THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF WATER

NATIONAL GUIDELINES ON DRINKING WATER QUALITY MONITORING AND REPORTING

SECOND EDITION

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AAS	Atomic Absorption Spectrometry
APHA	American Public Health Association
BOD	Biochemical Oxygen Demand
BWBs	Basin Water Boards
CBWSOs	Community-Based Water Supply Organizations
COD	Chemical Oxygen Demand
CR-WSP	Climate-Resilient Water Safety Plan
DPD	N, N-diethyl-p-phenylenediamine (Chlorine Test Method)
EC	Electrical Conductivity
E. coli	*Escherichia coli*
EDTA	Ethylenediaminetetraacetic Acid
EPA	Environmental Protection Agency
EWURA	Energy and Water Utilities Regulatory Authority
FCR	Free Chlorine Residual
GC-MS	Gas Chromatography–Mass Spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
HACCP	Hazard Analysis and Critical Control Point
HWTS	Household Water Treatment and Safe Storage
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
IEC	International Electrotechnical Commission
ILC	Inter-Laboratory Comparison
ISO	International Organization for Standardization
LC-MS	Liquid Chromatography–Mass Spectrometry
LGAs	Local Government Authorities
LIMS	Laboratory Information Management System
MoF	Ministry of Finance
MoH	Ministry of Health
MoW	Ministry of Water
NAWAPO	National Water Policy
NGO	Non-Governmental Organization
O&M	Operation and Maintenance

Abbreviation	Meaning
PPE	Personal Protective Equipment
PO-RALG	President's Office – Regional Administration and Local Government
POU	Point of Use
PT	Proficiency Testing
QA	Quality Assurance
QA/QC	Quality Assurance and Quality Control
QC	Quality Control
RAS	Regional Administrative Secretariat
RUWASA	Rural Water Supply and Sanitation Agency
SDGs	Sustainable Development Goals
SOP	Standard Operating Procedure
TDS	Total Dissolved Solids
TMA	Tanzania Meteorological Authority
TZS	Tanzania Standard
UNICEF	United Nations Children's Fund
UV	Ultraviolet
VPO	Vice President's Office
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WQMPCS	Water Quality Management and Pollution Control Strategy
WSP	Water Safety Plan
WSSAs	Water Supply and Sanitation Authorities
CFU	Colony Forming Unit
CSR	Corporate Social Responsibility
DO	Dissolved Oxygen
GST	Geological Survey of Tanzania
MTEF	Medium-Term Expenditure Framework
NDWQIS	National Digital Drinking Water Quality Information System
NEMC	National Environment Management Council
NTU	Nephelometric Turbidity Unit
PDCA	Plan–Do–Check–Act
RACI	Responsible, Accountable, Consulted and Informed
TBS	Tanzania Bureau of Standards

CHANGES IN THE SECOND EDITION

The Second Edition strengthens the national risk-based approach to drinking water quality monitoring and reporting by integrating operational monitoring, verification and surveillance; climate-resilient Water Safety Plan verification; standardized data management and digital reporting; sustainable financing; clearer institutional roles and accountability; monitoring and evaluation; and continuous improvement. It also expands guidance on point-of-use monitoring, emerging contaminants, quality assurance and quality control, corrective action, risk communication and national information management.

FOREWORD

Access to safe drinking water is a fundamental human right and a cornerstone of public health, socio-economic development, and environmental sustainability. The Government of the United Republic of Tanzania accords high priority to ensuring that all citizens have access to adequate, reliable, and safe drinking water, in accordance with the National Water Policy (NAWAPO, 2002; revised 2025), the Water Supply and Sanitation Act No. 5 of 2019, and national development frameworks, including Tanzania Vision 2050 and the Five-Year Development Plans.

Notwithstanding these commitments, unsafe drinking water continues to pose a serious risk to public health, serving as a major pathway for the transmission of waterborne and water-related diseases such as cholera, typhoid, dysentery, trachoma, schistosomiasis, and exposure to harmful chemical contaminants. These challenges necessitate the establishment of robust, coordinated, and enforceable systems for monitoring, reporting, and safeguarding drinking water quality across the country.

In response, the Ministry of Water has developed the Guidelines on Drinking Water Quality Monitoring and Reporting to provide a harmonized national framework for the systematic assessment, verification, and surveillance of drinking water quality at all levels of supply, from source to point of use. The Guidelines take into account the evolving pressures on water quality arising from population growth, urbanization, industrial development, agricultural intensification, climate variability, and the emergence of new and complex contaminants.

The primary objective of these Guidelines is to institutionalize evidence-based, risk-informed, and standardized drinking water quality monitoring practices that ensure compliance with established national and international standards and protect the health and well-being of all Tanzanians. The Guidelines have been developed through wide consultations with key national and international stakeholders and draw upon international best practices, including the World Health Organization Guidelines for Drinking-water Quality, Fourth Edition incorporating the First, Second and Third Addenda (2026), and the Water Safety Plan Manual (2nd edition, 2023), as well as other relevant regulatory and policy instruments.

The Ministry of Water calls upon all water sector institutions, regulatory authorities, water supply and sanitation service providers, and other stakeholders to use and implement these Guidelines as the national technical reference document, subject to obligations established under applicable laws, regulations and standards. Effective implementation will significantly contribute to the protection of public health, enhanced transparency and accountability within the water sector, and the achievement of national and global commitments toward universal access to safe drinking water.

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ACKNOWLEDGMENT

The development of these Guidelines commenced with a series of consultative review meetings aimed at assessing the prevailing status of drinking water quality monitoring in the country, during which a detailed outline of the Guidelines was agreed upon. Subsequently, the initial draft was reviewed through various stakeholder consultations and thereafter submitted to a multidisciplinary team of technical experts for further refinement and finalization.

The final version of these Guidelines is therefore the result of valuable contributions from numerous individuals and institutions, whose technical inputs, guidance, and commitment are sincerely acknowledged and greatly appreciated. The Ministry of Water also gratefully acknowledges the cooperation and support provided by UNICEF, particularly in relation to interventions supporting Water, Sanitation and Hygiene (WASH) activities. The financial and technical assistance extended by UNICEF was instrumental in enabling the successful completion of these Guidelines.

DEFINITION OF TERMS

Catchment: refers to an extent or an area of land where surface water from rain, converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another water body, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.

Chlorine Residue (Free Chlorine): chlorine present in water that is not combined with other chemicals and available to disinfect any additional contaminants introduced to the water.

Compliance monitoring: Is to determine through assessment whether water supplies comply with the standards and indicator parameter values in the regulations.

Contamination: deterioration of physical, chemical, biological, or radiological characteristics of water to the extent that it becomes less suitable or unsafe for its intended uses, including drinking, domestic use, agriculture, industry, and ecosystem support.

Critical Control Point (CCP): A point, step or procedure within a water supply system at which a control measure can be applied and is essential to prevent, eliminate or reduce a water quality hazard to an acceptable level.

Drinking water quality monitoring: is a wide-range assessment of the quality of water in the water supply system, which includes regular sampling and testing to ascertain whether water quality is meeting national standards and regulatory requirements or agreed levels of service.

Drinking water: potable water intended for human consumption.

Emerging Contaminants: Chemical, biological or other substances that are newly identified, increasingly detected or of growing concern in water and for which routine monitoring requirements or regulatory limits may not yet be fully established.

Hazard: A biological, chemical, physical or radiological agent in water, or a condition of water, with the potential to cause harm to human health.

Hazardous Event: An incident, situation or occurrence that introduces a hazard into a water supply system, increases its concentration, or prevents an existing control measure from effectively removing or reducing the hazard.

Health-Based Target: A measurable health-related objective or benchmark established to ensure that drinking water does not pose an unacceptable risk to human health.

Household water treatment and safe storage (HWTS): is a way of treating water and safely storing it in the home or treating water at the point of use (POU).

Incident: An unplanned event, operational failure, contamination occurrence or other abnormal condition that has caused, or has the potential to cause, deterioration of drinking water quality, interruption of safe water supply or increased risk to public health.

Laboratory Accreditation is the formal recognition by an authorized accreditation body that a laboratory is competent to perform specified tests, calibrations, or measurements in accordance with ISO/IEC 17025.

Non-Compliance: Failure of drinking water quality, monitoring activities, operational practices or institutional performance to meet an applicable legal requirement, drinking water quality standard, guideline, operational limit or other specified requirement.

Non-Piped/Vended Water Supply: A drinking water supply arrangement in which water is provided to consumers through means other than a conventional piped distribution network, including water tankers, carts, kiosks, containers, packaged water or other vending arrangements.

Operational monitoring: is to check whether the treatment works and distribution networks are operating effectively to deliver water that meets the standards and provide early warning that source water quality is deteriorating, a treatment process is failing or there is a problem in the distribution network.

Point of use (POU): is the technology designed to treat only the water intended for direct consumption (drinking and cooking), typically at a single tap or a limited number of taps.

Potable water: water that is safe, clean, and acceptable for human consumption and domestic use, and which meets the national drinking water quality standards as prescribed by the Government of the United Republic of Tanzania.

Risk Assessment is the systematic process of identifying hazards and hazardous events, evaluating the likelihood of their occurrence and the severity of their consequences, and determining the level of risk to drinking water safety.

Risk is the combination of the likelihood that a hazardous event or condition will occur and the severity of its potential consequences for drinking water quality and public health.

Risk Management is the coordinated process of selecting, implementing, monitoring, and reviewing preventive and corrective measures to eliminate, reduce, or control identified risks.

Sanitary Inspection: A structured on-site assessment of a water supply system using standardized observations or checklists to identify existing and potential sources of contamination, hazardous conditions and deficiencies in the source, treatment, storage, distribution or point-of-use environment.

Surveillance: The continuous and vigilant public-health assessment and independent review of the safety and acceptability of drinking water supplies. .

Toxic contaminants: are substances whose presence or concentration exceeds permissible limits established under national frameworks, including the Tanzania Drinking Water Standards, environmental regulations, and sector-specific guidelines, and which require preventive control, monitoring, and mitigation to protect public health and the environment.

Validation is the process of obtaining objective evidence that a control measure, treatment process, analytical method, equipment, or management system is capable of consistently achieving its intended performance under specified operating conditions before routine implementation.

Verification is the process of confirming, through monitoring, testing, inspection, audits, or other objective evidence, that drinking water quality management systems, control measures, and operational practices are functioning effectively and that drinking water consistently complies with established standards and regulatory requirements.

Water Quality: The physical, chemical, microbiological and radiological characteristics of water that determine its suitability for a specified use, including its safety and acceptability for human consumption.

Water Safety Plan (WSP) is a comprehensive risk assessment and risk management approach that systematically identifies, assesses, and controls hazards throughout the entire drinking water supply chain—from the catchment to the point of consumption.

CHAPTER ONE
INTRODUCTION

1.0 Background

Water quality is a fundamental consideration in all water supply projects, as it has a direct and significant influence on public health and human well-being. Ensuring the provision of safe drinking water requires that water quality be prioritized at every stage of the water supply chain development, including planning and design, source selection, treatment technology, system operation, and ongoing maintenance.

At the global level, the World Health Organization (WHO) provides internationally recognized benchmarks through the *Guidelines for Drinking-Water Quality* (4th edition, 2026: "incorporating 1st and 2nd Addenda") and the *Water Safety Plan Manual* (2nd edition, 2023). These documents promote integrated, preventive, and systematic approaches to safeguarding drinking water safety and have informed the development of these Guidelines. At the national level, the National Water Policy (NAWAPO, 2002; revised 2025) emphasizes the need for continuous monitoring of water quality to ensure compliance with agreed objectives and standards. In addition, the Water Supply and Sanitation Act No. 5 of 2019 obliges water authorities to supply water that meets national drinking water quality standards. The Water Quality Management and Pollution Control Strategy (WQMPCS, 2021) further underscores the importance of community participation in water quality management and calls for the expansion of monitoring services across the country.

Despite sustained government efforts to expand water supply coverage in both urban and rural areas, drinking water quality monitoring and assessment by water supply utilities have not been consistently adequate. As a result, drinking water quality does not always comply with national standards. This situation is largely attributable to the absence of clear and harmonized guidance on drinking water quality monitoring, as well as limited awareness of how systematic monitoring programmes can effectively identify and address water quality risks. In recognition of these challenges, the National Guidelines on Drinking Water Quality Monitoring and Reporting have been reviewed to strengthen the effective management of drinking water quality nationwide and to enhance the protection of public health.

Drinking Water Quality Monitoring is a comprehensive process involving regular sampling, testing, and evaluation of water within the supply system to verify compliance with national standards, regulatory requirements, and agreed service levels. The present guidelines promote a monitoring approach that includes the identification of actual and potential sources of contamination, the implementation of corrective actions, subsequent verification, and independent surveillance. This integrated approach represents international best practice in the provision of safe drinking water to communities.

These Guidelines are intended to serve as an authoritative national reference on what constitutes safe and good-quality drinking water, how it can be achieved, and how compliance can be assured. They provide a consistent basis for determining the quality of water supplied to consumers across all regions of the country. However, their application must take into account the diversity of local conditions, as well as economic, political, and cultural factors, including consumer expectations and the willingness and ability of users to pay for water services.

1.1 Objectives of the Guidelines

The overall objective of these Guidelines is to strengthen evidence-based planning, budgeting, policy formulation, regulatory oversight, and decision-making by generating, managing, analyzing, and disseminating reliable, timely, and accessible drinking water quality information.

Specifically, the Guidelines aim to:

i. Guide entities on the monitoring of water quality at the source, treatment units, storage points, distribution systems and point of use (households) as well as situations where communities are not yet served with potable water;
ii. To ensure compliance with national and/or international water quality standards;
iii. To promote water quality data sharing, transparency and accountability; and
iv. To describe the roles and responsibilities of various stakeholders in the management of drinking water quality.

1.2 Rationale of the Guidelines

The National Water Policy (NAWAPO, 2002; revised 2025) clearly emphasizes that providing safe drinking water is a fundamental requirement for safeguarding public health and must be ensured through systematic water quality monitoring and assessment in both public and private water supply schemes in rural and urban areas. This policy position underscores the central role of drinking water quality management in achieving national health and development objectives.

Despite notable achievements in expanding water supply coverage across the country, the quality of water supplied to consumers is not consistently and adequately monitored to determine compliance with national drinking water quality standards. This gap is largely attributed to the absence of harmonized and comprehensive guiding tools for drinking water quality monitoring and reporting. Furthermore, the Water Supply and Sanitation Act No. 5 of 2019 reinforces the legal obligation of water authorities to continuously treat water and monitor the quality of drinking water supplied to communities in accordance with established national standards.

Water quality management is primarily implemented by water quality laboratories in collaboration with other water quality stakeholders through monitoring and assessment programmes. However, drinking water quality within supply systems continues to face several challenges, including pollution from both point and non-point sources, inadequate monitoring and assessment procedures, limited adherence to prescribed standards by some stakeholders, and the use of inappropriate or insufficient water treatment technologies.

In response to these challenges, the reviewed *Guidelines on Drinking Water Quality Monitoring and Reporting* provide a structured and harmonized framework for identifying water quality risks within water supply systems, as well as clear procedures for implementing timely corrective actions, including incident and emergency response measures. The Guidelines, therefore, establish uniform national approaches to drinking water quality monitoring and restore best practices in the management of drinking water quality, thereby strengthening the availability of clean, safe, and reliable drinking water at all levels of supply

1.3 Legal Framework

The implementation of these Guidelines is supported by the legal and regulatory framework governing water resources management, water supply, public health, environmental protection, and drinking water quality in the United Republic of Tanzania. The National Water Policy (NAWAPO, 2002; revised 2025) recognizes the provision of safe and adequate drinking water as a national priority and requires systematic monitoring of water quality to safeguard public health and ensure sustainable water service delivery. Furthermore, the Water Resources Management (Amendment) Act, 2022 assigns the Ministry of Water responsibility for protecting water resources and monitoring water quality, while the Water Supply and Sanitation Act, No. 5 of 2019, requires Water Supply and Sanitation Authorities (WSSAs), RUWASA, Community-Based Water Supply Organizations (CBWSOs), and other water suppliers to provide drinking water that complies with the prescribed national standards.

These Guidelines are also implemented in accordance with the Tanzania Drinking Water Quality Standards (TZS 789, latest edition) and other applicable national standards issued by the Tanzania Bureau of Standards (TBS), together with relevant environmental legislation, including the Environmental Management

(Amendment) Act, 2025, Personal Data Protection Act No. 11 of 2019, and the Public Health legislative framework administered by the Ministry of Health. In addition, the Guidelines are aligned with internationally recognized best practices, particularly the World Health Organization (WHO) Guidelines for Drinking-water Quality (Fourth Edition incorporating the First and Second Addenda) and the WHO Water Safety Plan Manual (Second Edition). Collectively, these legal, regulatory, and technical instruments provide the statutory authority and institutional basis for coordinated drinking water quality monitoring, reporting, compliance verification, surveillance, and continuous improvement throughout the drinking water supply chain.

