WATER AND WASTEWATER QUALITY MONITORING GUIDELINES FOR WATER SUPPLY AND SANITATION AUTHORITIES

SECOND EDITION

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Water and Wastewater Quality Monitoring Guidelines- 2nd Edition

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ABBREVIATIONS AND ACRONYMS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CBWSOs	Community Based Water Supply Organizations
DAWASA	Dar es Salaam Water and Sewerage Authority
DEWATS	Decentralized Wastewater Treatment Systems
DTWSSA	District and Township Water Supply and Sanitation Authority
EWURA	Energy and Water Utilities Regulatory Authority
FSM	Faecal Sludge Management
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
MoW	Ministry of Water
NEMC	National Environment Management Council
NESC	National Environmental Standards Compendium
NPWSSA	National Project Water Supply and Sanitation Authority
OSS	On-site Sanitation Systems
PDWS	Private Drinking Water Suppliers
pH	Potentiometric Hydrogen ion concentration
RAS	Regional Administrative Secretariat
RWSSAs	Regional Water Supply and Sanitation Authorities
SDGs	Sustainable Development Goals
SSP	Sanitation Safety Planning
TBS	Tanzania Bureau of Standards
TSS	Total Suspended Solids
TZS	Tanzania Standards
UNICEF	United Nations Children`s Fund

VDWS	Vended Drinking Water Suppliers
WHO	World Health Organization
WQL	Water Quality Laboratories
WSP	Wastewater Stabilization Ponds
WSSA	Water Supply and Sanitation Authority
WWQMG	Water and Wastewater Quality Monitoring Guidelines

MEASUREMENT UNITS AND SYMBOLS

cfu/100ml	Colony forming unit per 100 milliliters
mg/L	Milligram per litre
mL	millilitre
TCU	True Colour Units
NTU	Nephelometric Turbidity Unit
MPN	Most Probable Number
Bq/l	Becquerel per litre

FOREWORD

In the year 2014, EWURA published the First Edition of the Water and Wastewater Quality Monitoring Guideline for Water Utilities. The overall objective of the Guidelines was to provide guidance to Water utilities to develop their own water quality monitoring programs for drinking water supply and wastewater effluent. Five years of implementation of the 1st Edition of Water and Wastewater Quality Monitoring Guidelines have passed and a number of changes and challenges have happened. The changes include various reforms in water sector including publication of the revised portable water specification by TBS (TZS 789:2008 to TZS789:2018-EAS12:2018) as well as the enactment of new national laws, regulations and guidelines to govern the water and sanitation sector in the country including the Water Supply and Sanitation Act (2019), the Water Supply and Sanitation Regulations (2019), the National Guidelines on Drinking Water Quality Monitoring and Reporting (2018) and the Guidelines for the Application of Small-Scale, Decentralized Wastewater Treatment Systems - A Code of Practice for Decision Makers (2018).

A review of the 1st Edition of the Guidelines revealed that the following were missing (1) description of the legal and regulatory framework within which WSSAs operate (2) clear procedures for preparation of the case specific Water and Wastewater Quality Monitoring Plans (3) climate change, water safety plans and safely managed sanitation plans and (4) adequate consideration for resources mobilizations to implement the guidelines and WSSAs programmes. Considering the above mentioned changes and gaps, and taking into account comments from WSSAs and other stakeholders on the improvement of the Guidelines, EWURA has prepared a Second Edition of the Guidelines so as to improve clarity and enhance performance improvement in water supply and sanitation services. This 2nd edition of the Guideline provides clarity in some of the sections from the previous edition by providing guidance to WSSAs to prepare their own water and wastewater quality monitoring programmes.

It is my sincere hope that, WSSAs will adhere to these Guidelines to ensure the water and wastewater quality monitoring is carried out effectively. In conclusion, I would like to thank all stakeholders for their valuable contributions in preparing these guidelines. Special thanks goes to the Ministry of Water, Water Supply and Sanitation Authorities (WSSAs), Tanzania Bureau of Standards (TBS) and National Environment Management Council (NEMC) who participated in providing very useful contributions during the field assessment of the existing water and wastewater quality monitoring practices and developing the second edition of the Guideline. I believe your continued cooperation and interaction will grow for the betterment of the sector and the economy at large.

Nzinyangwa E. Mchany

Acting Director General

1. INTRODUCTION

1.1 Background

Provisioning of Water and Sanitation Services by Water Utilities must be regulated to ensure the best and quality services to a consumer. Regulated water and sanitation service is key towards ensuring that the consumers' health is protected and not at a stake. On the other hand, however, the Sustainable Development Goal 6 (SDG6) target 6.1aspires that every person access to safely drinking water sources which entails reliability of water services within walking distance in 24 hours, water that is free from faecal contamination and primary chemical contaminants. Target 6.2 aspires for safely managed sanitation. Ensuring of best and quality water and sanitation services calls for putting in place, structures to regulate water and sanitation services.

In Tanzania, the water supply and sanitation services are regulated by the Energy and Water Utilities Regulatory Authority (EWURA). Powers to regulate the water supply and sanitation service providers emanate from EWURA Act, Cap 414; and Water Supply and Sanitation Act, Cap 272. The functions conferred to EWURA in relation to water supply and sanitation services include, among other things, to monitor water quality and standards of performance for the provision of water supply and sanitation services (The Water Supply and Sanitation Act (Cap 272): Section 29(1) (e)).

1.2 Scope of the Guidelines

This Second Edition of Guidelines covers all the key aspects of water and wastewater quality monitoring including the setting up of water and wastewater quality parameters, number of samples and frequency of sampling, monitoring aspects, both compliance and operation, interpretations and reporting. The guidelines highlight the procedures and methods to be adopted in undertaking the key elements of water and wastewater quality monitoring in the light of the special challenges encountered by WSSAs at local level.

1.3 Rationale for Developing the Guidelines

These Guidelines serve as framework to provide guidance to the WSSAs to monitor water and wastewater quality with a view of ensuring that the water and wastewater services are provided to protect the consumers' health. This will be accomplished by WSSAs by developing and implementing their own quality monitoring programs for water supply and wastewater effluent. The overall objective is to ensure that the WSSAs meet the National Water Quality and Wastewater Discharge Standards for the wellbeing and safety of the people. Specifically, the guidelines are intended to:

(i) Provide guidance to WSSAs in the steps involved in preparation of their own monitoring programmes;
(ii) Provide guidance on how WSSAs should integrate climate risks and issues into monitoring activities (Climate Change Resilient WSSAs);
(iii) Provide guidance to WSSAs in the implementation of Climate Resilience – Water Safety Plans; and
(iv) Provide quick reference for all stakeholders in issues related to water and wastewater quality monitoring activities in the country.

The primary target audience for these guidelines are WSSAs.

1.4 Structure of the Guidelines

The Guidelines are presented in four Chapters thereby building on key confounding elements and reflecting on the key stages of Water and Wastewater Quality Monitoring as follows:

(i) Chapter 1 covers a general introduction highlighting the background, objectives, scope and rationale for the Guidelines;
(ii) Chapter 2 highlights the legal and institutional framework within which the water and wastewater services provisions operates;
(iii) Chapter 3 covers the drinking water quality monitoring procedure which include the planning process, water sampling and analysis, interpretation and reporting;
(iv) Chapter 4 presents the wastewater quality monitoring procedure which also include the planning process, water sampling and analysis, interpretation and reporting; and
(v) The last section of the Guidelines embraces the appendices which basically are the necessary tools to aid the implementation of these Guidelines including checklist, template for preparation of Water Quality Monitoring Plan, limits for key characteristic parameters and reporting templates.

2. LEGAL FRAMEWORK FOR WATER AND WASTEWATER QUALITY

2.1 Overview

The regulation of Water and Wastewater Quality Monitoring will only be effectively and efficiently operated within the given space of enablers. This section of the guidelines presents a highlight of key legal and regulatory provisions to be observed and complied by WSSAs in the course of implementing the water and wastewater quality monitoring programmes.

2.2 National Laws, Regulations and Guidelines

2.2.1 Water Supply and Sanitation Act, 2019

Section 20 (b) of the Act requires WSSAs to secure the continued supply of water for all lawful purposes by continuously treating the water and monitoring the quality of water supplied. Also, Section 29(1)(e) and (f) of the Act requires EWURA to monitor water quality and standards of performance for the provision of water supply and sanitation services; and initiate and conduct investigations in relation to the quality of water and standards of service given to consumers.

