| **Address** | |
| **GPS Coordinate** | |

| **Is the water source vulnerable to Contamination from the following?** | **Upstream Industries (list)** | **Agricultural/ Livestock farms** | **Sewer systems such as leaking septic tanks, etc.** | **Surface Faecal run-off** | **Recreational use by the community** | **Other (Specify)** |
|---|---|---|---|---|---|---|
| | | | | | | |

| **Indicate which of the source water protection plans exist?** | **Zoning** | **Secure fencing** | **Locked gates** | **Limits on agriculture (e.g. phosphorous, pesticides)** | **Other (Specify)** |
|---|---|---|---|---|---|
| | | | | | |

| | | |
|---|---|---|
| | **Yes** | **No** |