1.4 Scope

These Guidelines are intended for use by implementing agencies with direct or indirect responsibilities for the monitoring and assessment of drinking water quality. The primary users include Water Supply and Sanitation Authorities (WSSAs), Community-Based Water Supply Organizations (CBWSOs), Private Drinking Water Supplies, Vended Drinking Water Supplies, Rural Water Supply and Sanitation Agency (RUWASA), Regional Administrative Secretariat (RAS), Energy and Water Utilities Regulatory Authority (EWURA), Water Quality Laboratories, Ministry of Health (MoH) and Ministry of Water.

Other stakeholders involved in the water and public health sectors will also benefit from these Guidelines, as they provide a concise and authoritative reference on key issues related to drinking water quality monitoring and management. Furthermore, the Guidelines provide practical guidance on the assessment and monitoring of drinking water quality parameters, including physical, chemical and bacteriological characteristics, across the entire water supply chain- from the source, through treatment and storage, to the point of use at the household level.

1.5 Applying the Guidelines

The application of these Guidelines will vary depending on the institutional and operational arrangements governing water supply within each jurisdiction. Drinking water supply may be managed by Water Supply and Sanitation Authorities (WSSAs), Community-Based Water Supply Organizations (CBWSOs), private operators, or water vendors, and these differing arrangements will influence the manner and extent to which the Guidelines are implemented. Nevertheless, all drinking water suppliers and relevant government institutions are required to use these Guidelines as a reference model for best practices to ensure the safety and quality of drinking water. The implementation of the Guidelines will also depend on the specific needs of each organization, the allocation of roles and responsibilities, and existing institutional frameworks. Accordingly, each organization is expected to develop an internal implementation plan that aligns with its operational context and capacity. The Guidelines may be applied as a stand-alone drinking water quality monitoring framework or integrated into existing water quality monitoring and operational systems.

The time and resources required to establish or strengthen a drinking water quality monitoring programme will depend on the extent to which the principles and elements of these Guidelines are already in practice, as well as the level of maturity of existing drinking water quality monitoring systems. Many drinking water suppliers and related agencies currently apply several elements outlined in the Guidelines. However, in some cases, existing practices may not be sufficiently comprehensive, systematically structured, or well documented to fully address the range of drinking water quality risks or to demonstrate compliance with required quality standards.

Where such gaps exist, organizations are encouraged to review, document, and formalize their existing practices, while also identifying and addressing areas requiring improvement. This process will strengthen the effectiveness, visibility, and accountability of drinking water quality monitoring and support consistent compliance with national drinking water quality requirements.

CHAPTER TWO

LOCALIZED WATER QUALITY ISSUES IN THE COUNTRY

2.0 Introduction

Evidence indicates that water quality challenges vary significantly across different parts of the country. As a result, water quality issues must be addressed using context-specific rather than uniform interventions. Local water quality problems arise from a combination of factors, including the geological characteristics of parent rocks (natural occurrence), human economic activities, climate change, pollution and over-exploitation of water resources. In addition, the pace of industrialization and prevailing individual practices play a critical role in determining the quality of water within a given locality.

These challenges are often exacerbated by uneven rainfall distribution and prolonged drought conditions. Accordingly, Localized water quality issues must be systematically identified, assessed, and addressed, and duly taken into account when planning and implementing drinking water quality monitoring activities.

2.1 Factors Affecting Water Quality

As water moves through the hydrological cycle - precipitation, evaporation, and evapotranspiration- its mineral composition changes due to physical, chemical, and biological processes occurring in the atmosphere, surface water, and Earth’s crust. Variability in the concentrations of chemical constituents (dissolved ions) in runoff, streamflow, and groundwater entering water sources are influenced by multiple interacting factors.

Understanding these water quality dynamics requires a multisectoral approach, including collaboration with relevant institutions to access complementary data, such as the Tanzania Meteorological Authority (TMA) and the Geological Survey of Tanzania (GST). Although many of these influencing factors are localized, they differ significantly from one area to another. Therefore, such variability must be carefully considered when planning and implementing drinking water quality monitoring activities. Key factors influencing localized water quality include:

i. The nature and composition of the parent rock materials in the area;
ii. Climate Change effects, particularly in arid and semi-arid regions;
iii. Geographic and topographic characteristics;

iv. Stream flow and hydrological conditions;
v. Human activities and dominant economic practices in the area;
vi. The potential for seawater intrusion, especially in coastal zones;
vii. Over-extraction of groundwater coupled with insufficient aquifer recharge; and
viii. The presence of new and emerging pollutants.

2.1.1 Nature of the Parent Rocks

The chemical characteristics of water are largely determined by the extent to which the water interacts with geological formations (rock units or parent rock) and the types of minerals present within those formations. Through chemical and physical weathering processes – such as dissolution and redox reactions-soil and rock release major dissolved ions into water.

Consequently, the geological composition of an area plays a critical role in shaping drinking water. For example, regions dominated by volcanic formations, such as areas surrounding Mount Meru and Mount Kilimanjaro, often have groundwater with elevated Fluoride concentrations. Excessive Fluoride levels can cause dental and skeletal Fluorosis, underscoring the importance of systematic water quality monitoring for public protection.

2.1.2 Climate effects

Climate change directly affects water temperature and indirectly influences physical and chemical processes that determine water quality. Intense rainfall events increase soil erosion, leading to higher runoff of nutrients and pollutants into surface waters. As a result, water bodies may become more eutrophic, reducing water clarity and overall quality. Conversely, prolonged droughts and sea-level rise can contribute to the salinization of surface and groundwater sources. Overall, climate change is expected to negatively affect the physicochemical quality of water.

2.1.3 Geographical effects

The chemistry of water entering an aquifer is influenced by watershed size, landscape slope, soil texture, and topographic variation. Diverse geographical settings—from coastal plains to highland plateaus—affect both water availability and quality. In low-lying coastal areas such as Dar es Salaam, groundwater is particularly vulnerable to contamination from surface pollutants and saline intrusion. In contrast, highland areas may experience erosion and leaching processes that introduce heavy metals into drinking water sources. Regular water quality testing is therefore essential to identify and mitigate location-specific risks.

2.1.4 Stream flow effects

Water quality in surface runoff, streams, and groundwater exhibits strong seasonal variation. During periods of high rainfall, surface water contributes significantly to aquifer recharge, generally resulting in lower concentrations of dissolved minerals. During dry seasons, groundwater becomes the dominant contributor to streams and aquifers, often leading to increased concentrations of dissolved constituents in the water.

2.1.5 Human Effects and Economic Practices

Human activities frequently and substantially alter the chemical composition of surface water and groundwater. Runoff from agricultural areas commonly contains elevated levels of sediments, nutrients (notably nitrogen and phosphorus), and agrochemicals such as herbicides and pesticides. Drainage from urban and suburban areas may carry trace organic compounds, toxic substances (including heavy metals and petroleum products), and nutrients from lawn and garden fertilizers. In addition, deforestation for charcoal production and timber harvesting—particularly around major urban centers—intensifies soil erosion and adversely affects groundwater recharge.

2.1.6 Possibility of seawater intrusion

Coastal areas are especially susceptible to seawater intrusion, primarily as a result of excessive groundwater abstraction. Increased salinity associated with seawater intrusion can render drinking water unfit for consumption, necessitating desalination measures and more stringent monitoring of salinity levels to protect freshwater sources.

2.1.7 Over-extraction of groundwater sources and less recharge of aquifers

In many urban areas, excessive groundwater extraction combined with inadequate recharge from rainfall leads to progressive aquifer depletion. Over-extraction can cause wells to dry up and concentrate contaminants such as fluoride and heavy metals. Sustainable groundwater management practices, supported by continuous monitoring, are essential to balance abstraction rates with natural recharge.

2.1.8 Emerging Contaminants

Emerging contaminants are newly recognized pollutants that pose potential risks to water quality and human health. These substances originate from diverse sources, including industrial activities, pharmaceuticals, personal care products, microplastics, and electronic waste. Their growing presence in drinking water is of concern because conventional treatment technologies may not effectively remove them. Addressing emerging contaminants therefore requires proactive monitoring and management measures to safeguard public health and the environment.

2.1.9 Local Specific Water Quality Problems in Tanzania

To develop an effective drinking water quality monitoring plan, each drinking water supplier must identify key local water quality issues that may compromise the safety and suitability of drinking water. These location-specific issues, together with the core water quality parameters discussed in Chapter 3, should be fully integrated into the monitoring program. Table 1 provides a summary of the major local water quality challenges across the country.

Table 1: Localized water quality problems in the country

Parameter	Affected regions/districts/ areas
Low pH	Dar Es Salaam -Ilala, Kinondoni, Temeke; Coast -Kisarawe; Kigoma -Buhigwe, Kasulu, Kigoma MC, Kakonko, Kibondo; Katavi -Mpanda, Nsimbo, Tanganyika, Mlele; Rukwa -Sumbawanga DC; Ruvuma -Mbinga, Namtumbo, Nyasa, Songea MC, Songea DC, Tunduru; Kagera -Bukoba DC, Bukoba MC, Karagwe, Kyerwa, Misenyi, Muleba, Ngara; Geita -Chato, Bukombe, Geita DC, Geita TC, Mbogwe, Nyang'hwale.; Mtwara- Newala; Shinyanga-Bukombe, Mbogwe; And Mbeya- Mbozi.
Hardness	Dodoma -Mpwapwa, Kongwa, Chamwino, Chemba; Dodoma City; Dar Es Salaam -Temeke, Kinondoni, Ilala; Singida -Singida Mc, Manyoni, Iramba, Mkalama, Ikungi; Morogoro -Gairo, Morogoro Dc, Morogoro Mc, Mvomero; Coast -Kibaha, Bagamoyo; Iringa -Iringa Dc.; Mbeya -Mbarali, Chunya; Songwe-Songwe Dc; Mara -Rorya, Musoma Dc, Butiama, Serengeti, Bunda.; Lindi -Lindi Mc, Ruangwa, Nachingwea.; Mtwara -Mtwara Mc; Tanga -Korogwe, Mkinga, Handeni, Pangani; Kagera -Kyerwa; Kigoma-Kigoma Mc; Kilimanjaro-Same, Mwanga; Manyara-Simanjiro; And Katavi-Mlele.
Fluoride	Arusha -Arumeru, Monduli, Ngorongoro, Arusha City, Longido; Manyara -Babati Tc, Babati Dc, Hanang, Simanjiro.; Kilimanjaro -Siha, Hai, Moshi Dc, Mwanga Same; Katavi -Mlele; Mwanza -Magu, Busega, Sengerema, Misungwi, Mwanza City, Kwimba; Singida -Singida Dc, Iramba, Mkalama; Shinyanga -Shinyanga Dc, Mc, Kishapu; Dodoma –Chemba; Simiyu-Maswa, Bariadi, Simiyu Dc, Itilima; Mbeya-Busokelo, Rungwe; Tabora-Nzega; Tanga-Korogwe: Lindi- Ruangwa and Nachingwea
Chloride	Lindi -Lindi MC, Kilwa, Ruangwa, And Nachingwea Liwale; Mtwara -Mtwara MC, DC, Tandahimba, Newala, Masasi And Nanyumbu; Dar Es Salaam -Temeke, Kinondoni, Ilala; Morogoro -Morogoro MC & DC, Gairo, ,Kilombero, Ulanga; Coast -Kisarawe, Bagamoyo; Tabora -Uyui; Kigoma -Kigoma DC; Geita -Nyang'hwale; Tanga -Korogwe, Mkinga, Tanga City, Handeni, Pangani; Dodoma -Dodoma MC, Mpwapwa, Kongwa, Chamwino, Chemba and Bahi; Coastal Areas; Kagera -Kyerwa; Singida - Singida MC, Manyoni, Iramba, Mkalama, Ikungi; Ruvuma-Tunduru; Manyara-Simanjiro, Babati; & Kilimanjaro-Same, Mwanga, Hai.
Nitrate	Mwanza -Magu, Sengerema; Geita - Nyang'hwale; Singida -Ikungi, Iramba, Manyoni, Singida DC, Singida MC; Tanga –Tanga City, Mkinga; Iringa-Iringa DC; Dodoma -Bahi, Chamwino, Chemba, Kondoa, Dodoma City; Dar Es Salaam -Temeke, Kinondoni; Lindi-Kilwa Masoko; Mbeya-Busokelo; Arusha- Longido, Arusha City.

Parameter	Affected regions/districts/ areas
Sulphate	Mtwara – Mtwara Mc; Lindi-Ruangwa; Dodoma – Kongwa, Mpwapwa; Morogoro-Morogoro Dc, Gairo; Singida- Singida Mc; Mbeya-Chunya; Kilimanjaro-Same, Mwanga; Manyara- Babati.
Iron	Mtwara -Mtwara MC, Tandahimba; Shinyanga- Shinyanga MC, Kahama, Ushetu, Msalala; Geita: Mara -Serengeti; Kigoma -Buhigwe; Lindi -Liwale, Kilwa; Coast -Kisarawe; Dar Es Salaam -Kinondoni, Ilala, Temeke; Tanga - Handeni, Muheza, Mkinga; Singida -Manyoni; Kagera -Ngara, Biharamulo, Karagwe, Bukoba DC, Muleba, Kyerwa; Tabora-Tabora MC, Uyui, Urambo, Kaliua; Ruvuma-Madaba, Namtumbo; Morogoro-Morogoro DC; Mbeya-Chunya, & Kyela; Katavi-Mpanda.
Manganese	Dar Es Salaam -Kinondoni; Lindi - Ruangwa, Nachingwea, Kilwa, Masasi, Liwale; Mtwara -Nanyumbu, Makonde, Nanyamba, Mtwara MC; Simiyu - Maswa, Bariadi; Ruvuma-Songea DC; Manyara -Kiteto; Kigoma -Kigoma MC, Kasulu, Buhigwe, Kibondo, Kakonko; Tabora-Tabora MC, Uyui, Urambo, Kaliua; Simiyu-Bariadi; Iringa-Iringa DC ; & Mbeya-Chunya, Kyela
Cadmium	Near mining sites
Selenium	Near mining sites
Arsenic	Near mining sites
Mercury	Near mining sites
Lead	Near dyes, textiles, paints, firearms industries
Copper	Near mining sites
Uranium	Near mining sites -Manyoni, Namtumbo.
Chromium	Near leather industry sites
Nickel	Kagera -Biharamulo, Kyerwa
Cyanide	Near mining sites
Hydrocarbons	Near petrol stations/fields/garages
Pesticides	Areas with agricultural activities

The foregoing discussion demonstrates that many areas experience multiple and diverse water quality challenges. Consequently, ensuring the provision of adequate and safe drinking water requires careful consideration of the wide range of water quality issues that exist across different localities in the country. Drinking water quality monitoring must therefore be planned and implemented in a comprehensive and context-specific manner.

Accordingly, the following key steps should be considered when planning and undertaking drinking water quality monitoring in different areas:

i All critical water quality parameters should be measured during monitoring of the drinking water supply system, as specified in Chapter Three.

ii Particular emphasis should be placed on local-specific factors—such as parent rock characteristics, climate effects, and other area-specific conditions—that contribute to water quality challenges in the given locality; and

iii Microbiological parameters should always be included as a core component of drinking water quality monitoring.

CHAPTER THREE

DRINKING WATER QUALITY MONITORING OVERVIEW

3.0 Introduction

The fundamental principle of potable water quality monitoring across the entire water supply system is to ensure that drinking water complies with national standards, while also enabling the timely detection of any problems that may require corrective action. Accordingly, the implementation of these Guidelines adopts a preventive, risk –based approach that safeguards potable water from the catchment through the consumer (Figure 1).