2.2.2 Water Supply Regulations, 2019

Regulation 20 of the Water Supply Regulations (2019) requires the water authorities, community organization or any person having the responsibility to provide water supply services, to ensure that the water supplied to consumers meet the prescribed quality standards issued by the Tanzania Bureau of Standards and any other relevant authority. The regulations emphasize that a consumer's service shall not at any time be in such defective condition or laid or fixed in such position in such manner as to cause damage, obstruction to any service, water or pollution of water supplied by the water authority.

2.2.3 National Guidelines on Drinking Water Quality Monitoring and Reporting, 2018

The guidelines are intended for use by implementing agencies with responsibilities associated with the monitoring of drinking water quality. These implementing agencies includes the WSSAs among others. The guidelines emphasize on monitoring water quality at the entire drinking water supply system (i.e. from the source/intake, at the water treatment processes, at the storage facilities, in the distribution system and at the point of use). The guidelines also provide types of parameters and indicators to be monitored at each stage of water supply system.

2.2.4 Guidelines for the Application of Small-Scale, Decentralized Wastewater Treatment Systems, A Code of Practice for Decision Makers, 2018

These guidelines aim to complement the existing regulatory framework on sanitation in Tanzania, in order to foster an enabling environment for scaling up small-scale DEWATS systems through effective dissemination, regulation and law enforcement. The document intends to provide guidance on best practices for DEWATS in Tanzania regarding all phases of a DEWATS project: Planning and design, Implementation, Handover and start-up, Operation and Maintenance (O&M), Management (including M&E). The guidelines were developed for relevant stakeholders such as ministries and local authorities, regulators, professional boards, urban planners, housing developers, public utilities, service providers, construction and consulting companies, and other private sector implementers.

2.2.5 The Standard Act 2009

The Tanzania Bureau of Standards (TBS) is the designated national authority (TBS Act, 2009) for the development and review of standards which include water quality and effluent discharge standards, among others. The water quality standards (TBS- TZS 789) referred in these guidelines is among the compulsory environmental standards which has been developed as part of the TBS' National Environmental Standards Compendium (NESC). As such, while observing the legal and regulatory provisions contained in this document, the implementation and compliance to water quality standards by TBS (TZS 789) stand to be a mandatory requirement for all WSSAs.

2.2.6 The Environmental Management Act, (No. 20), 2004

The Environmental Management Act (EMA) Cap 191, 2004 provides the legal and institutional framework for sustainable management of the environment in implementation of the National Environment Policy. The Act establishes and sets out roles and responsibilities for institutions and bodies for management of environment issues of concern. The National Environment Management Council (NEMC) is established under EMA, Cap. 191 Section 16; to undertake enforcement, compliance, review and monitoring of the environmental wellbeing. WSSAs should work and communicate with NEMC regarding the manner in which their undertakings are in conformity with environmental protection.

2.3 International Guidelines

2.3.1 International Organization for Standardization ISO

ISO has set a number of standards and guidelines related to provision of water and wastewater services. ISO 5667-1:2006 sets out the general principles for, and provides guidance on, the design of sampling programmes and sampling techniques for all aspects of sampling of water (including wastewater, sludge, effluents and bottom deposits).

ISO has also established quality management standards relating to drinking-water supply, including ISO 24510:2007, Activities relating to drinking water and wastewater services—Guidelines for the assessment and for the improvement of the service to users; and ISO 24512:2007, Activities relating to drinking water and wastewater services—Guidelines for the management of drinking water utilities and for the assessment of drinking water services.

2.3.2 APHA Standard Methods for Examination of Water and Wastewater, 2017

This is a global tool of Standard Methods for the Examination of Water and Wastewater since 1905. It is the trusted source of accurate, proven methodology for analyzing natural waters, water supplies, and wastewaters. The latest edition (23rd edition) of Standard Methods for the Examination of Water and Wastewater contains over 400 laboratory methods for the analysis of dissolved solids, metals, free and total chlorine, odor, taste, and flavor profile analysis, disinfection by-products, radionuclides, total organic carbon and total and fecal coli form. The methods are believed to be the best available, generally accepted procedures for analyzing water, wastewater, and related materials. They should be adopted by the WSSAs.

2.3.3 WHO-Guidelines for Drinking-water Quality, 2011

The guidelines emphasize that the most effective safety of drinking water supply is attained through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in the water supply from catchment to consumer. The guidelines propose the establishment of a Water Safety Plan (WSP) which should comprise of a system assessment; effective operational monitoring; management and communication. The guidelines provide the limits for the characteristic parameters for the drinking water quality.

3. MONITORING OF DRINKING WATER QUALITY

3.1 Criteria for setting water quality monitoring parameters

Any WSSA while establishing water quality parameters in its monitoring programme is recommended to consider to the following criteria.

3.1.1 Characteristics and nature of water source

The source of water and thus its geological location will determine the type of water quality parameters to be monitored. Surface and groundwater have varied water quality parameters. WSSAs should explore and understand the localized water quality problems and challenges (both surface and groundwater) in their areas of jurisdictions in order to develop and implement appropriate water quality programme. This should be based on experience of working in respective environment coupled with review of literature (i.e. National Guidelines on Drinking Water Quality Monitoring and Reporting, 2018).

3.1.2 Human Activities

Point and non-point sources of pollution will determine the water quality parameters to be monitored. Domestic, industrial, agricultural and mining activities affect quality of water source differently. Nature of these pollution sources and hence their wastewater characteristics will provide an indication and thus guidance on the type of water quality parameters for monitoring. Table 1 provides examples of parameters to be considered for monitoring for the different types of human activities.

Table 1: Possible parameters of consideration for different types of human activities

Activity	Possible parameters to be considered for monitoring
Domestic undertaking	Turbidity, suspended matter, total dissolved solids, residual chlorine, faecal coliforms or E. *coli*
Agricultural-Farming and Livestock keeping	Fertilizers, Pesticides, Herbicides, insecticides, Organic Manure; Eg. *Phosphates, Nitrogen compounds (Ammonia, Nitrites, Nitrates), BOD, Pesticides, Turbidity, Sediments due to land clearance, Microorganisms (Faecal coliforms),*
Manufacturing Industries	Untreated industrial discharge may contribute to various pollutants depending on the type industrial products. It may include Metals, Heavy Metals, Organic Matter, Nitrates, Oil and Grease, Phenols, Colour, Odour, Microorganisms
Mining	Mercury, Cadmium, Chromium, Lead, Uranium, Zinc and other heavy metals depending on the type mines
Auto-Mechanic Workshops eg Garages and other similar works (Workshops)	Oil and grease, Arsenic, Barium, Cadmium, Chromium, Cobalt, Lead, Dichlorodifluoromethane, Benzene, Trichlorotri fluoreethane, Toluene, 1,1,1-Trichloroethane, Xylene, Trichloroethane, Benz(a)anthracene,

Activity	Possible parameters to be considered for monitoring
	Tetrachloroethane Benzo(a) pyrene, Total Chlorine, Pyrene, Nickel, Naphthalene, Zinc, henanthrene

3.1.3 The type of water treatment

The type and level of water treatment efficiency will help in setting out the water quality parameters for monitoring. Water quality parameters to be considered for monitoring should also be those that the treatment works are specifically designed to remove.

3.1.4 Health and safety importance of water quality parameter

All the parameters that have strong health and safety importance to the water consumers must be selected for monitoring. This is in line with the requirement for safely managed drinking water sources that requires all drinking water sources be free from faecal contamination and priority chemical contaminates (fluoride and now in arsenic in Tanzania)

3.1.5 Legal and water quality standards requirement

The latest TBS potable water specification (TZS 789) recognizes that in many instances the cost of performing a full analysis against parameters set can be prohibitive. Thus parameters required for minimum monitoring are recommended. Appendices 2, 3, 4 and 5 presents the physico-chemical and microbiological parameters requirement for drinking water quality, thus require minimum monitoring. However, WSSAs may require additional tests thereby considering the criteria suggested under section 3.2.1 - 3.2.4 above.

3.2 Types of monitoring

There are two types of monitoring of drinking water quality namely compliance monitoring and operational monitoring as described in the subsequent section.

3.2.1 Compliance monitoring

This type of monitoring is meant to determine whether water supplied comply with the standards. Samples taken for compliance monitoring should be analyzed in accredited laboratories or any other laboratory under the Ministry of Water. There are two categories of compliance monitoring – **check monitoring** and **audit monitoring** as described below.

(i) Check Monitoring

This is carried out relatively frequently for a limited range of parameters. The purpose of check monitoring is regularly to provide information on the organoleptic and microbiological quality of the water supplied for human consumption as well as information on the effectiveness of drinking-water treatment (especially of disinfection) where it is used, in order to determine whether or not water intended for

human consumption complies with the relevant parametric values laid down in the latest standard issued by TBS.

(ii) Audit Monitoring

It is carried less frequently for all the parameters, including those parameters subject to check monitoring. This means that for some parameters the monitoring frequency is the sum of the check and audit monitoring frequencies. The purpose of audit monitoring is to provide the information necessary to determine whether or not all the parametric values specified in the latest standard issued by TBS.

3.2.2 Operational monitoring

The aim of operational monitoring is to check that treatment works and distribution networks are operating effectively to deliver water that meets the standards and to provide early warning that source water quality is deteriorating, a treatment process is failing or there is a problem in the distribution networks. The operational monitoring samples need not be analyzed in accredited laboratories. They may be analyzed in small laboratories/benches at treatment works provided the methods are properly calibrated and subject to analytical quality control

In general a WSSA's operational monitoring programme should consist of the following elements:

(i) Monitoring of the source water for parameters that provide a general indication of water quality, which if their concentration or value changed significantly would indicate that there could be deterioration in source water quality. It should also include any parameters that the treatment works is specifically designed to remove;

(ii) Monitoring of the coagulation, settlement and filtration processes for those parameters that provide evidence of the effectiveness of treatment such as jar tests for optimum coagulation conditions, coagulant residual, ph value and turbidity;

(iii) Monitoring of the disinfection process for those parameters that provide evidence of the effectiveness of disinfection such as chlorine residual, ph value and microbiological parameters;

(iv) Monitoring of the water leaving the treatment works for parameters that the works is designed to remove which are not adequately monitored by the compliance monitoring such as nitrate if nitrate removal is practiced; and

(v) Monitoring within the distribution network for parameters which provide evidence that there is no deterioration or contamination within distribution that are not adequately monitored by the compliance monitoring such as chlorine residual

3.3 Number of Samples and Sampling Frequency

Allocation of sample numbers and sampling frequency to be followed in any drinking (potable) water quality monitoring program should comply with the minimum requirements set by the Tanzania Bureau of Standards TZS 789. Irrespective of the size of the population, all types of water should be tested at least two times per year–once

under dry conditions and once under rainy conditions. Frequency of sampling should be based on:

(i) Size of the population served; and
(ii) Risk of pollution (i.e. distance from and nature of pollution source, nature and extent of sanitary protection of the source).

However, during the rainy season, epidemic and emergences sampling should be carried out more frequently.

The basis for the allocation of sample numbers and the frequency of sampling is based on the existing Tanzania Standard for drinking (potable) Water, TZS 789. Allocation of sample numbers and sampling frequency is based on the total population served as provided in Table 2. Where the sample test results indicates faecal pollution, the water supply in question should be re-examined within a fortnight, at the latest, irrespective of the type of source or population served.

Table 2: Recommended Minimum Sample Numbers and Sampling Frequency in Water Distribution System

Population served (P)	**Frequency * (minimum) of sampling**
P >100 000	10 samples every month per 100 000 of population served
25 001 – 100 000	10 samples every month
10 001 – 25 000	3 samples every month
2 500 – 10 000	2 samples every month
P <2 500	1 sample every month

Source: TBS - Portable Water Specification - TZS 789: 2018-EAC 12: 2018

*During the rainy season, epidemic and emergences sampling should be carried out more frequently.

The frequency of monitoring of each water quality parameter should consider the hazard and risk profile of the parameter as identified through analysis of the water supply system. In general, parameters that pose a high level of risk require more monitoring, while those posing a low risk require less monitoring. Typically, the most frequent monitoring is required for microbial safety, followed by known or identified high priority parameter and those with less frequent monitoring for any parameters that are not likely to present a risk.

Verification through operational monitoring for preventive measures and barriers throughout the water supply system must be carried out with sufficient frequency to promptly reveal any challenges or failures so that corrective actions can be taken. Continuous operational monitoring should be used whenever possible, particularly during essential processes identified as critical control points, such as disinfection and filtration.

Disease outbreaks associated with drinking water supplies are often linked to unusual events. Such events should, therefore, be recognized as potential triggers for more challenges and potential suboptimal performance. These should then alert water managers to the potentiality of the problems and the need for increased monitoring

frequency of performance throughout the system. Unusual events that include any sudden or extreme change in weather, flow or water quality, as well as treatment variations, and maintenance and repairs require an increased monitoring frequency until there is confidence that the quality of water conforms to the required standards.

Frequency of observations may be increased at times of increased risk; for example, inspections of reservoirs for algal blooms may be more frequent during dry season, or folk blanket observations during the coagulation process may be increased when there are higher flow rates through the treatment plant.

Verification through operational monitoring requirements and frequency of monitoring will vary for each water supply, depending on the key characteristic identified through analysis of the water supply system and risk assessment and the parameters required for minimum monitoring.

3.4 Selection of Sampling Sites and Points

Samples must be taken from locations that are representative of the distribution network, points at which water is delivered to the consumer, and points of use. In selecting sampling points, each locality should be considered individually. However, the following general selection criteria are usually applicable to all localities:

(i) Representative of each different water source entering the system;
(ii) Representative of conditions within the system, such as dead ends, loops, storage facilities and pressure zones;
(iii) Sampling points should be evenly distributed throughout the pipes distribution system, taking population distribution into account and the number of sampling points should be proportional to the number of links or branches; and
(iv) The sampling points chosen should generally yield samples that are representative of the system as a whole and of its main components.

Identification of the sampling points within the distribution system should be carried out by the Water Utility; and should be included in the monitoring programs that will be reviewed by EWURA. However, general guidelines for selection are the following (*Adopted from Handbook for Sampling and Sample Preservation of Water and Wastewater – (EPA – 600/4-82-029))*:

(i) Distribute the Sampling points uniformly throughout the system;
(ii) Locate the sample points in both types of distribution system configurations which are loops and branches and also in proportion to the relative number of loops and branches;
(iii) Locate adequate representative sample points within each zone if there is more than one pressure zone;
(iv) Locate points so that water coming from storage tanks can be sampled, and sample during time of high-demand;

(v) For systems having more than one water source, locate the sample points in relative proportion to the number of people served by each source; and
(vi) Check pressures during the proposed sampling times so that the source of sampled water can be determined. It is possible that excessive demand in one part of the distribution system can cause water to be brought into that area from other parts of the system and perhaps other sources.

Selection of sampling Site and point is very much dependent on the type of water supply distribution network. There are basically four types of water supply distribution network, namely:

(i) Distribution system Type 1: one/multiple inlet to distribution system;
(ii) Distribution system Type 2: branch distribution system;
(iii) Distribution system Type 3: loop distribution system; and
(iv) Distribution system Type 4: combined branch and loop systems.

The narrative below provides the detailed accounts of these different types of distribution network systems with their corresponding sampling sites and points selection.

3.4.1 Distribution System Type 1a: One Inlet to Distribution System

Figure 1 demonstrates one inlet to distribution system whereby, in this case the clear water tank outlet enters the distribution system at one point. One sampling location is needed to determine the quality of water entering the distribution system.