This approach requires that, at every stage of the potable water supply system, potential hazards and risk factors are systematically identified and appropriate preventive measures are implemented. The procedures for hazard and risk identification are guided by the Guidelines for the Preparation of Climate Resilience Water Safety Plan (CR-WSP) for Urban and Rural 2026

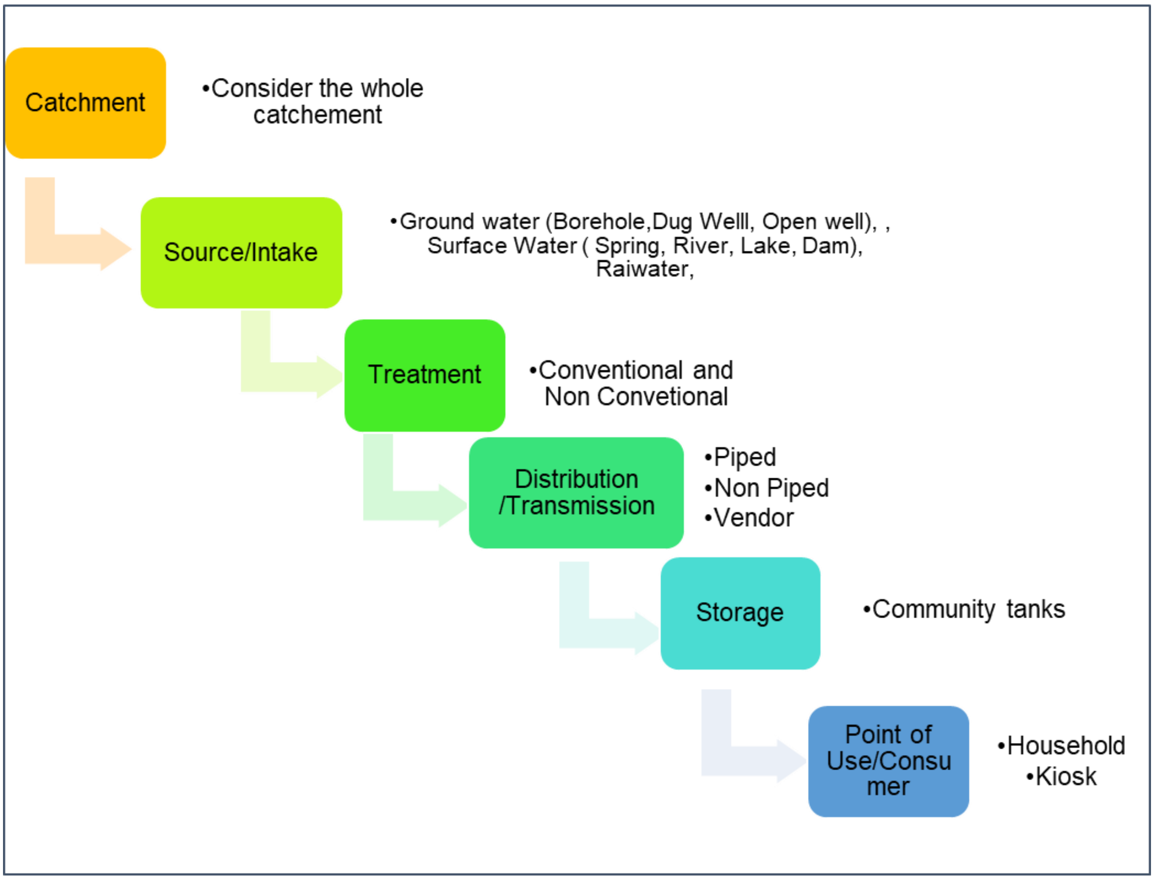

Figure 1: Water Supply from Catchment to Consumers

The following sections guide monitoring potable water quality from the source/intake through households, as well as for other communities that are not yet served with potable water. The monitoring parameters identified may be adjusted, expanded, or modified to reflect site-specific conditions and local risk profiles.

3.1 Water Quality Monitoring at Sources/Intake

A thorough understanding of the catchment area, reservoirs, and source water characteristics is essential for effective water quality monitoring. Source water monitoring supports strategic and evidence-based decision-making by providing critical information on the performance and risks of the water supply system. By understanding the water quality characteristics at the source, water suppliers are better able to identify catchment conditions, potential hazards, and contamination challenges within a given area, thereby enabling the selection and design of appropriate treatment systems.

Effective source water management offers additional benefits, including reduced contamination at the source, lower treatment costs, and decreased chemical usage. These improvements can result in public health benefits through reduced formation of treatment by-products, as well as economic benefits through minimized operational costs. Source water quality data should be used to continually improve understanding of the system and inform monitoring program design, rather than allowing monitoring activities to become static or routine. In both urban and rural settings, water suppliers should assess hazards and risks at potable water sources in accordance with the Climate-Resilient Water Safety Plan (CR-WSP, 2026), taking into account the following:

i. The location of water sources, including the presence of runoff paths or flood ways that may introduce contaminants into the source;
ii. Topographic features of the surrounding land (e.g. flat or sloping terrain) and the associated risk of erosion;
iii. Human and development activities in the vicinity of the source, such as agriculture, livestock grazing, mining, waste disposal, and open defecation areas;
iv. Source water quality, assessed through sampling and analysis to determine levels of microbial, chemical, and physical contaminants; and
v. The presence and condition of protective measures, including fencing, flood diversion ditches, and road crossings over water-bearing spring catchments.

Parameters to be monitored at the source are categorized into two groups. The first group includes parameters assessed during the development of the source or intake, while the second group includes parameters monitored on a routine basis: -

a) **During development of the source/intake:** Conduct a full analysis of all water quality parameters in accordance with the Tanzania Water Standard, *Potable Water — Specification (TZS 789), latest edition*.

b) **Routine monitoring at the source/intake:** Analyse the minimum required parameters as stipulated in Table 3 and Tanzania Water Standard, *Potable Water — Specification (TZS 789), latest edition*.

3.2 Water Quality Monitoring at the Treatment Units

Monitoring of the water quality at each treatment unit is essential for evaluating treatment efficiency, maintaining confidence in water safety, providing timely information for process adjustments in response to source water variability, and optimizing treatment costs.

When monitoring of potable water quality at treatment facilities, the following should be applied:

i. Water Samples must be collected in accordance with approved sampling protocols, including appropriate procedures for sample collection, handling, preservation, and analysis, to ensure representative and reliable results;

ii. Variation in water supply characteristics should be considered based on the type of source, recognizing that surface water is subject to seasonal and hydrological changes, whereas groundwater generally exhibits less short-term variability;

iii. The treatment capacity and operational performance of treatment facilities;

iv. The vulnerability of the water source to potential contamination;

v. Historical water quality trends, including raw water source data, to inform monitoring priorities and operational decisions; and

vi. The parameters to be monitored at the treatment plants for both Raw and treated Water) are indicated in Table 3.

Note 1: Jar Test:

Jar testing should be conducted before the water treatment process to assess the effectiveness of coagulants, flocculants, and other treatment chemicals. The jar test provides critical information on how raw water responds to chemical dosing, enabling operators to optimize dosages and achieve effective coagulation and flocculation. This practice is essential for maintaining treated water quality and for guiding timely operational adjustments when changes in source water characteristics occur.

3.3 Water Quality Monitoring at the Storage Facilities

Treated water may become contaminated during storage, leading to deterioration due to the survival of bacteria after treatment or the ingress of contaminants through damaged or leaking pipes, followed by microbial regrowth within the storage system. Waterborne disease outbreaks have been reported in communities where birds and other animals contaminated water through open storage reservoirs. Uncovered reservoirs also create favourable conditions for the growth of microorganisms, including fungi and toxin-producing cyanobacteria, which further compromise water quality. The rate of water quality deterioration can be effectively controlled through additional treatment measures such as post-chlorination.

Monitoring at water storage facilities should therefore include the following measures:

i. Ensure that all clear water storage tanks are properly covered;
ii. Conducting regular Bacteriological testing to verify the effectiveness of disinfection;
iii. Carrying out routine inspections of the storage system to identify defects or risks: and
iv. Implementing regular cleaning and maintenance of storage facilities.

The specific water quality parameters to be monitored at the storage facilities are presented in Table 3.

3.4 Water Quality Monitoring in the Distribution System

Ensuring that the quality of treated drinking water is maintained throughout the distribution system up to the point of delivery to consumers is a critical component of drinking water quality management. Recontamination within the distribution system remains a significant challenge and is a major cause of waterborne disease outbreaks. Such outbreaks are commonly associated with microbial and chemical recontamination arising from cross-connections, back siphonage, leaking or burst mains, repair works and the leaching of metals from pipes and fittings.

Accordingly, monitoring of the distribution system must take into account the potential for water stagnation and ingress of contaminants through defects within the network. Stagnation and biofilm growth may occur in poorly designed, inadequately operated, or intermittently supplied distribution systems. Similarly, contamination can enter the system through storage tanks and reservoirs, damaged or leaking pipes, cross-connections within the pipe network, and inadequate control during repair works or installation of new mains. In these Guidelines, the distribution system is classified into three categories, each with specific water quality parameters to be monitored as presented in Table 3, depending on the type of distribution facilities. These categories are described in detail in the following subsections: -

3.4.1 Piped water supply system

Piped drinking water distribution systems are as critical to the quality and safety of drinking water as the treatment processes themselves. Water entering the distribution system must be bacteriologically safe and ideally, chemically stable. When properly designed, operated, and maintained, the distribution system serves as a protective barrier that preserves water quality as it is conveyed from the treatment facility to consumers. To ensure continued compliance with drinking water safety requirements, the distribution system should be monitored through analysis of the minimum required water quality parameters in accordance with the Tanzania Water Standard, *Potable Water — Specification (TZS 789), latest edition* and Table 3.

3.4.2 Non-piped water supply system

Water contamination in a non-piped water supply system- such as springs and shallow or deep wells- often results from poor handling practices during water collection, storage, and transportation. To safeguard water quality in these systems, appropriate monitoring is essential. The water quality parameters to be monitored for non-piped water supply systems are specified in Table 3.

3.4.3 Vended potable water supply system

The principal risk to human health associated with vended water supplies is contamination by pathogenic microorganisms. To ensure the safety of vended drinking water, emphasis should be placed on regular inspection of the vending systems to identify any actual or potential sources of contamination, as well as on ensuring that water is obtained from clean, safe and uncontaminated sources.

When the vendors do not obtain water from utility managed piped supply systems, routine water quality testing and sanitary inspections are strongly recommended. For very small-scale vendors, routine monitoring may not always be feasible; however, periodic assessments remain valuable and should be encouraged. Monitoring arrangements for private and vendor- operated water supplies should include the following:

i. Verification of the vendor's registration and regulatory compliance status;
ii. Awareness creation and training on safe drinking water handling, storage, and hygiene practices;
iii. Sanitary inspections of source water, abstraction points, and conveyance equipment (including hoses) to ensure protection from external contamination; and
iv. Assessment of the integrity, cleanliness, and maintenance of equipment and facilities such as hydrants, standpipes, backflow prevention devices, storage tanks, hoses, containers, and bulk water tankers.

The water quality parameters to be monitored for private and vendor-operated water supplies are provided in Table 3.

Note 2

i. *These guidelines can be applied as a standalone drinking water quality management system for private and vendor drinking water supplies, or can be integrated within an existing managerial system. Where private and vendor are registered or have a contract with a utility, implementation and operation of their activities should be regularly checked by the regulatory organization (utility itself);*

ii. *It is very critical that the monitoring of private and vendor supplies leads to some form of action, either through working with them to improve practices and regulate their practices or by banning all drinking water activities being undertaken by private and vendors if they do not comply with the required standards.*

iii. *Drinking water supplied by private and vendors must be of a quality consistent with regulated standards, and every water supply utility must monitor the performance of private and vendor water supplies within its area of jurisdiction to ensure standards and norms are met.*

3.5 Monitoring of Drinking Water Quality at the Point of Use

Monitoring consumer satisfaction is an important component of drinking water surveillance. Consumers are distributed throughout the water distribution system, and their feedback on the quality of drinking water supplied in their respective areas provides valuable input to the monitoring process. Consumer reports can offer timely and practical information on emerging or localized problems- particularly within the distribution system- that might otherwise remain undetected through routine technical monitoring.

It is generally recognized that a drinking water supplier is responsible for delivering clean and safe water up to the point of supply and has limited control over how water is handled after it reaches the consumer. Nevertheless, it is recommended that water suppliers, through relevant institutions, promote the continued safety of supplied water by providing consumers with appropriate information and guidance. Such information should focus on practices that help maintain water quality and safety during household handling and storage.

In this context, household water treatment and safe storage (HWTS) is an important intervention for improving drinking water quality at the household level and interrupting a major pathway of waterborne disease transmission. To establish effective mechanisms for promoting and sustaining the correct use of HWTS, it is essential to monitor and evaluate its uptake. Monitoring should employ clearly defined indicators to track progress, with indicators grouped according to reported and observed use, as presented in Table 2.

In this context, household water treatment and safe storage (HWTS) is an important intervention for improving drinking water quality at the household level and interrupting a major pathway of waterborne disease transmission. To establish effective mechanisms for promoting and sustaining the correct use of

HWTS, it is essential to monitor and evaluate its uptake. Monitoring should employ clearly defined indicators to track progress, with indicators grouped according to reported and observed use, as presented in Table 2.

Point-of-use monitoring and risk communication should be inclusive and responsive to the roles of women, men, children, older persons and persons with disabilities in water collection, handling, storage and household treatment. Where household interviews are used, relevant data should be disaggregated by sex, age and disability where appropriate and lawful. Public communication should use accessible formats and languages suited to the affected community, including Kiswahili and locally appropriate communication channels.

Table 2: Indicators for monitoring potable water safety at the point of use

Indicator	Question	Answer/observation
Percentage of households treating drinking water	What do you usually do to the water to make it safe to drink?	• Nothing • Water is already safe • Boil • Bleach/chlorine • Strain through a cloth • Filter • Solar disinfection • Stand and settle • Other (specify)
	Ask to see drinking water treatment Method	• Observe boiled water, fuel source • Observe chlorine bottles/tablets, and test free chlorine residual (FCR) • Observe the filter, and if it appears intact • (i.e. not broken) • Observe if bottles are in the house/on the roof • Observe settling containers or • sediment • Other (if other option listed)
Percentage of households with designated drinking water storage containers	How do you store your drinking water?	• Do not store water • In a container with no lid or cover • In a container with a lid but no spigot/tap • In a container with a lid and spigot • In a narrow-mouthed container • Other (specify) • Do not know

The minimum required parameters are intended to focus on potential contamination risks that may arise during storage and handling. Minimum required parameters for water quality monitoring at the household level are shown in Table 3

Table 3: Integrated Drinking Water Quality Monitoring Matrix Across the Entire Water Supply System[1]

S/N	Parameter	Source/ Intake	Raw Water (Treatment)	Treated Water	Storage Facility	Piped Distribution	Non-Piped Supply	Vendor/Private Supply	Point of Use (Household)	Monitoring Objective	Recommended Analytical Method	Responsible Institution	Applicable Standard/Guideline	Remarks
1	Temperature	✓	✓	✓						Assess source characteristics and treatment efficiency	Field Thermometer	Water Supplier	TZS 789	Indicator parameter
2	pH	✓	✓	✓	✓	✓	✓	✓	✓	Assess corrosion, treatment efficiency and acceptability	pH Meter	Water Supplier/Laboratory	TZS 789	Core parameter
3	Turbidity	✓	✓	✓	✓	✓	✓	✓	✓	Assess suspended solids and treatment efficiency	Turbidimeter	Water Supplier/Laboratory	TZS 789	Critical operational parameter
4	Colour	✓	✓	✓		✓			✓	Assess aesthetic quality and contamination	Spectrophotometer/Visual	Laboratory	TZS 789	Consumer acceptability
5	Odour	✓		✓		✓			✓	Detect contamination	Organoleptic	Water Supplier	TZS 789	Consumer complaints indicator
6	Electrical Conductivity	✓	✓	✓		✓				Assess mineral content	EC Meter	Laboratory	TZS 789	Salinity indicator
7	Total Dissolved Solids	✓	✓	✓		✓				Assess dissolved minerals	Gravimetric/EC	Laboratory	TZS 789	Chemical quality
8	Free Residual Chlorine			✓	✓	✓		✓	✓**	Verify disinfection efficiency	DPD Colorimetric	Water Supplier	TZS 789	Chlorinated supplies only
9	Total Coliforms	✓		✓	✓	✓			✓	Assess distribution integrity	Membrane Filtration	Laboratory	TZS 789	Indicator organism
10	E. coli	✓	✓	✓	✓	✓	✓	✓	✓	Verify microbiological safety	Membrane Filtration	Laboratory	TZS 789	Primary microbiological parameter
11	Thermotolerant (faecal) coliforms	✓	✓	✓	✓	✓	✓	✓		Alternative microbiological indicator	Membrane Filtration	Laboratory	TZS 789	Where E. coli analysis is unavailable
12	Aluminium			✓						Verify coagulant residual	Spectrophotometer	Laboratory	TZS 789	Where alum is used
13	Filter Head Loss		✓							Assess filter performance	Operational Measurement	Plant Operator	Plant SOP	Operational control
14	Floc Characteristics		✓							Evaluate coagulation	Visual/Jar Test	Plant Operator	Plant SOP	Operational control
15	Visual Floc Observation		✓							Process optimization	Visual Inspection	Plant Operator	Plant SOP	Operational control
16	UV Dose			✓						Verify UV disinfection	UV Sensor	Plant Operator	Manufacturer Specifications	UV systems only