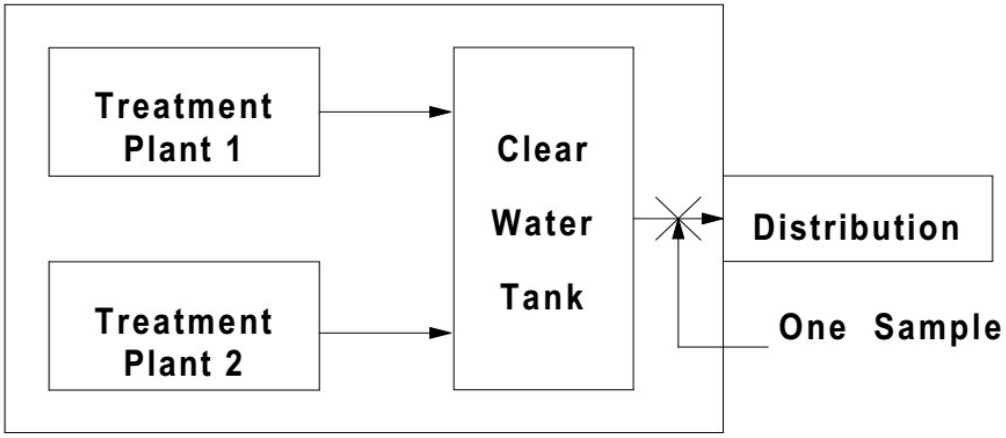

Figure1: One Source Entering Distribution

3.5.2 Distribution System Type 1b: Multiple inlets to Distribution System

Figure 2 demonstrates multiple inlets to distribution system whereby in this case water enters the distribution system through two clear water tanks. Multiple sampling locations are needed to determine the quality of water entering the distribution systems as marked in Figure 2.

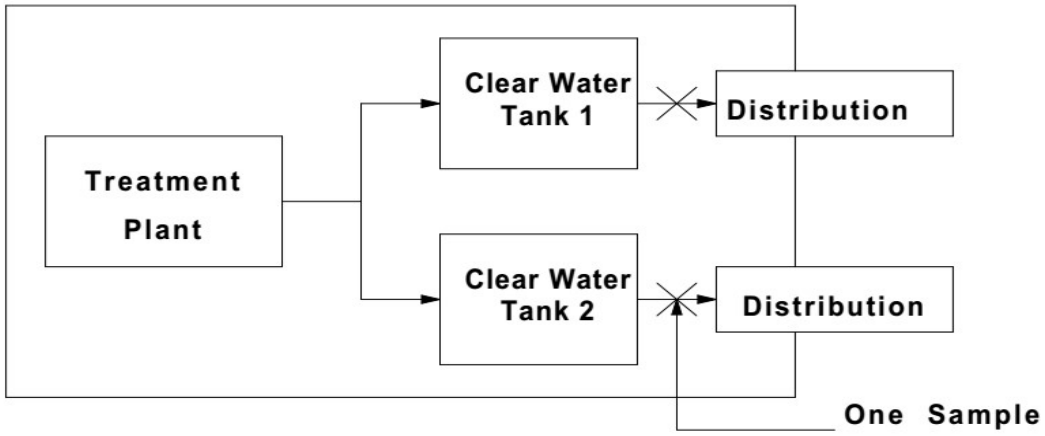

Figure 2: Water from One treatment plant entering two clear water tanks

3.5.3 Distribution System Type 2: Branch Distribution System

Figure 3 demonstrates determination of representative sampling locations in a branch, dead-end or tree distribution system. Sampling location A is for the entry into the distribution, location B representative of the water in the main line, location C is representative of water in the main dead end, and location D and E are representative of the water in the branch and branch dead end, respectively.

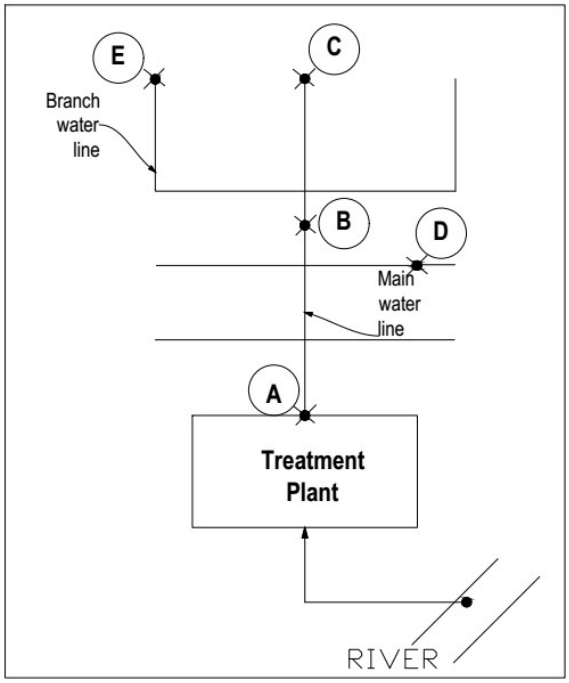

Figure 3: Branch Distribution System

3.5.4 Distribution System Type 3: Loop Distribution System

Figure 4 demonstrates sampling locations for a Loop distribution system. Sampling location A represents water entering into the distribution whereas locations D and B

represent water in the main line loop and location C represents water in one of the branch line loops.

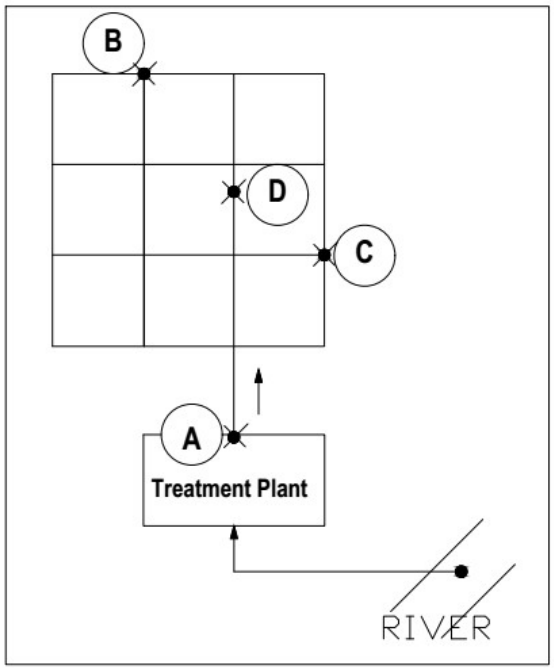

Figure 4: Loop Distribution System

3.5.5 Distribution System Type 4: Combined Branch and Loop Systems

Table 3 shows the evaluation of sampling locations (Figure 5) for a water distribution system consisting of a combined Branch and Loop system. A demonstration of an evaluation for designating sampling locations is shown on Table 3.

Table 3: Evaluation of Sampling Locations

Sampling Location	Evaluation of Sampling Points
A	Unacceptable for compliance monitoring. Location not on the distribution system nor at its entry. Location to be maintained for operational monitoring only
B	Acceptable. Location on main loop in high-pressure zone; should produce representative samples for that part of the system
C	Acceptable. Location on branch loop in the high-pressure zone; serves for water flow from the storage to the system.
D	Judgmental. Many authorities advise against dead end sampling points as they do not produce representative samples. Possibly true; however, consumers do take water from branch-line dead ends. In this example there are seven branch-line dead ends, no doubt serving significant number of customers. It would be representative to have one or two sample points on these branch-lines at or near the end.
E	Acceptable. Located on the main loop of low pressure zone and representing water from treatment plant No. 2, the well, the storage tanks at F, or any combination (depending on system demand at sampling time)

Sampling Location	Evaluation of Sampling Points
F	Judgmental. Although important to sample water quality entering the water distribution system from storage, it is better to collect the sample at junction of stored water line and main loop (point F), unless consumers are served directly from storage branch.
G	Judgmental. Only one dead end need be sampled in low-pressure system. If D is selected, G not needed.

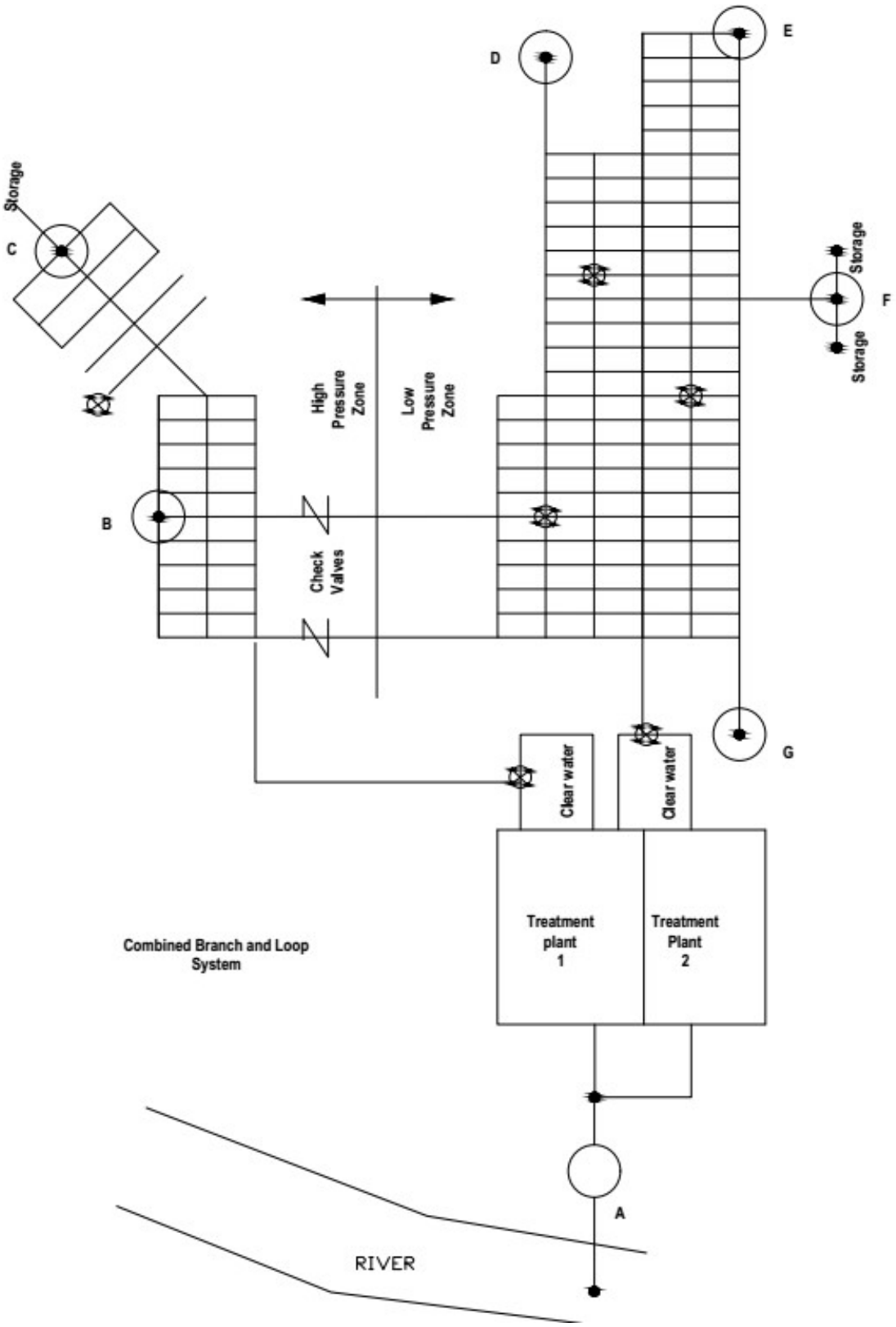

Figure 5: Combined Branch and Loop System

3.5 Preparation of Water Safety Plans - Resilient To Climate Change for Water Supply and Sanitation Authorities

Climate Change would possibly result to prolonged rainfall and thereby causing flood or otherwise lack of rainfall and higher temperatures leading to serious drought. The major water quality related issues that may impact heavily on community health include:

(i) Increased concentration of pollutants when conditions are drier. This is of particular concern for groundwater sources that are already of low quality in areas where concentrations of arsenic, iron, manganese, and fluorides are often problems.

(ii) Increased storm runoff can increase loading of pathogens, nutrients, and suspended sediment.

(iii) Sea level rise that increases the salinity of coastal aquifers, in particular where groundwater recharge is also expected to decrease.

(iv) Algal blooms and increased risks from cyanotoxins and natural organic matter in water sources as a result of higher water temperature, requiring additional or new treatment of drinking-water.

In view of the above mentioned climate issues, the WSSAs must factor in the requirement of Water Safety Plans (WSP) in the Water Quality Monitoring Programme. The WSP should be developed and implement to consistently ensure the safety of a drinking-water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer. Figure 6 and Appendix 9 illustrate and elaborate the key action points of consideration in the preparation and implementation of the WSP.

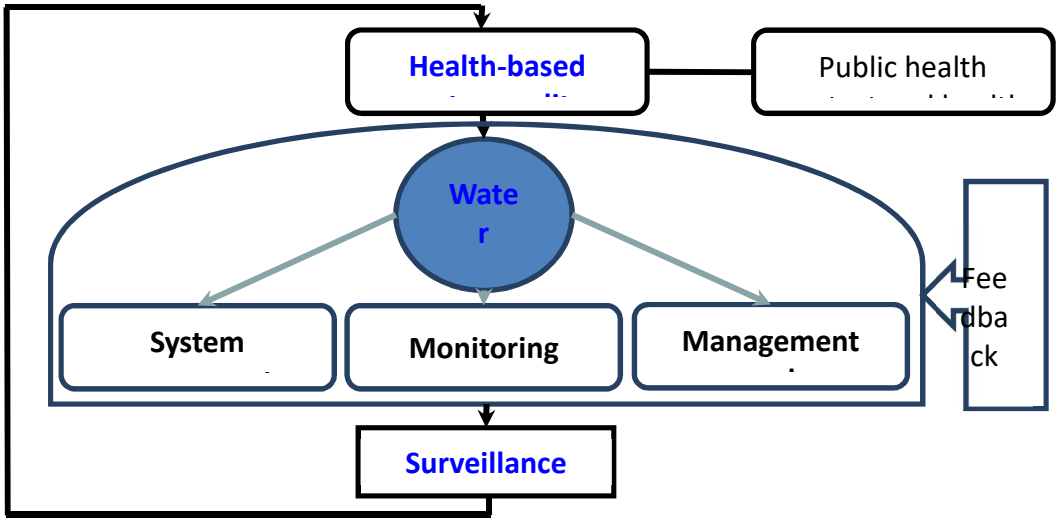

Figure 6: Safe Water chain framework

Source: Adapted from WHO Drinking Water Quality Guidelines 4th edition, 2011

Table 4: Frequency of operational monitoring of the water supply system, critical limits and possib actions

Where	Climatic event	What	When	Who	Critical limits	How (methods of monitoring)	Corrective a surpassed
Source (intake chamber)	Flood/ severe drought	Turbidity	Seasonally	Technician	Less than 1000 NTU	Conduct Visual observation and Water quality test	Divert flood suspend raw turbidity dro
	Floods	Fence around intake	Weekly	Technician	Intact and gate secured	Conduct Visual observation /inspection	Repair comp secure gate
Clear water tank (outlet)	Flood/ severe drought	PH	Weekly	Technician	pH: 6.5-8.5	Conduct Water quality test	Investigate c
	Flood/ severe drought	Turbidity	Weekly	Technician	<5 NTU	Conduct Visual observation and Water quality test	Confirm w performance breaks in pip
	Flood/ severe drought	Chlorine	Weekly	Technician	Cl_2: 0.6-0.8mg/L	Conduct Water quality test	Check and needed
Distribution network	Floods	Leakage and vandalism	Daily/ad-hoc	Technician	Fault connection, breakage and exposure to run off and damage	System observation / inspection	Maintenance distribution n
Consumer tap (5 taps each time)	Floods	pH	Weekly	Technician	pH: 6.5-8.5	Conduct Water quality test	Investigate c
	Floods	Turbidity	Weekly	Technician	<5 NTU	Conduct Visual observation and Water quality test	Confirm w performance breaks in pip
	Floods	Chlorine	Weekly	Technician	Cl_2: 0.2-0.5mg/L	Conduct Water quality test	Check and needed

Source: Adapted from WHO Water Safety Plan Manual (WHO 2009)

4. MONITORING OF WASTEWATER QUALITY

Wastewater quality monitoring will have to be undertaken to meet the following objectives:

(i) Operational reasons - to understand the effectiveness of the plant performance;
(ii) Compliance - Receiving environment river, sea, reused; and
(iii) Health – discharging/ irrigating.