[1] *The minimum sampling frequencies for drinking water quality monitoring shall be in accordance with TZS 789, Potable Water — Specification, latest applicable edition.*

S/N	Parameter	Source/ Intake	Raw Water (Treatment)	Treated Water	Storage Facility	Piped Distribution	Non-Piped Supply	Vendor/Private Supply	Point of Use (Household)	Monitoring Objective	Recommended Analytical Method	Responsible Institution	Applicable Standard/Guideline	Remarks
17	Disinfection By-products			✓						Compliance verification	Laboratory Analysis	Laboratory	TZS 789	Large systems
18	Nitrate	✓				✓			✓	Agricultural pollution	Spectrophotometer	Laboratory	TZS 789	High-risk areas
19	Nitrite	✓				✓				Health protection	Spectrophotometer	Laboratory	TZS 789	Groundwater supplies
20	Ammonia	✓				✓				Pollution indicator	Spectrophotometer	Laboratory	TZS 789	Source assessment
21	Chloride	✓				✓				Salinity intrusion	Argentometric Method	Laboratory	TZS 789	Coastal areas
22	Sulphate	✓				✓				Chemical quality	Spectrophotometer	Laboratory	TZS 789	Groundwater
23	Fluoride	✓				✓				Public health protection	Ion Selective Electrode/SPADNS	Laboratory	TZS 789	Endemic areas
24	Hardness	✓				✓				Scaling potential	EDTA Titration	Laboratory	TZS 789	Consumer acceptability
25	Iron	✓				✓				Aesthetic quality	Spectrophotometer	Laboratory	TZS 789	Groundwater
26	Manganese	✓				✓				Aesthetic quality	Spectrophotometer	Laboratory	TZS 789	Groundwater
27	Heavy Metals****	✓				✓				Toxicological assessment	ICP-MS/AAS	Accredited Laboratory	TZS 789	Mining/industrial areas
28	Cyanide	✓				✓				Mining pollution	Spectrophotometer	Accredited Laboratory	TZS 789	Mining areas
29	Hydrocarbons	✓				✓				Petroleum contamination	GC-MS	Accredited Laboratory	TZS 789	Fuel storage areas
30	Pesticides	✓				✓				Agricultural contamination	GC-MS/LC-MS	Accredited Laboratory	TZS 789	Agricultural catchments
31	Emerging Contaminants*****	✓				✓				Emerging public health risks	Advanced Instrumentation	Reference Laboratory	WHO/TZS	As capacity develops

CHAPTER FOUR

VERIFICATION AND SURVEILLANCE OF DRINKING WATER QUALITY

4.0 Introduction

Verification and surveillance are fundamental components of an effective drinking water quality management system. While operational monitoring confirms that treatment processes and operational controls are functioning as intended, verification and surveillance provide independent evidence that drinking water supplied to consumers consistently meets national drinking water quality standards and remains safe for human consumption. Together, these activities strengthen confidence in water supply systems, support regulatory compliance, facilitate timely corrective actions, and protect public health.

The Ministry of Water adopts an integrated verification and surveillance approach that links operational monitoring, laboratory analysis, regulatory oversight, and continuous improvement. The approach emphasizes preventive risk management, routine assessment of system performance, and evidence-based decision-making throughout the entire water supply chain from catchment to consumer.

4.1 Integrated Drinking Water Quality Assurance Framework

Drinking water quality assurance is achieved through a series of complementary activities that collectively ensure the effectiveness of preventive measures and continuous compliance with drinking water standards. The framework integrates operational monitoring undertaken by water suppliers with verification, independent surveillance, laboratory quality assurance, corrective actions, and continual improvement. Each component supports the others and contributes to the overall safety and reliability of drinking water supplies.

The integrated framework consists of six major components described in Figure 2 and Table 4.

Figure 2: Integrated Drinking Water Quality Assurance Framework

Table 4: Integrated Drinking Water Quality Assurance Framework

Component	Description	Primary Objective	Responsible Institution	Output
Operational Monitoring	Operational monitoring refers to routine observations and measurements conducted by water suppliers to confirm that treatment processes, operational controls, and distribution systems are functioning effectively. It provides early warning of process failures and enables operators to implement corrective actions before water quality deteriorates. Operational monitoring forms the first line of defence in ensuring drinking water safety.	Monitor operational control measures	WSSAs, RUWASA, CBWSOs, Private Suppliers	Operational records
Verification	Verification is the process of confirming that operational monitoring and preventive control measures are achieving the intended drinking water quality objectives. It relies on laboratory analysis, review of monitoring records, compliance assessment, and trend evaluation to determine whether drinking water consistently complies with	Confirm compliance with drinking water standards	Water Suppliers and Water Quality Laboratories	Compliance reports
Independent Surveillance	Independent surveillance provides an external public health assessment of drinking water safety. Unlike operational monitoring, surveillance is conducted by regulatory authorities or other independent institutions to verify compliance, assess risks, and ensure that drinking water suppliers continue to protect consumers.	Protect public health through independent assessment	Ministry of Water, Ministry of Health, EWURA	Surveillance reports
Corrective Actions	Corrective actions are undertaken whenever monitoring identifies non-compliance or system failure. Preventive actions are implemented to eliminate the root causes of recurring problems and reduce future risks. Together, these actions strengthen system resilience and promote continuous compliance.	Restore compliance following non-conformance	Water Suppliers	Corrective Action Report
Reporting	Accurate reporting and timely communication ensure that monitoring results are properly documented, interpreted, and shared with relevant stakeholders. Effective communication enhances accountability, facilitates regulatory oversight, and supports informed decision-making during both routine operations and emergency situations.	Communicate monitoring findings	All stakeholders	Monitoring Reports
Continuous Improvement	Continuous improvement involves the periodic review of monitoring results, operational performance, surveillance findings, and corrective actions to identify opportunities for enhancing drinking water safety. Lessons learned should be incorporated into Water Safety Plans, operational procedures, and institutional capacity development.	Improve water quality management	All institutions	Updated CR-WSPs

Table 5: Comparison of Operational Monitoring, Verification and Surveillance

Item	Operational Monitoring	Verification	Surveillance
Objective	Process control	Confirm water quality	Public health protection
Responsible	Water supplier	Water supplier & laboratory	Independent authority
Frequency	Continuous	Periodic	Risk-based
Main Focus	Treatment performance	Compliance	Public health
Data Source	Operational measurements	Laboratory analysis	Independent inspections
Output	Process adjustments	Compliance confirmation	Regulatory actions

4.2 Operational Monitoring

Operational monitoring is a routine management activity undertaken by water suppliers to verify that individual treatment processes and operational controls remain within established performance limits. The primary purpose of operational monitoring is to detect deviations before they result in unsafe drinking water reaching consumers. Monitoring should therefore focus on parameters that provide immediate information regarding treatment efficiency and system performance.

Operational monitoring should cover every stage of the drinking water supply system as described in Figure 3.

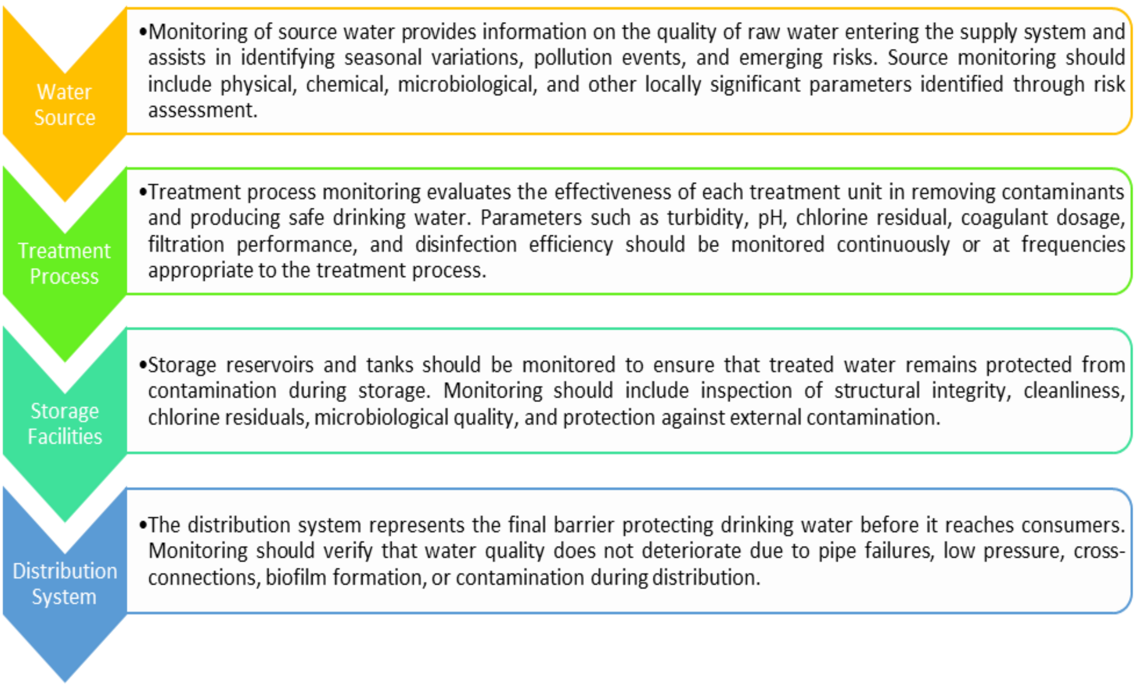

Figure 3: Operational monitoring Stages

4.3 Verification of Drinking Water Quality

Verification provides objective evidence that the drinking water supply system is achieving the desired water quality outcomes. Unlike operational monitoring, which focuses on process control, verification evaluates the final quality of water supplied to consumers and confirms compliance with national standards.

Verification activities shall include several complementary approaches described in Figure 4.

Laboratory Verification

- Laboratory verification involves independent analysis of drinking water samples collected from representative locations throughout the supply system.
- Laboratory testing should cover microbiological, physical, chemical, and radiological parameters as appropriate and be conducted using validated analytical methods.

Compliance Assessment

- Compliance assessment compares analytical results against national drinking water quality standards and regulatory requirements.
- This assessment determines whether the water supplier consistently meets mandatory quality objectives and identifies areas requiring corrective action.

Trend Analysis

- Trend analysis examines monitoring data over time to identify gradual deterioration, seasonal variations, emerging contaminants, or recurring operational problems.
- Statistical evaluation of historical data supports preventive management and investment planning.

Figure 4: Verification activities

4.4 Drinking Water Quality Surveillance

Surveillance is an independent public health function intended to protect consumers by verifying the effectiveness of drinking water quality management systems. Surveillance complements operational monitoring by providing external oversight and ensuring transparency and accountability within the water sector.

Surveillance programmes should be risk-based and proportional to the complexity of the water supply system as described in Figure 5.

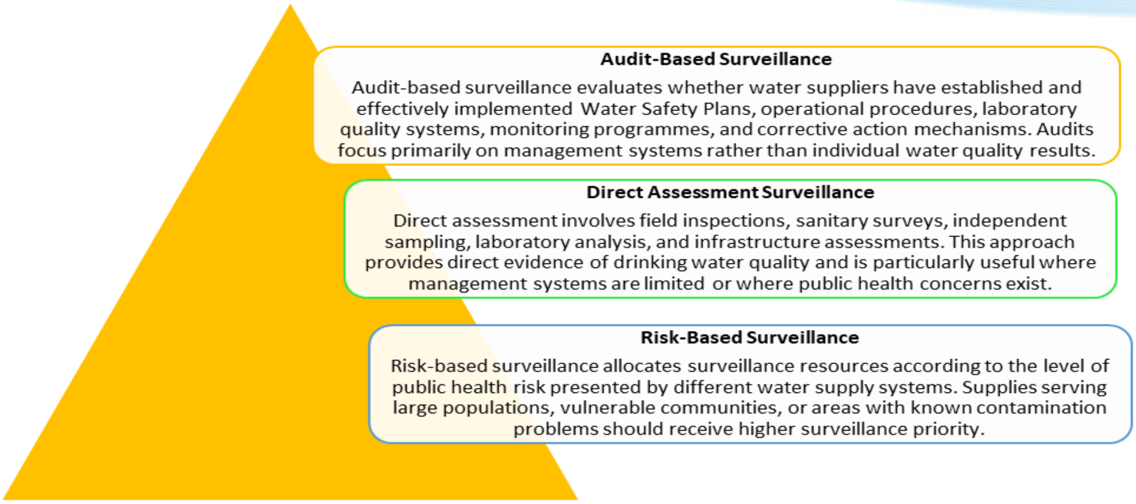

Figure 5: Surveillance programmes

4.5 Water Sampling Programme

A well-designed water sampling programme is the foundation of drinking water quality verification and surveillance. It provides representative information on the quality of water throughout the supply chain and enables water suppliers and regulatory authorities to assess compliance with national standards, evaluate treatment performance, identify contamination events, and support public health protection. The sampling programme should be developed using a risk-based approach that considers source vulnerability, treatment processes, population served, historical water quality data, and operational characteristics of the water supply system.

Sampling programmes should be documented, periodically reviewed, and updated whenever there are significant changes in water sources, treatment facilities, distribution networks, or emerging public health risks. Every water supplier shall prepare an annual sampling plan approved by the responsible authority and integrated into the Climate-Resilient Water Safety Plan.

4.5.1 Selection of Sampling Locations

Sampling locations shall be selected to provide representative information on the entire drinking water supply system. The objective is to ensure that water quality is assessed at all critical control points where contamination may occur or where operational performance requires verification.

Sampling points should therefore include raw water sources, abstraction points, treatment units, storage reservoirs, transmission mains, distribution networks, consumer taps, public institutions such as schools and health facilities, and household points of use where appropriate. Additional sampling points should be established in areas identified through risk assessment as vulnerable to contamination, including locations with intermittent water supply, low system pressure, frequent pipe bursts, or known water quality complaints.

4.5.2 Representative Sampling

Representative sampling ensures that collected samples accurately reflect the quality of water supplied to consumers. Sampling should consider hydraulic conditions, seasonal variability, water demand patterns, and population distribution to avoid biased results.

Where multiple water sources supply a distribution network, samples should be collected from each source and from representative mixing zones within the network. Similarly, sampling should include areas located at the extremities of the distribution system where water age is greatest and disinfectant residuals are most likely to decline.

4.5.3 Risk-Based Sampling

The intensity of sampling should reflect the level of risk associated with the water supply system. High-risk supplies should receive more frequent monitoring than systems with consistently satisfactory performance.

Factors influencing risk include source vulnerability, treatment complexity, previous compliance history, population served, proximity to pollution sources, climate variability, and the occurrence of waterborne disease outbreaks. Risk assessments should be reviewed periodically and updated following major operational changes or emergency events.

4.6 Sampling Information Requirements

Accurate documentation during sample collection is essential for ensuring traceability, maintaining analytical integrity, and facilitating interpretation of laboratory results. Every sample collected shall be accompanied by sufficient information to enable its origin, handling, analytical history, and associated environmental conditions to be fully understood.

Standardized sampling forms should be used throughout the country to ensure consistency and facilitate integration into national water quality information management systems.

4.6.1 Sampling Point Identification

Every sampling location shall have a unique identification code that remains consistent over time. The sampling record should include the name of the water supply scheme, GPS coordinates, administrative location, type of facility, and description of the sampling point.

Proper identification enables long-term trend analysis, reduces transcription errors, and supports integration with Geographic Information Systems (GIS) and Laboratory Information Management Systems (LIMS).

4.6.2 Sampling Date and Time

The exact date and time of sample collection shall be recorded because water quality may vary throughout the day due to operational conditions, demand fluctuations, rainfall events, or treatment adjustments.

Recording accurate timing also assists laboratories in verifying compliance with prescribed holding times before analysis.

4.6.3 Environmental and Operational Conditions

Environmental observations provide valuable context for interpreting laboratory results. During sampling, officers should record prevailing weather conditions, rainfall events, flooding, drought, construction activities, maintenance works, unusual odours, colour changes, or other observations that may influence water quality.

Operational information such as treatment plant status, chlorine dosage, system pressure, pump operation, and recent repairs should also be documented whenever applicable.

4.6.4 Chain of Custody

A documented chain-of-custody procedure shall accompany every sample from collection through laboratory analysis. The chain of custody provides assurance that samples have not been tampered with, substituted, or mishandled during transportation and storage.

Chain-of-custody records shall include the names and signatures of all personnel responsible for handling the sample, dates and times of transfer, storage conditions, and receipt by the laboratory.