The wastewater effluent quality discharges should comply with the latest Tanzania Standard, TZS 860:2006, Limits for Municipal and Industrial Wastewaters. The purpose of the standard is to indicate the quality of effluents permitted to be discharged into water bodies. The use thereof is meant to promote a consistent approach towards prevention of water pollution in Tanzania. The standard prescribes the permissible limits for municipal and industrial effluents discharged directly into water bodies (i.e. receiving water bodies).

This guideline serves to assist the WSSAs to:

(i) Determine the effluent quality as it is released into the environment;
(ii) Check on the operational efficiency of the wastewater treatment system; and
(iii) Monitor industrial effluent in their service areas.

4.1 Type of Monitoring

The types of monitoring for wastewater quality monitoring are the same as those for water quality monitoring which include Check and Audit Monitoring.

4.1.1 Check Monitoring

The selection of parameters that constitute the Check Monitoring is to be made on the basis of the latest TZS 860. The parameters proposed for regular Check Monitoring by the WSSAs includes:

(i) Ammonium;
(ii) Biological Oxygen Demand (BOD);
(iii) Chemical Oxygen Demand (COD);
(iv) Color;
(v) Faecal Coliform;
(vi) Nitrate;
(vii) pH;
(viii) Phosphorus;
(ix) Total Coliform; and
(x) Total Suspended Solids (TSS).

The above list of parameters are subjected to regular monitoring could be expanded to take into account the nature of quality of wastewater collected from industrial, commercial and residential establishments by the sewerage network or brought to the wastewater treatment plants by wastewater tankers. Chemical parameters could be added to the list for Check Monitoring in consultation with EWURA and NEMC.

4.1.2 Audit Monitoring

The Audit Monitoring is to provide information necessary to determine whether or not all the parametric values specified in the latest TZS 860. The selection of parameters that constitute the Audit Monitoring is to be made on the basis of the latest TZS 860. All such parameters must be subjected to audit monitoring unless it can be established that the nature of wastewater coming from the sewerage area are not expected to contain some of the parameters to be excluded.

4.2 Procedure for establishing number of samples, sampling frequency and sampling points

4.2.1 Sampling Locations and Sampling Frequency

Since the effluent standards apply to municipal and industrial effluents discharged directly into water bodies, it implies that sampling locations should be points at which the effluent leaves the wastewater treatment plants just before it enters the receiving water bodies. However, since the TZS 860 is silent on the frequency of sampling from the wastewater treatment facilities, this Guideline proposes that sampling frequency should be at least twice in a month for Check Monitoring and at least twice in year for Audit Monitoring. However, considerations for sampling frequency must be done with the intention to ensure that the effluent discharged to the receiving bodies comply with the standards.

4.2.2 Sampling and Test Methods

Monitoring should be done by sampling in accordance with latest TBS specified sampling methods or ISO standard or any other International Standard.

4.3 Preparation of Safely Managed Sanitation Plans - Resilient to Climate Change for Water Supply Utilities

4.3.1 Overview

The underlying purpose of sanitation interventions is to protect public health. Management and investments in improvements on sanitation systems should be made based on adequate understanding of the actual health risks posed by the systems and how these risks might best be controlled.

Sanitation Safety Planning (SSP) is a risk based management tool for sanitation systems. The SSP manual provides practical step-by-step guidance to assist in the implementation of the safely managed sanitation. However, the approach and tools in the manual can be applied to all sanitary systems to ensure the system is managed to meet health objectives.

The SSP guideline is targeted at a variety of users at different levels:

(i) Local authorities (e.g. as a tool for planning investment in sanitation especially in low resource settings);

(ii) Wastewater utility managers (e.g. to assist in managing effluent quality and safeguarding public and occupational health from source to end use or disposal);
(iii) Sanitation enterprises and farmers (e.g. to complement quality assurance procedures for safety of end products, workers, local communities, and consumers or users of the product); and
(iv) Community based organizations, farmers associations and NGOs (e.g. to support community based water and sanitation programs in safe use of human wastes).

In addition to its site specific use related to a particular SSP process, SSP is also useful for those working at a national level, including:

(i) Health authorities and regulators (e.g. as a tool to introduce risk based approaches in the sanitation sector, and verify their effectiveness); and
(ii) Those guiding the development of policies and programmes to improve the sanitation management.

The SSP manual assists users to:

(i) Systematically identify and manage health risk along the sanitation chain;
(ii) Guide investment based on actual risks, to promote health benefits and minimize adverse health impacts; and
(iii) Provide assurance to authorities and the public on the safety of sanitation-related products and services.

The WSSAs must factor in the requirement of Sanitation Safety Plans (SSP) in the Wastewater Quality Monitoring Programme.

4.3.2 Sanitation Safety Planning Steps

These guidelines present the SSP process in six steps.

Figure 7: Sanitation Safety Planning modules.
Source: WHO, 2015

Step 1: Prepare for Sanitation Safety Planning
Preparing for the SSP process requires clarity on the priority area, the specific public health objectives of the SSP and the components in the sanitation chain that need to be included to meet the objectives. Additionally, a lead organization and team need to be identified. These should represent the various steps of the sanitation system.

Step 2: Describe the Sanitation System
The main objective of step 2 is to generate a complete description of the sanitation system within the boundary identified in Step 1. A thorough understanding of all parts the sanitation system and its performance requirements supports the subsequent risk assessment process.

Step 3: Identify Hazardous Events, Assess Existing Control Measures and Exposure Risks
An underlying purpose of all sanitation systems is to protect public health. Step 3 ensures that subsequent efforts and investments in system monitoring and improvements respond to highest health risks first.

Step 4: Develop and Implement an Incremental Improvement Plan
In Module 3, the SSP team identified the highest priority risks. Step 4 allows flexibility in selecting new control measures or other improvements that address these risks at the most effective places in the system. This process helps to ensure that funding and effort targets the highest risks with greatest urgency.

Step 5: Monitoring Control Measures and Verify Performance
Sanitation systems are dynamic. Even the most well designed systems can under-perform and result in unacceptable public health risk and loss of confidence in the service or products. Step 5 develops a monitoring plan that regularly checks that the system is operating as intended and defines what to do if it is not. Operational and verification monitoring provide assurances to the operators, the public and the authorities of adequate system performance.

Step 6: Develop Supporting Programmes and Review Plans
Step 6 supports the development of people's skills and knowledge, and an organization's ability and capacity to meet SSP commitments. Existing programmes (e.g. training) may be reconsidered in light of the extent to which they support the SSP objectives.

5. PREPARATION AND PERIODIC REVIEW OF WATER AND WASTEWATER QUALITY MONITORING PROGRAMME

The preparation and implementation of water and wastewater quality monitoring programme should be in-line with WSSAs` business plan. However, changes and reforms in the water sector; and emergence of new technologies (methods, approaches and tools) for water and wastewater quality analysis may prompt earlier review of the programme.

All WSSAs must elaborate an annual monitoring program, calculate the costs and include it in the yearly budget. A sampling schedule for all networks is part of the monitoring program. Sampling schedules indicates when and where sampling has to be done and which parameters will be tested. This is an important aspect of planning for water quality monitoring programme and must be given high priority.

The sampling schedule will be done for operational and compliance monitoring and should include all the established sampling points. However, the reactive sampling in response to queries or other problems occurring will have to be done additionally and cannot be counted as scheduled sample thereby reducing the number of remaining samples required. At the end of the financial year an assessment of the planned schedule will have to be done versus what has been implemented.

6. COST ESTIMATES FOR WATER AND WASTEWATER QUALITY MONITORING

WSSAs shall ensure that all costs associated with water and wastewater quality monitoring are included in their business plan and annual budgets. The costs will cover the following items:

(i) Administration, including design and revision of monitoring network;
(ii) Capital costs of sampling, equipment, transport facilities, data processing (hardware and software) including wear and tear factors;
(iii) Labor and associated operating costs of sampling, in-situ measurement; laboratory analysis and data storage and processing; and
(iv) Programme Monitoring, Evaluation and reporting.

7. DOCUMENTATION AND REPORTING

Depending on the type of monitoring, the WSSAs are required to report the status of water quality to EWURA as prescribed on Table 5. The WSSAs should also incorporate the water quality monitoring report in their annual reports. The format of reporting is shown in Appendix 11. The reporting by the WSSAs should be accompanied by a good layout of a water distribution system diagram showing and naming designated sampling locations.

Table 5: Frequency of Reporting and Content of Report for the Drinking Water

Type of Monitoring	**Frequency of Reporting**
Check Monitoring	Monthly through MajIs and annually as part of WSSAs annual report
Audit Monitoring	Annually as part of WSSAs annual report

In case an occasional water quality monitoring detects faults of non-compliance of a parameter with respect to parametric standard value or a risk of such non-compliance is in premises where water is supplied for human consumption the water utility shall ensure that:

(i) Appropriate measures are taken to reduce or eliminate the risk of non-compliance with the parametric value, including advising premises' owners affected of any possible remedial action which could be taken by them; or

(ii) Other measures are taken, such as application of appropriate treatment techniques, to change the nature or properties of the water before it is supplied so as to reduce or eliminate the risk of the water not complying with the parametric value after supply, and the consumers concerned are duly informed and advised of any possible additional remedial action that should be taken by them

EWURA or its delegated agency will also conduct water quality monitoring as an external auditor. The results of water and wastewater quality monitoring conducted by WSSAs and EWURA will be included in the annual water utilities performance review report which is published by EWURA. The Annual Performance Review Reports are usually made available to consumers and other stakeholders.

8. APPROVAL AND RESPONSIBILITY

The Board of Directors of WSSAs shall approve the water and wastewater quality monitoring programme. Prior to its approval, the programme shall first be discussed and endorsed by the Board of Directors of WSSAs and then be submitted to EWURA for review and providing recommendations. The Board of Directors of the WSSAs have the ultimate responsibility to ensure implementation of the monitoring programme.

APPENDICES

Appendix 1: Presentation Layout for WSSAs Water and Wastewater Quality Monitoring Programme

Cover Page • Name and Logo of the WSSA • Title of the Programme: Water and Wastewater Quality Monitoring Programme • Contact details of the WSSA (physical address, postal address, telephone and mobile and email address) • Month and year of approval of the programme		
Table of Content		
List of Tables		
List of Figures		
Abbreviations and Acronyms		
1	**Introduction**	
	1.1	General Background (WSSA Profile)
	1.2	Objectives of the Programme
	1.3	Water Sources
	1.4	Water treatment and Storage facilities
	1.5	Human (Economic) Activities at the service area
2	**Water Safety Plans**	
	2.1 Water Quality Monitoring	
	2.1.1	Water Quality Parameters Selection o Parameters for Check Monitoring o Parameters for Audit Monitoring
	2.1.2	Sampling and Sample Analysis ✓ Sampling ▪ Number of sample and Sampling frequency ▪ Location of sampling points (including layout) Fixed and Random (variable) sampling points ▪ Sampling methods ▪ Handling, Preservation and Storage of samples ✓ Analysis of Samples ▪ Bacteriological analysis ▪ Physicochemical analysis ▪ Aesthetic Analysis
	2.1.3	Data Analysis, Interpretation and Reporting

3	**Safely Managed Sanitation Plans**	
	3.1 Wastewater Quality Monitoring Programme	
	3.1.1	Planning for wastewater quality programme o Plans for Check Monitoring o Plans for Audit Monitoring
	3.1.2	Wastewater Sampling and Analysis ✓ Sampling ▪ Location of sampling points (including layout) ▪ Sampling frequency ▪ Sampling methods ▪ Handling, Preservation and Storage of samples ✓ Analysis of Samples ▪ Bacteriological analysis ▪ Physicochemical analysis
	3.1.3	Data Analysis, Interpretation and Reporting
4	**Plans for Implementation of Water and Wastewater Quality Monitoring Programme**	
	4.1	Budget (Resources Mobilizations) for Water Quality Monitoring (a) Water Quality Test Laboratories (b) Equipment and instruments (c) Transport Services (d) Staffing (e) Human Resources Development and Training (f) Communication Strategy
	4.2	Funding of Water and Wastewater Quality Monitoring Programme
9. Programme Monitoring and Reporting		
Appendices		
Appendix 1: Summary of Water Quality Distribution System Performance Report (see Appendix 8-A of this guideline)		
Appendix 2. Sampling Schedule Network(s) (see Appendix 8-B of this guideline)		
Appendix 3. Designated Sampling Locations (see Appendix 8-C of this guideline)		

Appendix 2: Physico-Chemical Requirements for Potable Water

S/N	Characteristic	Treated potable water	Natural potable water	Method of test
i)	Colour (TCU[a] max)	15	50	ISO 7887
ii)	[1]Turbidity (NTU max)	5	25	ISO 7027
iii)	pH	6.5 – 8.5	5.5-9.5	ISO 10523
iv)	Conductivity	1500	2500	ISO 7888
	(µS/cm)max			
v)	Suspended matter	Not detectable	Not detectable	ISO 11923
Vi)	Total dissolved solids, mg/l	1000	1500	ASTM D 5907-13
vii)	Total hardness, as CaCO3,	300	600	ISO 6059
viii)	Aluminum, as Al^{+++},	0.2	0.2	ISO 12020
ix)	Chloride, as Cl^-	250	250	ISO 9297
x)	Total Iron as Fe	0.3	0.3	ISO 6332
xi)	Sodium, as Na^+	200	200	ISO 9964
xii)	Sulphate SO4	400	400	ISO 22743
xiii)	Zinc, as Zn^{++}	5	5	ISO 8288
xiv)	Magnesium, as Mg^{++}	100	100	ISO 7980
xv)	Calcium, as Ca^{++}	150	150	ISO 7980
xvi)	Potassium(K), mg/l, max	50	50	ISO 9964
a) True colour units (TCU) mean 15 hazen units after filtration.				

Source: TBS - Portable Water Specification - TZS 789

Appendix 3: Limits for inorganic contaminants in treated and natural portable water

Sl. No.	Substance	Treated water limit of concentration mg/L, max.	Natural potable water	Method of test
i)	Arsenic, as As	0.01	0.01	ISO 11969
ii)	Cadmium, as Cd	0.003	0.003	ISO 5961
iii)	Lead, as Pb	0.01	0.01	ISO 8288
iv)	Copper, as Cu	1.000	1.000	ISO 8288
v)	Mercury (total as Hg)	0.001	0.001	ISO 12846
vi)	Manganese, as Mn	0.1	0.1	ISO 6333
vii)	Selenium, as Se	0.01	0.01	ISO 9965
viii)	Ammonia (NH3)	0.5	0.5	ISO 11732
ix)	Chromium Total, as Cr	0.05	0.05	ISO 9174
x)	Nickel, as Ni	0.02	0.02	ISO 8288
xi)	Cyanide, as CN	0.01	0.01	ISO 6703
xii)	Barium, as Ba	0.7	0.7	ISO 14911
xiii)	Nitrate as $NO3^-$	45	45	ISO 7890

[1]For the case of turbidity monitoring in portable water, the systems should be flushed before taking samples

xiv)	Boron, as Boric acid	2.4	2.4	ISO 9390
xv)	Fluoride, as F	1.5	1.5	ISO 10359
xvi)	Bromate, as $BrO3^-$	0.01	0.01	ISO 15061
xvii)	Nitrite	0.003	0.003	ISO 6777
xviii)	Molybdenum	0.07	0.07	ISO 11885
xix)	Phosphates, as $PO4^{3-}$	2.2	2.2	ISO 15681
xx)	Free residue Chlorine	0.2-0.5 [a]	Absent	ISO 7393
	Uranium	0.03	0.03	ASTM D 6239-9

[a] Under conditions of epidemic diseases, it may be necessary to increase the residual chlorine temporarily