4.7 Sampling Frequency

Sampling frequency determines how often water quality is assessed and should be sufficient to detect changes before they pose a public health risk. Sampling frequencies should be scientifically justified and based on the level of risk presented by the water supply system rather than relying solely on fixed schedules.

The minimum sampling frequency for drinking water quality monitoring shall be determined in accordance with Tanzania Standard TZS 789, latest applicable edition, Table 6. The minimum number of samples shall be based on the population served by the water supply system. These frequencies represent the minimum national requirement and shall be increased where risk assessment, compliance history, sanitary inspection findings, operational failures, emergencies or other local conditions indicate a higher risk to drinking water safety.

Table 6: Minimum Sampling Frequency Based on Population Served

Population Served (P)	Minimum Sampling Frequency in the Distribution System	Equivalent Minimum Number of Samples
P < 2,500	1 sample every month	12 samples/year
2,500 – 10,000	2 samples every month	24 samples/year
10,001 – 25,000	3 samples every month	36 samples/year
25,001 – 100,000	10 samples every month	120 samples/year
P > 100,000	10 samples every month for every 100,000-population served	120 samples/year per 100,000 population served

Source: TZS 789:2018/EAS 12:2018, Drinking (Potable) Water — Specification

Notes:

1. The frequencies shown above constitute the minimum sampling requirements. Sampling frequency shall be increased where risk assessment, previous non-compliance, sanitary inspection, operational failure, disease outbreak, emergency, flooding or other local conditions indicate increased water-quality risk.
2. During the rainy season, epidemics and emergencies, sampling should be conducted more frequently.
3. Where bacteriological examination indicates faecal contamination, the affected water supply should be re-sampled within two weeks at the latest, irrespective of population served.
4. Sampling points should be distributed throughout the water-supply system and rotated to provide representative coverage of the distribution network.
5. Each annual sampling plan should state the population served, required minimum number of samples, planned number of samples, sampling locations and justification for any additional risk-based sampling.

4.7.1 Review of Sampling Frequency

Sampling frequencies should be reviewed annually based on operational experience, compliance history, surveillance findings, and risk assessments. Supplies demonstrating consistently satisfactory performance may optimize monitoring programmes, whereas systems experiencing repeated non-compliance should increase monitoring intensity.

4.8 Sample Collection, Preservation, and Transportation

The reliability of laboratory results depends heavily on proper sample collection, preservation, handling, and transportation. Errors introduced during these stages cannot be corrected during laboratory analysis and may result in inaccurate conclusions regarding drinking water safety.

Standard operating procedures shall therefore be developed and implemented for every stage of sample management.

4.8.1 Collection of Microbiological Samples

Microbiological samples shall be collected using sterile sampling bottles and aseptic techniques to prevent contamination during collection. Where water has been disinfected, bottles shall contain sodium thiosulphate to neutralize residual chlorine.

Personnel shall avoid touching the inside surfaces of bottles or caps and ensure that sampling taps are properly disinfected before collection.

4.8.2 Collection of Physicochemical Samples

Samples intended for physicochemical analysis shall be collected using containers appropriate for the parameters being analysed. Different analyses may require plastic, glass, or specially preserved containers to prevent contamination or chemical changes during storage.

Sampling personnel shall ensure that preservation methods comply with internationally accepted analytical procedures.

4.8.3 Sample Preservation

Appropriate preservation techniques shall be applied immediately after sample collection to minimize biological activity and chemical transformation. Preservation methods may include cooling, acidification, addition of preservatives, protection from light, or immediate analysis, depending on the parameter of interest.

Preservation requirements shall follow Standard Methods for the Examination of Water and Wastewater or other nationally approved procedures.

4.8.4 Sample Transportation

Samples shall be transported to the laboratory as quickly as possible while maintaining appropriate temperature conditions. Transportation containers should protect samples from physical damage, excessive heat, and direct sunlight.

Laboratories shall establish maximum holding times for different parameters and reject samples that exceed acceptable storage limits unless justified and documented.

4.9 Laboratory Analysis

Laboratory analysis is a fundamental component of drinking water quality verification because it provides objective evidence of the physical, chemical, microbiological, and radiological quality of drinking water. Reliable laboratory results enable water suppliers and regulatory authorities to determine compliance with national drinking water standards, evaluate treatment effectiveness, identify emerging contaminants, and assess risks to public health. The credibility of monitoring programmes depends largely on the competence of laboratories and the quality of analytical procedures used.

All drinking water analyses shall be undertaken by laboratories operating under documented quality management systems and using validated analytical methods. Laboratories should progressively achieve accreditation in accordance with **ISO/IEC 17025:2017** to ensure technical competence, consistency, and international recognition of analytical results.

4.9.1 Selection of Analytical Methods

Analytical methods shall be selected based on their suitability for the intended purpose, required detection limits, analytical accuracy, and compliance with national and international standards. Laboratories should use methods published in internationally recognized references such as Standard Methods for the Examination of Water and Wastewater, ISO Standards, or nationally approved procedures issued by the Ministry of Water.

When selecting analytical methods, laboratories should consider the characteristics of the parameter being analysed, the available laboratory infrastructure, staff competency, equipment requirements, and the expected concentration ranges. Any alternative analytical method shall be validated before routine application to demonstrate equivalence with approved reference methods.

4.9.2 Microbiological Analysis

Microbiological examination provides the primary indication of the microbiological safety of drinking water and should receive the highest priority in routine monitoring programmes. The presence of *Escherichia coli* (E. coli) indicates recent faecal contamination and the possible presence of pathogenic microorganisms that may pose serious public health risks.

Laboratories shall analyse microbiological samples using approved culture-based or molecular methods appropriate to the required level of sensitivity. Routine monitoring should include, as a minimum, E. coli, Total Coliforms where appropriate, and other microbiological indicators based on local risk assessment.

Any detection of E. coli or thermotolerant (faecal) coliforms in drinking water shall trigger immediate investigation and confirmatory sampling. The affected point shall be resampled as soon as practicable together with hydraulically relevant upstream and downstream points, and free residual chlorine, turbidity and relevant operational conditions shall be checked. Corrective action and notification shall not be delayed where the result indicates an immediate public-health risk.

4.9.3 Physicochemical Analysis

Physicochemical analysis evaluates characteristics that influence the acceptability, safety, and operational performance of drinking water. Routine analyses should include parameters such as pH, turbidity, electrical conductivity, temperature, colour, free residual chlorine, nitrate, fluoride, hardness, iron, manganese, chloride, sulphate, and other parameters identified through local risk assessments.

Where localized water quality problems exist, laboratories should expand monitoring to include heavy metals, pesticides, hydrocarbons, cyanotoxins, salinity indicators, emerging contaminants, and other parameters of public health significance.

4.9.4 Field Measurements and Use of Field Test Kits

Field measurements are an important component of drinking water quality monitoring because some parameters are most reliably measured at the sampling location or require immediate determination due to their instability during sample storage and transportation. Field instruments and test kits may include DPD comparators or photometers for free residual chlorine, portable pH meters, conductivity meters, turbidimeters, thermometers and other approved portable analytical devices.

Field measurements may be used for operational monitoring, screening, verification and, where appropriate, compliance determination, depending on the parameter, analytical method, equipment performance and applicable national standard. The intended use of the result shall be clearly defined in the monitoring programme.

a) Field measurements acceptable for compliance determination

A field measurement may be used for compliance determination where:

i. The parameter is suitable for direct field determination and the applicable Tanzania Drinking Water Quality Standard or an approved analytical procedure permits the method used;
ii. The analytical method has adequate accuracy, precision, sensitivity and measurement range for comparison with the applicable standard or operational limit;
iii. The field instrument or test kit is fit for purpose, maintained and calibrated or verified in accordance with the manufacturer's instructions and documented institutional procedures;
iv. The measurement is undertaken by trained and competent personnel using an approved Standard Operating Procedure (SOP);
v. Applicable quality-control requirements have been satisfactorily met and documented; and

vi. The result is traceable to the sampling location, date, time, instrument or kit used, and the person conducting the measurement.

Parameters such as **temperature, pH, electrical conductivity, turbidity and free residual chlorine** may therefore be determined in the field for compliance or operational decision-making where the approved method and applicable quality-control requirements are satisfied. In particular, free residual chlorine should normally be determined immediately at the sampling point because its concentration may change rapidly following sample collection.

b) Field measurements for screening purposes

Field test kits or portable instruments that have not been validated or verified for the intended measurement, do not provide adequate sensitivity or accuracy at the applicable standard limit, or do not meet the required quality-control criteria shall be used only for screening and operational assessment.

Screening results may be used to identify potential non-compliance, guide operational adjustments, select samples for laboratory analysis, identify areas requiring further investigation or trigger precautionary corrective action. However, where a screening result indicates non-compliance with a health-based chemical standard or where the result may lead to significant regulatory or enforcement action, a confirmatory sample should be analysed using an approved laboratory method, unless the applicable approved method expressly recognizes the field determination as sufficient.

The requirement for confirmatory laboratory analysis shall not delay immediate operational or public-health protective action where field results indicate a potentially significant risk to drinking water safety.

c) Minimum quality-control requirements for field measurements

As a minimum, institutions using field test kits and portable instruments shall:

i. Use approved methods and equipment that are suitable for the intended parameter and concentration range;
ii. Calibrate or verify instruments at the prescribed frequency using appropriate standards or reference materials;
iii. Conduct appropriate zero checks, blank checks, standard checks or control measurements, depending on the analytical method;
iv. Check reagents for expiry dates, appropriate storage conditions, deterioration and contamination before use;
v. Maintain equipment in accordance with manufacturer specifications and institutional SOPs;
vi. Ensure that personnel conducting field measurements are trained and their competency is periodically assessed;
vii. Conduct duplicate measurements or other appropriate quality-control checks at a defined frequency;

viii. Periodically compare field measurements with laboratory or reference-method results to demonstrate continuing fitness for purpose;
ix. Document instrument identification, calibration or verification status, reagent lot where applicable, sampling location, date, time, analyst and test result; and
x. Investigate, document and correct any quality-control failure before results are used for compliance assessment.

Field measurement records shall form part of the drinking water quality monitoring data. They shall be subjected to the same principles of data integrity, traceability, review and reporting applicable to laboratory-generated monitoring information.

4.9.5 Laboratory Data Management

Laboratories shall establish standardized procedures for recording, validating, storing, retrieving, and reporting analytical data. Data management systems should ensure accuracy, traceability, confidentiality, and protection against unauthorized alteration.

Where feasible, laboratories should utilize Laboratory Information Management Systems (LIMS) integrated with national water quality databases to facilitate data sharing, trend analysis, reporting, and evidence-based decision-making.

4.9.6 Quality Assurance and Quality Control

Quality Assurance (QA) and Quality Control (QC) are essential components of laboratory operations that ensure analytical results are accurate, reliable, reproducible, and fit for their intended purpose. QA encompasses the planned and systematic activities implemented throughout the analytical process to prevent errors, while QC consists of operational techniques used to detect and correct analytical problems.

All laboratories conducting drinking water quality analysis shall establish documented QA/QC programmes covering personnel competency, equipment performance, analytical methods, sample handling, calibration, internal quality control, proficiency testing, and continual improvement.

Table 7: Quality Assurance and Quality Control

Internal Quality Control	External Quality Assessment	Equipment Calibration and Maintenance
• Internal quality control provides continuous assessment of analytical performance during routine laboratory operations. QC procedures should be applied to every analytical batch to verify the accuracy and precision of measurements before results are released. • Internal QC measures should include laboratory blanks, duplicate samples, certified reference materials, spiked samples, calibration verification, control charts, and routine instrument performance checks.	• External quality assessment provides independent evaluation of laboratory competence through participation in proficiency testing schemes and inter-laboratory comparison programmes. These programmes allow laboratories to benchmark their analytical performance against other laboratories and identify areas requiring improvement. • Water quality laboratories should participate in recognized national, regional, or international proficiency testing programmes at least once each year for all major analytical disciplines.	• Analytical equipment shall be calibrated using traceable reference standards at intervals specified by manufacturers or quality management procedures. Preventive maintenance schedules should be implemented to minimize equipment failures and maintain analytical reliability. • Calibration records, maintenance reports, service certificates, and instrument performance checks shall be maintained for all analytical equipment.

4.10 Method Validation

Before introducing new analytical methods into routine use, laboratories shall demonstrate that the methods are suitable for their intended application. Validation should evaluate accuracy, precision, selectivity, sensitivity, detection limits, quantification limits, linearity, robustness, and measurement uncertainty.

Documented validation reports shall be retained and reviewed whenever significant modifications are introduced.

Table 8: Minimum QA/QC Requirements

QA/QC Activity	Minimum Frequency
Instrument calibration	According to SOP
Laboratory blanks	Every analytical batch
Duplicate samples	Minimum 10%
Certified reference materials	Every batch
Internal audits	Annually
Proficiency testing	At least annually
Management review	Annually

4.11 Field and Laboratory Safety

The protection of personnel engaged in water quality monitoring and laboratory analysis is essential for maintaining effective and sustainable monitoring programmes. Field activities expose personnel to physical, biological, chemical, and environmental hazards, while laboratory work involves additional risks associated with hazardous chemicals, infectious microorganisms, compressed gases, and specialized equipment.

Every institution responsible for drinking water quality monitoring shall establish comprehensive occupational health and safety programmes consistent with national legislation and internationally accepted laboratory safety standards.

4.12 Sanitary Inspection and Risk Scoring

A sanitary inspection is a structured on-site assessment used to identify observable contamination hazards and deficiencies in the source, abstraction, treatment, storage, distribution or point-of-use environment. Standardized checklists should be used for each supply type. Each identified risk factor should be recorded and scored consistently; the sanitary inspection score should then be interpreted together with E. coli results and operational information to assign a risk category and prioritize corrective action. High sanitary risk combined with E. coli detection shall receive the highest response priority.

4.13 Verification of Climate-Resilient Water Safety Plans

Verification of Climate-Resilient Water Safety Plans (CR-WSPs) confirms that preventive risk management measures remain effective under both normal operating conditions and climate-related events. Verification complements operational monitoring by evaluating the overall effectiveness of hazard control measures and confirming that drinking water continues to meet health-based targets.

Verification should be undertaken using monitoring results, sanitary inspections, laboratory analyses, surveillance findings, internal audits, customer complaints, and periodic management reviews as shown in Figure 6 and Table 9.

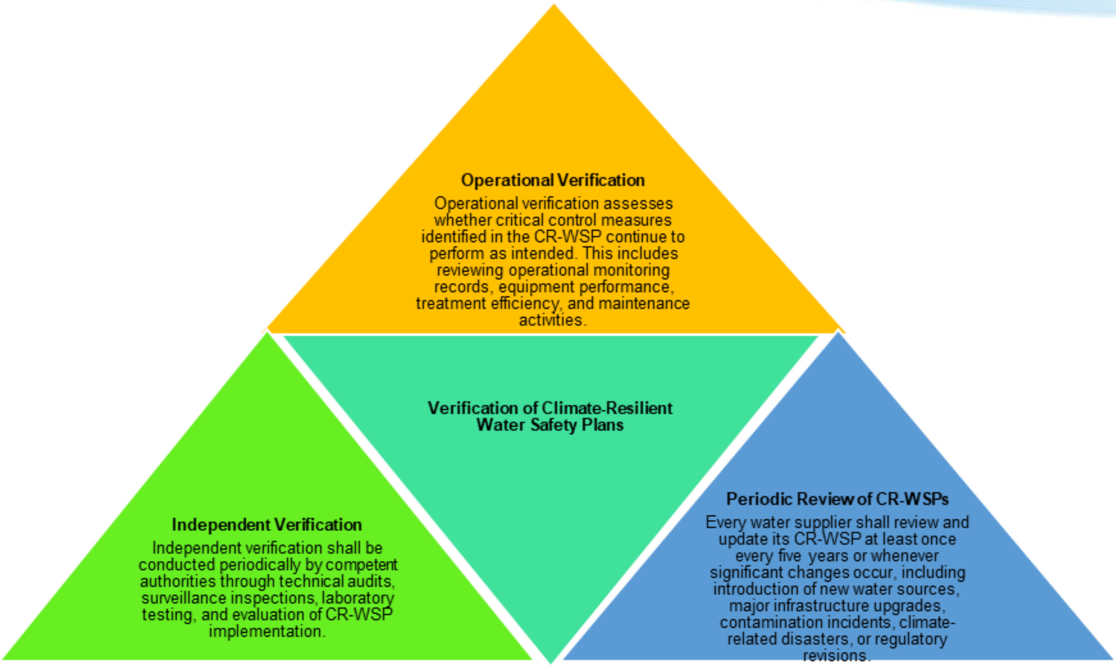

Figure 6: Verification of Climate-Resilient Water Safety Plans

Table 9: Verification Activities for CR-WSPs

Activity	Frequency	Responsible Institution
Operational review	Monthly	Water Supplier
Internal audit	Annual	Water Supplier
External verification	Every 2–3 years	Ministry of Water
CR-WSP review	Every 5 years	Water Supplier

4.14 Corrective and Preventive Actions

Whenever monitoring, verification, or surveillance identifies non-compliance with drinking water quality standards, immediate corrective actions shall be implemented to restore safe water supply and minimize risks to consumers. Corrective actions should address the immediate cause of non-compliance, while preventive actions focus on eliminating root causes to prevent recurrence.

Corrective and preventive actions should be documented, monitored, and evaluated as part of the continual improvement process (Figure 7).

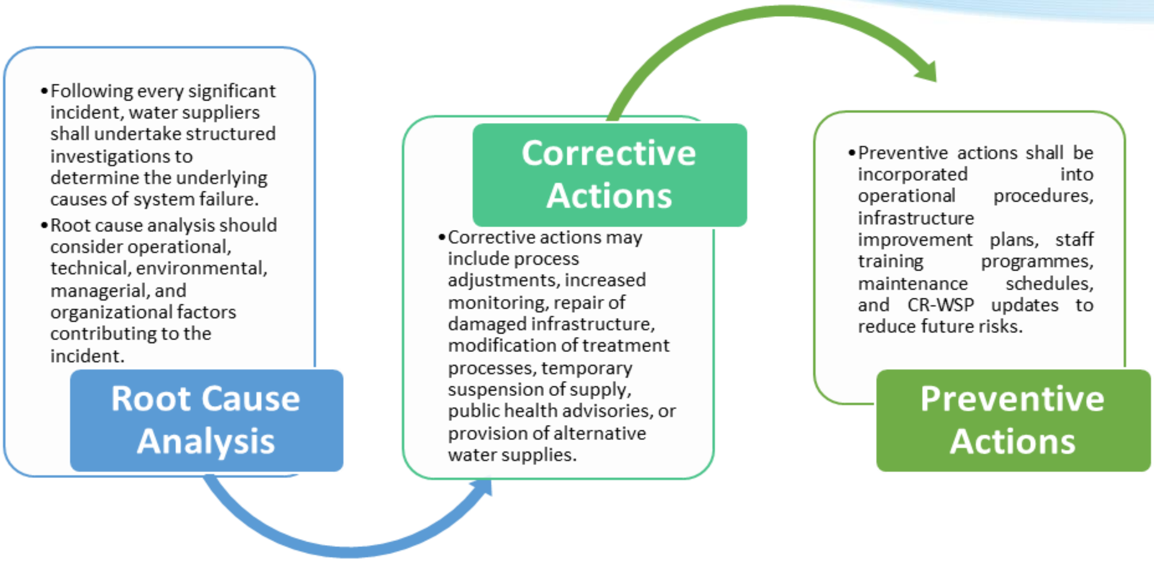

Figure 7: Corrective and Preventive Actions

4.15 Continuous Improvement

Continuous improvement ensures that drinking water quality management systems remain effective, responsive, and capable of adapting to changing environmental conditions, technological developments, regulatory requirements, and emerging public health risks. Improvement should be based on systematic evaluation of monitoring results, surveillance findings, customer feedback, audits, and performance indicators.

Water suppliers shall foster a culture of continual improvement through leadership commitment, evidence-based decision-making, capacity development, innovation, and periodic review of operational procedures.

4.15.1 Performance Monitoring

The effectiveness of drinking water quality monitoring, verification, surveillance and corrective actions shall be periodically assessed to support continuous improvement. Performance monitoring shall consider implementation of approved monitoring programmes, compliance with drinking water quality requirements, laboratory performance, implementation of corrective and preventive actions, and other relevant institutional performance measures.

4.15.2 Management Review

Senior management shall conduct formal reviews of the drinking water quality management system at least annually. Reviews should assess monitoring results, audit findings, resource adequacy, staff competency, infrastructure needs, risks, opportunities, and progress toward strategic objectives.

4.15.3 Capacity Development

Continual improvement requires sustained investment in human resources, laboratory infrastructure, monitoring equipment, digital information systems, research, and institutional collaboration. Training programmes should be implemented regularly to strengthen technical competence across all levels of the drinking water quality monitoring system.

CHAPTER FIVE

MONITORING DATA, DOCUMENTATION, AND REPORTING

5.0 Introduction

Drinking water quality monitoring generates valuable information for protecting public health, ensuring compliance with national standards, and supporting the sustainable management of water supply systems. The usefulness of monitoring programmes depends not only on the quality of sampling and laboratory analysis but also on how monitoring data are managed, analysed, reported, and used to support operational and regulatory decisions. A well-coordinated data management system transforms analytical results into reliable information that guides risk management, corrective actions, planning, and policy development.

This chapter provides a standardized framework for managing drinking water quality information in Tanzania. It outlines procedures for data collection, quality assurance, analysis, documentation, reporting, information sharing, and decision-making. The guidance is intended to strengthen institutional coordination, improve transparency, enhance evidence-based management, and support the implementation of Water Safety Plans (WSPs), national drinking water quality standards, and regulatory requirements.

5.1 Drinking Water Quality Data Management Framework

Effective drinking water quality management depends on an integrated system that links monitoring activities from field sampling to management decisions (Figure 8). Monitoring data should be collected using standardized procedures, verified for quality, analysed to determine compliance and trends, and communicated to relevant stakeholders promptly. Each stage of the process contributes to protecting public health and improving the performance of water supply systems.

Monitoring information should be generated throughout the water supply chain, including water sources, treatment facilities, storage reservoirs, distribution networks, and consumer points. Field observations, laboratory analytical results, operational records, and sanitary inspection findings should be integrated into a unified information management system to support evidence-based decision-making.

Validated monitoring information should be used to assess compliance with Tanzania Drinking Water Quality Standards (TZS 789), evaluate treatment performance, identify emerging risks, prioritize corrective actions, and support implementation of Climate-Resilient Water Safety Plans (CR-WSPs). The same information should also contribute to national reporting, investment planning, and continuous improvement of drinking water quality management.

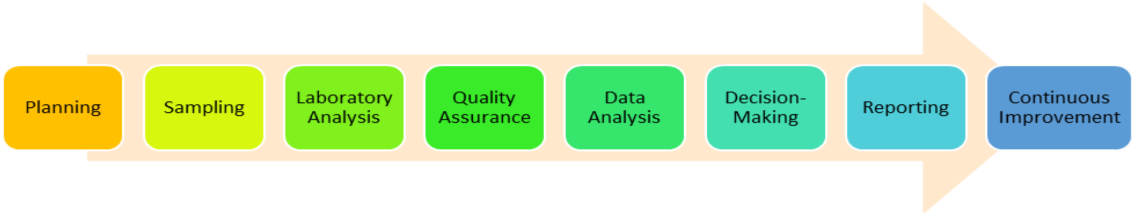

Figure 8: Drinking Water Quality Data Management Framework

5.1.1 Drinking Water Quality Data Collection

Reliable monitoring depends upon the systematic collection of representative and complete information. Data should be collected from field monitoring, laboratory analysis, operational monitoring, and surveillance activities using standardized forms approved by the Ministry of Water. All monitoring records should be complete, accurate, and traceable to facilitate interpretation and future verification. Table 10 shows the Stages of Drinking Water Quality Data Management

Field data should include sampling location, date and time of collection, GPS coordinates, source identification, field measurements, environmental observations, and sanitary inspection findings. Laboratory records should include sample identification, analytical methods, test results, quality control records, analyst identification, and approval of results before release. Operational monitoring records should include treatment performance, chemical dosing, equipment maintenance, distribution system observations, and customer complaints.

Table 10: Stages of Drinking Water Quality Data Management

Stage	**Main Activity**	**Expected Output**
Planning	Develop a monitoring programme	Approved monitoring plan
Sampling	Collect representative samples	Water samples and field records
Laboratory Analysis	Analyse water quality parameters	Analytical results
Quality Assurance	Validate and verify data	Approved monitoring data
Data Analysis	Assess compliance and trends	Technical interpretation
Decision-Making	Determine corrective actions	Management decisions
Reporting	Prepare and disseminate reports	Compliance and monitoring reports
Continuous Improvement	Review performance	Improved monitoring programme

5.1.2 Data Quality Assurance

Reliable monitoring information is essential for effective drinking water quality management. All monitoring data should therefore undergo systematic quality assurance to ensure that results are accurate, complete, consistent, traceable, and suitable for decision-making. Data quality assurance applies to every stage of the monitoring process, including sampling, transportation, laboratory analysis, data entry, interpretation, reporting, and record management.

Water suppliers and laboratories shall establish documented quality assurance procedures consistent with ISO/IEC 17025:2017 and National requirements. These procedures should include staff competency, use of approved analytical methods, equipment calibration, internal quality control, proficiency testing, document control, and periodic internal audits. The objective is to ensure confidence in monitoring results and maintain consistency across all institutions responsible for drinking water quality monitoring.

5.1.3 Principles of Data Quality

High-quality monitoring information should possess characteristics that ensure reliability and suitability for regulatory, operational, and public health decision-making. Monitoring data should accurately represent actual water quality conditions, be complete and consistent throughout the monitoring programme, remain traceable to original records, and be available within the required reporting period. Table 11 describes the principles.

Table 11: Principles of Drinking Water Quality Data Assurance

Principle	Description	Purpose
Accuracy	Results correctly represent water quality	Reliable compliance assessment
Completeness	All required information is recorded	Comprehensive evaluation
Consistency	Standardized monitoring procedures	Trend comparison
Traceability	Results linked to original records	Verification and audits
Timeliness	Results available when required	Prompt decision-making
Integrity	Protection against unauthorized alteration	Confidence in monitoring data

5.1.4 Institutional Responsibilities

Maintaining data quality is a shared responsibility among all institutions involved in drinking water quality monitoring. Field personnel are responsible for representative sampling and accurate documentation; laboratories are responsible for producing technically valid analytical results; water suppliers are responsible for reviewing monitoring information and implementing corrective actions. At the same time, the Ministry of Water and regulatory authorities are responsible for surveillance, auditing, and oversight of the national monitoring system.

5.1.5 Data Validation and Verification

Before monitoring results are entered into national databases or incorporated into reports, they should be reviewed to confirm technical accuracy and completeness. Validation should include examination of field records, laboratory worksheets, quality control results, calibration records, duplicate analyses, and analytical consistency. Any discrepancies or abnormal results should be investigated before approval.

Only validated and authorized monitoring results should be released for operational use, regulatory reporting, or public dissemination. Document any corrections made during validation to preserve traceability and ensure transparency.

5.2 Data Analysis and Utilization

Validated monitoring data should be analysed to determine compliance with drinking water quality standards, evaluate operational performance, identify emerging risks, and support evidence-based management of water supply systems. Data analysis transforms laboratory results into practical information that guides operational improvements, regulatory enforcement, investment planning, and public health protection.

Interpretation of monitoring results should consider historical trends, seasonal variation, source characteristics, treatment performance, sanitary inspection findings, and potential sources of contamination. This integrated approach provides a more comprehensive understanding of drinking water quality than interpretation based solely on individual analytical results.

5.3 Compliance Assessment

Compliance assessment involves comparing analytical results with the Tanzania Drinking Water Quality Standards (TZS 789) and other applicable regulatory requirements. Where results exceed permissible limits, water suppliers should investigate the causes, assess potential risks to consumers, and implement corrective actions without delay. Persistent non-compliance should trigger a review of treatment processes, operational controls, and Water Safety Plans. Table 12 describes the interpretation of Compliance Status.

Table 12: Interpretation of Compliance Status

Compliance Status	Interpretation	Required Action
Compliant	All parameters meet applicable standards	Continue routine monitoring
Minor Deviation	Limited exceedance of an aesthetic/operational parameter with no evidence of acute health risk; excludes any E. coli detection.	Investigate cause, correct as appropriate and verify through follow-up monitoring.
Significant Non-compliance	Multiple parameters exceed standards	Implement corrective actions
Critical Public Health Risk	Serious microbiological or chemical contamination	Immediate public health response
Critical / Health Alert	Any E. coli detection, acute health-based exceedance, treatment-barrier failure, outbreak linkage or widespread contamination.	Immediate investigation, corrective action, confirmatory sampling and notification; issue public-health advisory where safety cannot be assured.

5.4 Data Interpretation

Monitoring information should be analysed to identify temporal trends, geographical variations, and potential risks to drinking water quality. Statistical analyses, graphical presentations, and Geographic Information Systems (GIS), where available, should be used to identify contamination hotspots, seasonal changes, treatment performance, and emerging threats. Interpretation should support prioritization of interventions and review of monitoring programmes.

5.5 Utilization of Monitoring Information

Drinking water quality monitoring information should support operational management, regulatory compliance, infrastructure planning, research, and policy development. Water suppliers should use monitoring results to optimize treatment processes, improve distribution system performance, and strengthen Water Safety Plans.

Regulatory authorities should use the information to verify compliance, evaluate utility performance, and prioritize surveillance activities. At the national level, monitoring information should support water sector planning, climate resilience initiatives, reporting on Sustainable Development Goal 6, and development of evidence-based policies.

The Ministry of Water should promote the integration of monitoring information into strategic planning and decision-making to ensure that investments in drinking water quality management are guided by reliable scientific evidence and contribute to the continuous improvement of drinking water services throughout Tanzania.

5.6 Documentation and Record Management

Documentation and record management ensure that drinking water quality monitoring activities are properly documented, traceable, and available to support operational management, regulatory compliance, and public health protection. All organizations involved in drinking water quality monitoring shall establish and maintain standardized documentation systems that ensure records are complete, accurate, secure, and readily retrievable throughout their retention period.

Documentation shall provide objective evidence that monitoring activities have been conducted in accordance with approved procedures and that analytical results are technically valid. Proper record management also facilitates audits, investigations, trend analysis, regulatory inspections, and continual improvement of drinking water quality management systems.

5.6.1 Categories of Monitoring Records

Monitoring records should be maintained throughout the drinking water supply chain and should adequately document planning, sampling, laboratory analysis, operational monitoring, surveillance, and reporting activities. Each institution shall maintain records relevant to its functions while ensuring compatibility with the national drinking water quality information management system (Table 13).

Field records should include monitoring plans, sampling schedules, chain-of-custody forms, field observations, sanitary inspection reports, GPS coordinates, and field measurements. Laboratory records should include sample receipt registers, analytical worksheets, quality control records, calibration records, maintenance logs, proficiency testing records, analytical reports, and laboratory authorization records. Water suppliers should maintain operational records including treatment plant logs, chlorine dosing records, maintenance reports, customer complaints, incident reports, and corrective action records.

Table 13: Categories of Drinking Water Quality Records

Record Category	Examples	Responsible Institution
Planning Records	Monitoring plans, sampling schedules	Water Supplier/Ministry of Water
Field Records	Sampling forms, sanitary inspections, GPS records	Sampling Team
Laboratory Records	Analytical reports, QC records, calibration logs	Laboratory
Operational Records	Treatment logs, maintenance, chlorine dosing	Water Supplier
Compliance Records	Compliance assessments, corrective actions	Water Supplier/Regulator
Surveillance Records	Inspection and audit reports	Ministry of Water
Communication Records	Public notices and customer complaints	Water Supplier

5.6.2 Document Control

All documents used in drinking water quality monitoring shall be controlled to ensure that only current, approved versions are available for operational use. Controlled documents include monitoring procedures, standard operating procedures, laboratory methods, sampling protocols, reporting templates, quality manuals, and technical guidelines.

Each controlled document should have a unique identification number, version number, approval date, review date, and approving authority. Superseded documents should be withdrawn from operational use but retained where required by institutional or legal requirements. Electronic document management systems should incorporate version control mechanisms that prevent unauthorized modification of approved documents.

5.6.3 Record Storage and Retention

Monitoring records shall be stored under conditions that prevent deterioration, loss, unauthorized access, or accidental destruction. Both electronic and hard-copy records should be organized to facilitate efficient retrieval during audits, inspections, and investigations.

Electronic records should be protected through password-controlled access, routine backups, disaster recovery procedures, and cybersecurity safeguards. Hard-copy records should be stored in secure facilities protected from fire, flooding, pests, and physical damage. Record retention periods should comply with national legislation and institutional requirements while ensuring that sufficient historical information remains available for trend analysis and legal purposes as described in Table 14.