Source: TBS - Portable Water Specification - TZS 789

Appendix 4: Limits for organic contaminants in treated and natural potable water

Sl. No.	Substance	Limit µg/L max.	Method of Test
i)	**Aromatics**		-
	Benzene	10	ISO 11423
	Toluene	700	
	Xylene	500	
	Polynuclear aromatic hydrocarbon	0.7	ISO 28540
ii)	**Chlorinated Alkanes and Alkenes**		
	Carbon tetrachloride	2	
	1,2-Dichloroethane	30	
	1,1-Dichloroethylene	0.3	ISO 10301
	1,1-Dichloroethene	30	
	Tetrachloroethene	40	
iii)	**Phenolic substances**		
	Phenols	2	ISO 8165
	2,4,6-Trichlorophenol	200	ISO 14402
iv)	**Trihalomethanes**		
	Chloroform	30	ASTM D 3871-84
v)	**Pesticides**		
	Aldrin/Dieldrin	0.03	
	Chlordane (total)	0.3	
	2,4- Dichlorophenoxyacetic acid	30	
	DDT (total)	1	
	Heptachlor and Heptachlor Epoxide	0.03	
	Hexachlorobenzene	1	
	Lindane BHC	2	
	Methoxychlor	20	"ISO 15089
vi)	Surfactants (reacting with methylene Blue)	200	ISO 16265
vii)	Organic matter	3	ISO 8245

Source: TBS - Portable Water Specification - TZS 789

Appendix 5: Microbiological limits for potable water

Sl. No.	Type of micro-organism	Potable water	Method of test
i)	Total viable counts at 22 °C,in mL, max. [a)]	100	ISO 6222
	Total viable counts at 37 °C, in mL, max. [a)]	50	ISO 6222
ii)	Total Coliforms [b)] in 100 mL	Absent	ISO 9308-1 ISO 9308-2
iii)	*E. coli* [b)]in 100 mL	Absent	ISO 9308-1 ISO 9308-2
iv)	*Staphylococcus aureus* in100 mL	Absent	ISO 6888-1
v)	Sulphite reducing anaerobes in100 mL	Absent	ISO 6461-2
vi)	*Pseudomonas aeruginos*afluorescence in 100 mL	Absent	ISO 16266
vii)	*Streptococcus faecalis* in 100mL	Absent	ISO 7899-2
viii)	*Shigella* in 100 mL	absent	ISO 21567
ix)	*Salmonella* in 100 mL	Absent	ISO 6785
x)	*Giardia, per 100 ml*	Absent	ISO 15553
xi)	*Cryptosporidium per 100 ml*	absent	ISO 15553

[a] This parameter is for monitoring the system at source. Total time before analysis should be not more than 6 h at 4 °C. Determination of total viable counts shall start within 12 h after collection of the potable water sample.

[b] During the bacteriological quality

Source: TBS - Portable Water Specification - TZS 789

Appendix 6: Limits for radioactive materials in treated and natural potable water

Sl. No.	Radioactive material	Limits in Bq/L	Method of test
i)	Gross alpha activity	0.5	ISO 9696
ii)	Gross beta activity	1	ISO 9697

Source: TBS - Portable Water Specification - TZS 789

Appendix 7: Bacteriological quality requirements for different types of water supplies

Type of supply	Number per 100 ml		Methods of test
Treated water entering the distribution system	E. coli	Absent	ISO 9308-1 ISO 9308-2
	Coliform organisms	Absent	
Untreated water entering the distribution system	E. coli	Absent	
		3 coliform organisms in any one sample	
		Absent in any two consecutive samples	
		Absent in 98 % of yearly samples	

Water in distribution system	E. coli	Absent	
		3 coliform organisms in any one sample	
		Absent in any two consecutive samples	
		Absent in 95 % of yearly samples	
Unpiped supplies	E. coli	Absent	
	Coliform organisms	10	
Emergency supplies of water	E. coli	Absent	
	Coliform organisms	Absent	

Source: TBS - Portable Water Specification - TZS 789

Appendix 8: Check and Audit Monitoring Reporting for Water Quality

A: Summary of Water Quality Distribution System Performance Report (applies for Check and Audit Monitoring)

Sample Location	Test Parameter	Population Served	Frequency (Number of samples per year)	Required number of samples as per TBS Standards	Number of tests conducted in a quarter of a year	Number of tests in compliance with Tanzania standard limit	Cause of non-compliance	Mitigation/corrective actions taken (indicate time frame to completion)	Minimum and Maximum Values	Test Methods	Remarks
	Parameter 1										
	Parameter 2										
	Parameter 3										
	Etc.										

B: Sampling Schedule Network No…… (Applies for Check Monitoring Only)

	Type of water distribution system					
	One Source Entering distribution system	**Water from one Treatment Plant entering two clear water tanks**	**Branch Distribution system,**	**Loop Distribution system**	**Combined Branch and Loop System**	**Others Describe**
Describe/Tick the applicable drinking water system						

C: Designated Sampling Location: Monthly Sampling Schedule for Water Quality (Applies for Check Monitoring Only)

Sample Location	Month and Year	Month of ……, Year ……																												
	Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Parameter 1																															
	Parameter 2																															
	Parameter 3																															
	Etc.																															

It is mandatory for the WSSAs to provide these data and information as appendices to their reports

Appendix 9: Water Safety Plans

A.1 Drinking water systems operators should develop, implement and maintain a water safety plan taking into consideration the potential risks to the safety of the water from the supply catchment area to the consumer.

A.2A water safety plan should consist of three key components:

a) System assessment to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets;

b) Identifying control measures in a drinking water system that will collectively control identified risks and ensure that the health-based targets are met; and

c) Management plans describing actions to be taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

A.3A water safety plan should include:

a) Measures to protect the source of drinking water from risks of pollution;

b) Measures to ensure all installations intended for the production of drinking water exclude any possibility of contamination. For this purpose and in particular: the installation for collection, the pipes and the reservoirs should be made from materials suited to the water and in such a way as to prevent the introduction of foreign substances in water; the equipment and its use for production should meet hygienic requirements;

c) Measures to ensure an appropriate treatment such as pre-treatment processes, coagulation, flocculation, sedimentation, filtration and disinfection are undertaken to assure the safety of water for the consumers;

d) Appropriate operational monitoring system including monitoring parameters that can be measured and for which limits have been set to define the operational effectiveness of the activity; frequency of monitoring and procedures for corrective action that can be implemented in response to deviation from limits. If, during production it is found that the water is polluted, the producer shall stop all operations until the cause of pollution is eliminated; and a verification plan to ensure that individual components of a drinking-water system, and system as a whole is operating safely.

Appendix 10: Check and Audit Monitoring Reporting for Wastewater Quality

A: Summary of Wastewater Quality Performance Report (applies for Check and Audit Monitoring)

Sample Location	Test Parameter	Population Served	Frequency (Number of samples per year	Required number of samples as per TBS Standards	Number of tests conducted in a quarter of a year	Number of tests in compliance with Tanzania standard limit	Cause of non-compliance	Mitigation/corrective actions taken (indicate time frame to completion)	Minimum and Maximum Values	Test Methods	Remarks
	Parameter 1										
	Parameter 2										
	Parameter 3										
	Etc.										

B: Designated Sampling Location: Monthly Sampling Schedule for Wastewater Quality (Applies for Check Monitoring Only)

Sample Location	Month and Year	Month of ……, Year ……																												
	Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Parameter 1																															
	Parameter 2																															
	Parameter 3																															
	Etc.																															

It is mandatory for the WSSAs to provide these data and information as appendices to their reports

Appendix 11: Reporting Format for Water and Wastewater Quality Monitoring

A: The Cover page should have the following information:

(i) Name of the WSSA (Including Logo)
(ii) Contact details of the WSSA (physical address, postal address, telephone and mobile and email address)
(iii) Title of the report
(iv) Reporting period
(v) Date of submission.

A: The quality monitoring report shall contain the following information:

(i) Executive summary;
(ii) Acknowledgement;
(iii) Acronyms;
(iv) Introduction (covering the general background, objective of water and wastewater quality monitoring, scope of the quality monitoring and report structure;
(v) Approach and Methodology (consisting of the sampling plan, methods adopted, onsite measurements methods, laboratory analysis methods and reports preparation methods).
(vi) Quality Monitoring Findings. Should be a summary of monitoring findings for the physical, chemical (inorganic and organic) and microbiological characteristic parameters against parametric standard values and regulatory requirements.
(vii) A summary explanation highlighting the problem areas (noncompliance) and the corrective measures taken by the WSSA.
(viii) Interpretation of the monitoring findings. Should include tables and figures as well as a comparison between check and audit monitoring.
(ix) Potential incidences that will or are likely to adversely affect water and wastewater effluent quality.
(x) Conclusion and recommendations.
(xi) References.
(xii) Appendices.

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