Table 14: Recommended Record Retention Periods

Record Type	Minimum Retention Period
Field Sampling Records	5 Years
Laboratory Reports	10 Years
Calibration Records	10 Years
Quality Assurance Records	10 Years
Customer Complaints	5 Years
Corrective Action Reports	10 Years
Surveillance Reports	Permanent
National Drinking Water Quality Reports	Permanent

5.7 Drinking Water Quality Reporting and Information Management

An effective reporting and information management system ensures that validated drinking water quality information is communicated to decision-makers in a timely, accurate, and consistent manner. Reporting supports operational management, regulatory oversight, public health protection, and national planning by transforming monitoring data into information that can be readily understood and acted upon.

The reporting system should integrate information generated by laboratories, Water Supply and Sanitation Authorities (WSSAs), RUWASA, Community-Based Water Supply Organizations (CBWSOs), Basin Water Boards, and the Ministry of Water. Reports should be standardized to facilitate national compilation, comparison, and performance evaluation.

5.8 Reporting Responsibilities

Every institution participating in drinking water quality monitoring shall have clearly defined reporting responsibilities. Laboratories are responsible for issuing technically authorized analytical reports, while water suppliers are responsible for consolidating monitoring results, assessing compliance, implementing corrective actions, and preparing routine monitoring reports.

Water Quality Laboratory should review performance, consolidate monitoring information, and provide technical support to water suppliers (Table 15). The Ministry of Water shall prepare national drinking water quality reports, monitor sector performance, coordinate national reporting, and disseminate information to Government and relevant stakeholders.

Table 15: Reporting Responsibilities

Institution	Main Responsibility
Laboratory	Analytical reports/Water quality services
Water Supplier	Monitoring and compliance reports
CBWSO	Community water quality reports
RUWASA	Rural water quality reports
WSSA	Urban water quality reports
Ministry of Water	National drinking water quality reports

5.9 Data and Information Sharing

Drinking water quality information should be shared among authorized institutions to support coordinated management of water quality, environmental protection, and public health. Information sharing should improve institutional collaboration, reduce duplication of monitoring activities, and strengthen evidence-based decision-making.

The Ministry of Water should maintain a centralized drinking water quality information management system capable of receiving, storing, analysing, and disseminating validated monitoring information. The system should support integration with Laboratory Information Management Systems (LIMS), Geographic Information Systems (GIS), and other relevant national databases.

Information should only be shared with authorized users according to established institutional arrangements governing data ownership, confidentiality, user access, and responsibilities for maintaining data quality as described in table 16. Sensitive information should be protected in accordance with applicable laws and institutional policies.

Table 16: Principles of Data Sharing and Information Management

Principle	Application
Accessibility	Information available to authorized users
Accuracy	Validated information is shared consistently
Confidentiality	Sensitive information is appropriately protected
Integrity	Protection against unauthorized modification
Interoperability	Compatible with national information systems
Security	Password protection, backup and cybersecurity
Traceability	Complete audit trail maintained

5.1.1 Routine Public Communication

Routine communication should be undertaken as part of normal drinking water quality management and should not be limited to emergencies. Water suppliers should disseminate monitoring information through annual water quality reports, quarterly compliance summaries, utility websites, public notice boards, community meetings, customer service centres, radio, television, and other appropriate communication channels as described in Table 17.

Routine communication should also encourage consumers to report water quality concerns, including unusual colour, taste, odour, low pressure, or suspected contamination. Customer feedback should be documented and used to strengthen monitoring programmes and improve service delivery.

Table 17: Routine Public Communication Channels

Communication Channel	**Purpose**	**Frequency**
Annual Water Quality Report	Report utility performance	Annual
Compliance Bulletin	Summarize monitoring results	Quarterly
Utility Website	Public information	Continuous
Community Meetings	Stakeholder engagement	As Required
Radio and Television	Public awareness	Periodic
Social media	Timely updates	Continuous
Customer Service Centre	Consumer enquiries and complaints	Daily

5.1.2 Risk Communication, Incident Classification, Notification and Public Advisory

Risk communication should be initiated whenever monitoring identifies actual or potential threats to public health arising from drinking water contamination. The objective is to provide timely, accurate, and coordinated information that enables consumers and responsible institutions to take appropriate protective measures.

Water suppliers should immediately notify relevant authorities where monitoring identifies microbiological contamination, chemical contamination exceeding health-based limits, treatment failures, pollution incidents, or natural disasters affecting drinking water supplies. Public health advisories should clearly describe the nature of the problem, affected areas, recommended protective measures, expected duration of the incident, and contact information for obtaining further guidance.

Communication during emergencies should be coordinated among the Ministry of Water, the Ministry responsible for Health, local government authorities, and water suppliers to ensure consistency of public messages and avoid the dissemination of conflicting information.

Water-quality incidents should be classified as Level 1 (localized operational deviation with no evidence of acute health risk), Level 2 (confirmed or probable non-compliance with potential public-health significance), or Level 3 (major event, outbreak association, widespread contamination or failure of critical treatment barriers). Level 2 and Level 3 incidents require prompt notification of the responsible water supplier, Ministry of Water and relevant public-health/regulatory authorities, with Level 3 notification initiated immediately upon confirmation or credible suspicion. A boil-water or other public-health advisory should be issued where microbiological safety cannot be assured, treatment/disinfection has failed, or competent public-health authorities determine that consumption poses an unacceptable risk. Advisories should be lifted only after corrective measures are completed, operational controls are restored and verification results demonstrate that the affected supply is safe.

5.10 National Digital Drinking Water Quality Information System

The Ministry of Water shall establish and maintain the National Digital Drinking Water Quality Information System (NDWQIS) as the official national platform for the electronic collection, validation, storage, analysis, visualization, reporting, and dissemination of drinking water quality information. The system shall provide a harmonized national framework for managing drinking water quality data generated throughout the water supply chain, from water sources to the point of use.

The NDWQIS shall improve the efficiency, consistency, accessibility, traceability, and reliability of drinking water quality information by replacing fragmented and predominantly manual reporting mechanisms with an integrated digital system. It shall support compliance monitoring, early identification of water quality risks and incidents, trend analysis, planning, regulatory oversight, budgeting, emergency response, and evidence-based decision-making. The NDWQIS shall:

i. Standardize electronic collection, validation, storage, analysis and reporting of drinking water quality data;

ii. Improve data quality, traceability, accessibility and timeliness;

iii. Facilitate timely identification of non-compliance and emerging water quality risks;

iv. Strengthen coordination and information sharing among responsible institutions;

v. Support compliance assessment, trend analysis, planning and regulatory oversight; and

vi. Provide reliable information for national reporting, investment prioritization and decision-making.

5.10.1 System Architecture and Components

The NDWQIS shall operate as a centralized web-based platform accessible to authorized users at national, regional, basin, utility, laboratory and district levels. It shall integrate the principal digital functions required for drinking water quality monitoring and reporting.

The system shall include, as appropriate:

i. Mobile/electronic field data collection for monitoring and sanitary inspection;

ii. Laboratory Information Management Systems (LIMS) for sample registration, tracking, laboratory workflows and analytical results;

iii. National Water Quality Database for centralized storage of validated monitoring information;

iv. Geographic Information System (GIS) for spatial analysis, mapping and identification of high-risk areas;

v. Compliance assessment and data-quality modules for validation against applicable standards;

vi. Dashboards and automated reporting tools for visualization, trend analysis and generation of reports;

vii. Notification and early-warning functions for non-compliance and water-quality incidents; and

viii. Data backup, recovery and system administration functions to ensure continuity and integrity of information.

5.10.2 Data Flow and Institutional Responsibilities

Water quality information shall be generated, validated, and transmitted through clearly defined institutional reporting channels. WSSAs, CBWSOs, RUWASA, Water Quality Laboratories and other authorized institutions shall collect and submit monitoring information using standardized procedures.

Laboratories shall verify analytical results before submission, while implementing agencies shall validate operational monitoring information for completeness and accuracy. The Ministry of Water shall administer the national database, establish reporting requirements, oversee data quality and system maintenance, and coordinate national drinking water quality reporting.

5.10.3 System Interoperability

The NDWQIS shall be interoperable, where appropriate, with existing national and sector information systems, including LIMS, GIS, CR-WSP databases, EWURA regulatory systems, Ministry of Health disease-surveillance systems, utility operational databases, Tanzania Meteorological Authority information systems, and other Government-approved digital platforms.

Interoperability shall follow nationally approved standards for data exchange, metadata, coding systems and electronic communication to minimize duplicate data entry and facilitate coordinated decision-making.

5.10.4 Data Security, Access, Backup and Recovery

The NDWQIS shall operate within an appropriate information-security framework to protect drinking water quality information against unauthorized access, alteration, loss, misuse and cyber threats. Access shall be controlled through role-based authorization and secure authentication.

The system shall incorporate audit trails, routine backups, disaster-recovery procedures, cybersecurity monitoring and periodic security assessments. Validated aggregate water-quality results and routine compliance information should be publicly accessible where appropriate, while personal, confidential, security-sensitive and unvalidated information shall be restricted to authorized users.

5.10.5 Dashboards, Reporting and Decision Support

The NDWQIS shall provide interactive dashboards and automated reporting tools showing monitoring results, compliance status, water-quality trends, monitoring coverage, laboratory performance, corrective-action status and high-risk water supply systems.

Dashboards shall support strategic planning, regulatory oversight, budgeting, emergency response and management decision-making through visual analytics, spatial mapping, trend analysis and early-warning alerts. The Ministry of Water shall use validated information generated through the system for periodic national drinking water quality reports.

5.11 Drinking Water Quality Reporting

Standardized reporting is essential for communicating drinking water quality information in a consistent, accurate, and timely manner. Monitoring reports provide evidence of compliance with national drinking water quality standards, support operational and regulatory decision-making, and demonstrate accountability to consumers and stakeholders. All institutions responsible for drinking water quality monitoring shall prepare reports using standardized formats approved by the Ministry of Water.

Reports should be based only on validated monitoring data and should present analytical results objectively, together with interpretation, corrective actions undertaken, and recommendations for improvement. Depending on the purpose of the report, information may be presented in tabular, graphical, or spatial formats to facilitate understanding and comparison of monitoring results.

5.11.1 Contents of Drinking Water Quality Reports

Monitoring reports should provide sufficient technical information to enable assessment of drinking water quality, compliance with standards, and effectiveness of corrective actions. Although the level of detail may vary depending on the reporting level, all reports should follow a common structure to facilitate national consolidation and comparison.

The report should include an executive summary highlighting key findings, the scope of monitoring activities, analytical results, compliance assessment, significant trends, corrective actions implemented, challenges encountered, and recommendations for improving drinking water quality management. Supporting information such as detailed laboratory reports, sampling location maps, sanitary inspection findings, and quality assurance records should be included as annexes where necessary. Table 18 describes the Recommended Structure of Drinking Water Quality Monitoring Reports.

Table 18: Recommended Structure of Drinking Water Quality Monitoring Reports

Section	Description
Executive Summary	Key findings and recommendations
Introduction	Reporting period and objectives
Monitoring Programme	Sampling locations, frequency and methods
Analytical Results	Summary of laboratory results
Compliance Assessment	Comparison with TZS 789 requirements
Trend Analysis	Significant temporal or spatial trends
Corrective Actions	Measures implemented
Challenges	Operational and technical constraints
Recommendations	Proposed improvements
Annexes	Supporting technical information

5.11.2 Reporting Schedule

Drinking water quality reports should be prepared according to nationally approved reporting schedules that support operational management, regulatory oversight, and sector performance monitoring. Routine reports should be complemented by immediate reporting of incidents that may present significant risks to public health.

Operational monitoring reports should support day-to-day management of water supply systems, while monthly, quarterly, and annual reports should provide progressively higher levels of analysis and performance evaluation. Emergency reports should be submitted immediately following confirmation of significant contamination events or treatment failures. Table 19 describes the National Drinking Water Quality Reporting Schedule

Table 19: National Drinking Water Quality Reporting Schedule

Report Type	Prepared By	Submitted To	Frequency
Operational Monitoring Report	Treatment Plant	Water Supplier	Daily
Laboratory Analytical Report	Laboratory	Water Supplier	Immediately after analysis
Monthly Monitoring Report	Water Supplier/ Laboratories	Ministry of Water	Monthly
Compliance Report	Laboratory and Regulatory institutions	Ministry of Water	Quarterly
National Drinking Water Quality Report	Ministry of Water	Government and Stakeholders	Annually
Emergency Incident Report	Water Supplier	Relevant Authorities	Immediately

5.11.3 Report Review and Approval

All drinking water quality reports shall undergo technical review before dissemination to ensure completeness, consistency, and technical accuracy. The review should verify analytical results, confirm interpretation of monitoring data, assess implementation of corrective actions, and ensure consistency with applicable standards and reporting requirements.

Reports should be approved by authorized officers before submission to regulatory authorities or release to the public. Where reports contain information relating to public health incidents, approval should be coordinated with the relevant public health authorities before dissemination.

5.12 Digital Drinking Water Quality Information Management

Digital information management enhances the efficiency, accuracy, and accessibility of drinking water quality monitoring information. The Ministry of Water shall promote the adoption of digital systems that support electronic data collection, laboratory information management, centralized data storage, analysis, visualization, and reporting.

Digital information systems reduce manual data entry, improve traceability, facilitate timely reporting, and strengthen coordination among institutions involved in drinking water quality management. They also support evidence-based planning, regulatory oversight, and national reporting obligations.

5.12.1 Components of the Digital Information Management System

The national digital information management system should integrate field data collection, laboratory information management, centralized databases, spatial analysis, reporting tools, and information security measures into a unified platform. Integration of these components enables rapid access to reliable monitoring information and supports informed decision-making at all levels.

The system should support electronic data capture during field monitoring, Laboratory Information Management Systems (LIMS) for laboratory operations, Geographic Information Systems (GIS) for spatial analysis, automated report generation, and secure storage of monitoring information as described in Table 20.

Table 20: Components of the Digital Drinking Water Quality Information Management System

Component	Primary Function
Mobile Data Collection	Electronic field data capture
Laboratory Information Management System (LIMS)	Laboratory workflow and analytical records
National Water Quality Database	Centralized storage of validated data
Geographic Information System (GIS)	Spatial analysis and mapping
Reporting Dashboard	Automated reporting and visualization
Data Backup and Recovery	Protection and recovery of information

5.12.2 Information Security

Digital monitoring information shall be protected against unauthorized access, loss, alteration, or cyber threats. Institutions should establish procedures governing user authorization, password management, system backups, disaster recovery, and cybersecurity monitoring.

Appropriate safeguards should be implemented to protect confidential information while ensuring that authorized users can readily access monitoring information required for operational management and regulatory decision-making. Regular system maintenance and periodic security reviews should be undertaken to maintain the integrity and reliability of the information management system.

5.12.3 Performance Evaluation

Performance evaluation should determine whether monitoring programmes are achieving their intended objectives and contributing to improved drinking water safety. Evaluation should consider implementation of monitoring plans, laboratory performance, compliance with reporting schedules, customer satisfaction, quality assurance performance, and effectiveness of corrective actions.

Performance indicators should be reviewed regularly to identify strengths, weaknesses, and opportunities for improvement. Results should be incorporated into institutional planning and annual performance reviews. Table 21 describes the KPIs for Drinking Water Quality Monitoring.

Table 21: Key Performance Indicators for Drinking Water Quality Monitoring

Performance Indicator	Performance Measure
Monitoring Programme Implementation	Percentage of planned samples collected
Compliance with Drinking Water Standards	Percentage of compliant samples
Laboratory Turnaround Time	Average reporting time
Data Submission Timeliness	Percentage of reports submitted on time
Corrective Actions Implemented	Percentage completed within schedule
Quality Assurance Performance	Percentage of satisfactory QA/QC results
Customer Complaints Resolved	Percentage resolved within the target period
Staff Competency	Percentage of staff trained annually

5.12.4 Continuous Improvement Process

Continuous improvement should be based on periodic review of monitoring programmes, implementation of corrective and preventive actions, strengthening of institutional capacity, and adoption of new technologies. Monitoring programmes should be updated whenever significant changes occur in water sources, treatment processes, infrastructure, regulatory requirements, or public health risks.

Institutions should encourage innovation through investment in laboratory modernization, digital technologies, research, and professional development. Lessons learned from audits, surveillance activities, emergency responses, and operational experience should be incorporated into revised procedures and Climate-Resilient Water Safety Plans.

CHAPTER SIX
RESOURCE MOBILIZATION

6.0 Introduction

Effective implementation of these Guidelines requires a comprehensive package of resources covering institutional capacity, infrastructure, equipment, operational logistics, information systems, and human resources. Investment decisions should consider current service gaps, future population growth, emerging contaminants, climate variability, and technological advancement.

The sustainability of drinking water quality monitoring depends on the availability of predictable, adequate, and long-term financial resources. Routine monitoring should not rely solely on project-based funding but should be institutionalized within the annual planning and budgeting processes of all responsible institutions. Sustainable financing ensures continuous sampling, laboratory analysis, equipment maintenance, procurement of reagents and consumables, staff capacity development, data management, emergency response, and implementation of corrective actions. Diversifying funding sources also strengthens resilience against financial uncertainties and supports uninterrupted public health protection.

Resource requirements should therefore be categorized into:

i) Institutional resources;
ii) Human resources;
iii) Laboratory infrastructure;
iv) Analytical equipment;
v) Field monitoring equipment;
vi) Transport and logistics;
vii) Digital information systems;
viii) Emergency response capacity; and
ix) Research and innovation resources.

Each implementing institution should periodically assess its resource requirements and prepare medium-term investment plans to address identified gaps.

For smooth and sustainable implementation of the guidelines in urban and rural settings, adequate financial resources should be mobilized to cover the required costs. In the context of implementing this guideline, resources can be mobilized through the following modalities: -

6.1 Resource Mobilization Modalities

6.1.1 Government Budget Allocation

The Government shall remain the primary financier of national drinking water quality monitoring programmes. The Ministry of Water, Water Supply and Sanitation Authorities (WSSAs), RUWASA, Basin Water Boards, Local Government Authorities and other responsible institutions shall integrate drinking water quality monitoring activities into their Medium-Term Expenditure Frameworks (MTEF) and annual budgets.

Government financing should support:

i. Routine surveillance and compliance monitoring.
ii. Operation and maintenance of water quality laboratories.
iii. Procurement of laboratory equipment, reagents and field-testing kits.
iv. Maintenance and calibration of laboratory instruments.
v. Laboratory accreditation and quality assurance programmes.
vi. Capacity building of laboratory and field personnel.
vii. Development and maintenance of digital water quality information systems.
viii. Emergency monitoring during disease outbreaks, floods, droughts and other disasters.
ix. Research and innovation for emerging contaminants and climate-related water quality risks.

Priority should be given to protecting core monitoring functions to ensure uninterrupted surveillance of drinking water quality throughout the country.

6.1.2 Development Partner Support

Development partners play an important complementary role in strengthening national drinking water quality monitoring systems. Their support should be aligned with national priorities and coordinated through the Ministry of Water to ensure sustainability and avoid duplication.

Potential areas of support include:

i. Strengthening laboratory infrastructure.
ii. Procurement of advanced analytical equipment.
iii. Provision of laboratory reagents and consumables.
iv. Development of Laboratory Information Management Systems (LIMS).
v. Capacity development and specialized technical training.
vi. Climate-resilient drinking water quality monitoring.
vii. Research, innovation and pilot projects.
viii. Digital monitoring platforms and data management systems.
ix. Emergency response during disease outbreaks and natural disasters.

Development partner support should complement, rather than replace, domestic financing, with sustainability plans incorporated from project inception.

6.1.3 Institutional Cost-Sharing Mechanism

Routine drinking water quality monitoring is a shared responsibility requiring financial contributions from all institutions benefiting from the monitoring system. A cost-sharing mechanism promotes ownership, sustainability and efficient utilization of available resources. Table 22 shows the institutional financing arrangements: -

Table 22: Financing arrangements

Institution	Primary Financing Responsibility
Ministry of Water	National coordination, surveillance, policy implementation, reference laboratories, national database and capacity development
Water Supply and Sanitation Authorities (WSSAs)	Routine operational monitoring, laboratory operation, chemicals, sampling, equipment maintenance and reporting
RUWASA	Rural water quality monitoring and support to Community-Based Water Supply Organizations
Basin Water Boards	Source water quality monitoring and catchment surveillance
Local Government Authorities	Community monitoring, public health surveillance, sanitation inspections and emergency response
Ministry of Health	Public health surveillance, outbreak investigations and risk communication
Development Partners	Strategic investments, innovation, technical assistance and institutional strengthening
Academic and Research Institutions	Research, innovation, laboratory collaboration and specialized analytical services
Private Water Suppliers	Compliance monitoring and payment for laboratory services in accordance with regulatory requirements

6.1.4 Cost Recovery for Laboratory Services

Water quality laboratories should implement transparent cost-recovery mechanisms for analytical services provided to utilities, private water suppliers, industries, institutions and other clients. Revenue generated should be retained and reinvested, in accordance with Government financial regulations, to support:

i. Procurement of laboratory reagents and consumables.
ii. Instrument maintenance and calibration.
iii. Replacement of obsolete equipment.
iv. Laboratory accreditation activities.
v. Staff competency development.
vi. Improvement of customer services and laboratory information systems.

Cost recovery should not compromise regulatory surveillance or public health monitoring responsibilities.

6.1.5 Public–Private Partnerships and Corporate Support

Where appropriate, public-private partnerships may be established to strengthen water quality monitoring through investment in laboratory infrastructure, analytical technologies, mobile laboratories, digital monitoring systems and research initiatives. Corporate social responsibility programmes may also support community-based monitoring, awareness campaigns and laboratory improvement projects.

6.1.6 Corporate Social Responsibility (CSR) Initiatives

Corporate Social Responsibility (CSR) initiatives from industries such as mining, manufacturing, and beverage companies can provide financial and technical support for water quality monitoring. These companies should be encouraged to fund laboratory infrastructure, community awareness programs, and research initiatives. Engaging industries in collaborative partnerships ensures that they contribute to the sustainability of safe drinking water.

6.1.7 Research and Innovation Grants

Academic institutions and research organizations can provide funding through grants focused on water quality innovation. Research-driven solutions, such as mobile-based water quality reporting systems and artificial intelligence-driven analysis tools, can enhance monitoring efficiency. Universities and scientific organizations should be encouraged to collaborate with water supply entities to develop

6.2 Financial Planning and Resource Mobilization Strategy

Each institution responsible for drinking water quality monitoring should prepare a multi-year resource mobilization strategy that includes:

i. Estimated annual monitoring costs.
ii. Funding gaps and priorities.
iii. Potential domestic financing sources.
iv. Development partner contributions.
v. Cost-sharing arrangements.
vi. Investment plans for laboratory infrastructure and equipment.

vii. Risk mitigation measures for financial sustainability.
viii. Monitoring indicators for financing performance.

The strategy should be reviewed annually and aligned with institutional strategic plans and national development priorities.

6.3 Monitoring Indicators for Sustainable Financing

Implementation of the financing framework should be monitored using the following indicators: -

i. Percentage of annual water quality monitoring budget funded through Government allocations.
ii. Percentage of planned monitoring activities implemented using domestic resources.
iii. Amount of revenue generated through laboratory cost recovery.
iv. Number and value of development partner-supported projects.
v. Percentage of laboratories with uninterrupted supplies of essential reagents and consumables.
vi. Percentage of monitoring equipment calibrated and operational throughout the year.
vii. Percentage of WSSAs and RUWASA offices with dedicated annual budgets for routine drinking water quality monitoring.
viii. Percentage of planned monitoring activities completed on schedule.

6.4 Capacity Development

Sustainable drinking water quality monitoring depends not only on adequate financial resources but also on the availability of competent human resources, functional institutions, modern laboratories, and appropriate technologies. Capacity development is therefore an integral component of resource mobilization and should be prioritized by all institutions responsible for drinking water quality management. The Ministry of Water, in collaboration with sector institutions, development partners, academic and research institutions, and professional organizations, shall promote continuous capacity development to strengthen technical, managerial, and institutional capabilities required for effective implementation of these Guidelines. Capacity development programmes should support competency-based training, mentoring, professional certification, knowledge exchange, and adoption of innovative technologies to enhance monitoring, laboratory analysis, data management, and risk-based decision-making.

Water Supply and Sanitation Authorities (WSSAs), RUWASA, Water Quality Laboratories, and other implementing institutions shall prepare annual capacity development plans based on identified training needs and institutional performance assessments. Priority areas should include:

i. implementation of Climate-Resilient Water Safety Plans (CR-WSPs), drinking water sampling techniques,
ii. Laboratory quality management systems in accordance with ISO/IEC 17025, laboratory information management systems (LIMS),
iii. Digital data management, quality assurance and quality control (QA/QC), emergency response, and
iv. monitoring of emerging contaminants.

Investment in capacity development should also include upgrading laboratory infrastructure, provision of modern analytical equipment, strengthening institutional coordination, and supporting operational research and innovation. Continuous investment in human and institutional capacity will improve the quality, reliability, and sustainability of drinking water quality monitoring and reporting while enhancing resilience to emerging public health and climate-related risks.

CHAPTER SEVEN
ROLES AND RESPONSIBILITIES

7.0 Roles and Responsibilities of Stakeholders in Monitoring Drinking Water Quality

One of the most critical aspects relating to achieving effective drinking water quality monitoring in the country is ensuring effective and meaningful sector collaboration. The objective is to create an enabling and supporting environment that fosters collaboration, mutual support, and learning among stakeholders. Given that different stakeholders have different strengths and weaknesses within their areas of expertise, nationally based knowledge of drinking water quality initiatives is required for smooth implementation. Thus, formal coordination of responsible stakeholders and a national commitment to drinking water quality monitoring should be promoted. To maintain sustainable drinking water supply services with the goal of safeguarding public health, the implementation of the national drinking water quality monitoring should be a duty of several stakeholders. A brief explanation of roles and responsibilities of stakeholders for effective execution of these guidelines is outlined in a RACI(Responsible–Accountable–Consulted–Informed) matrix (Table 23).

A RACI Matrix clearly distinguishes who performs the work, who has final accountability, who provides technical input, and who should be informed. This will improve governance, coordination, and accountability across the drinking water quality monitoring system.

Table 23: Institution's role and responsibilities

Key Activity	Institutions														
	MoW	WSSAs	RUWASA	MoH	EWURA	BWBs	LGAs	Water Quality Laboratories	CBWSOs/Private Suppliers	Development Partners	TBS	NEMC	PMO-RALG/LGAs	GCLA	Academic/ Research
Develop national policies, standards and guidelines	A/R	I	I	C	C	C	I	C	I	C	R/C	C	C	C	C
Coordinate national drinking water quality monitoring programme	A/R	R	R	C	C	C	C	C	I	I	C	C	C	C	C
Develop annual monitoring plans	A	R	R	C	I	C	C	C	I	I	I	C	R/C	C	C
Implement Water Safety Plans (CR-WSPs)	C	A/R	A/R	C	I	C	I	C	R	I	I	C	R/C	C	C
Operational water quality monitoring	I	A/R	A/R	I	I	C	I	C	R	I	I	I	R/C	C	C
Surveillance monitoring	A	C	C	R	C	C	R	C	I	I	C	C	R	C	C
Laboratory analysis	C	R	R	C	I	I	I	A/R	I	I	I	I	I	R	R/C
Quality assurance and proficiency testing	A	C	C	C	I	I	I	R	I	C	C	I	I	R/C	R/C
Data validation and quality assurance	A	R	R	C	I	I	I	R	I	I	C	I	I	R/C	C
National drinking water quality database management	A/R	R	R	C	C	I	I	C	I	I	I	I	I	I	C
Routine reporting	A	R	R	C	C	I	I	C	I	I	I	I	R	C	C

Key Activity	Institutions														
	MoW	WSSAs	RUWASA	MoH	EWURA	BWBs	LGAs	Water Quality Laboratories	CBWSOs/Private Suppliers	Development Partners	TBS	NEMC	PMO-RALG/LGAs	GCLA	Academic/ Research
Develop national policies, standards and guidelines	A/R	I	I	C	C	C	I	C	I	C	R/C	C	C	C	C
Coordinate national drinking water quality monitoring programme	A/R	R	R	C	C	C	C	C	I	I	C	C	C	C	C
National reporting and publication	A/R	C	C	C	C	I	I	C	I	I	C	C	C	C	C
Compliance inspection and enforcement	A	R	R	C	R	C	C	I	I	I	C	R	R/C	C	I
Outbreak investigation and emergency response	C	R	R	A/R	I	C	R	C	I	I	I	C	R	R/C	C
Public awareness and risk communication	A	R	R	R	C	I	R	I	C	C	I	C	R	I	C
Capacity building and technical support	A/R	R	R	C	C	C	C	C	I	R	R/C	C	R/C	R/C	R
Resource mobilization and financing	A/R	R	R	C	C	I	C	I	I	R	I	C	R/C	C	R/C
Annual performance review	A/R	R	R	C	C	C	C	C	I	C	C	C	C	C	C

Key

R – Responsible: Performs the activity.
A – Accountable: Has final decision-making authority and is answerable for results (only one institution should normally be accountable).
C – Consulted: Provides technical advice or contributes to decisions.
I – Informed: Kept informed of progress and outcomes.

CHAPTER EIGHT

MONITORING, EVALUATION AND CONTINUOUS IMPROVEMENT

8.0 Introduction

Monitoring, evaluation and continuous improvement are essential for determining whether implementation of these Guidelines is achieving the intended improvements in drinking water quality monitoring, reporting, compliance and public-health protection. A structured Monitoring and Evaluation (M&E) framework provides the Ministry of Water and other responsible institutions with a systematic mechanism for tracking implementation, measuring performance, identifying gaps, and determining whether corrective actions are producing the expected results.

The M&E process shall cover the entire drinking water quality monitoring system, including implementation of monitoring programmes, compliance with drinking water quality standards, laboratory performance, data quality and reporting, implementation of corrective and preventive actions, institutional capacity, and application of risk-based approaches. Information generated through monitoring and evaluation shall support evidence-based planning, budgeting, management review, resource allocation and improvement of drinking water quality management.

Monitoring and evaluation shall be implemented as a continuous management process rather than a stand-alone reporting exercise. Results shall therefore be routinely analysed and used to identify emerging risks, recurring non-compliance, institutional and operational weaknesses, and opportunities for improvement. Findings shall feed into corrective actions, institutional planning, revision of monitoring programmes and improvement of Climate-Resilient Water Safety Plans (CR-WSPs).

8.1 Objectives of Monitoring and Evaluation

The overall objective of monitoring and evaluation is to provide a systematic framework for assessing the effectiveness, efficiency and consistency of implementation of the National Guidelines on Drinking Water Quality Monitoring and Reporting.

Specifically, the M&E framework shall:

i. Track implementation of drinking water quality monitoring programmes against approved plans, targets, sampling schedules and institutional responsibilities;

ii. Assess compliance with national drinking water quality standards and identify trends in water quality performance and areas of persistent or emerging non-compliance;
iii. Assess institutional and laboratory performance, including analytical turnaround time, quality assurance and quality control, data submission, reporting, staff competency and implementation of assigned responsibilities;
iv. Monitor implementation and effectiveness of corrective and preventive actions arising from monitoring, surveillance, audits, incidents and non-compliance;
v. Identify operational, technical, institutional and resource gaps affecting effective implementation of drinking water quality monitoring programmes;
vi. Provide reliable evidence for planning, budgeting, resource allocation, regulatory oversight and management decision-making; and
vii. Promote continuous improvement by ensuring that findings and lessons from monitoring, evaluation, audits, surveillance and emergency responses are systematically incorporated into subsequent monitoring programmes and management systems.

8.2 Monitoring Framework

The monitoring framework shall provide a coordinated mechanism for collecting, analysing, reviewing and reporting information on implementation of these Guidelines. Monitoring shall be undertaken at institutional and national levels using standardized performance indicators and reporting arrangements.

Each responsible institution shall integrate the relevant indicators into its annual work plans and drinking water quality monitoring programmes. Monitoring shall assess both implementation performance and results achieved. Implementation monitoring shall determine whether planned activities—including sampling, laboratory analysis, reporting, sanitary inspections, CR-WSP verification, capacity development and corrective actions—are being undertaken as scheduled. Results monitoring shall determine whether these activities are contributing to improved compliance, data quality, institutional performance and drinking water safety.

Monitoring information shall be obtained from existing systems and records, including:-

i. Drinking water quality monitoring plans and sampling records;
ii. Laboratory analytical records and QA/QC results;
iii. Compliance assessment reports;
iv. Sanitary inspection and surveillance reports;
v. CR-WSP verification reports;
vi. Corrective and preventive action records;
vii. Incident and emergency response reports;
viii. Institutional monthly, quarterly and annual reports;

ix. Training and competency records; and
x. The National Digital Drinking Water Quality Information System (NDWQIS).

The Ministry of Water shall coordinate national-level performance monitoring and consolidate information submitted by implementing institutions. WSSAs, RUWASA, CBWSOs, Water Quality Laboratories and other responsible institutions shall monitor activities within their respective mandates and ensure that accurate and timely information is submitted through established reporting mechanisms.

Monitoring results shall be periodically reviewed to identify deviations from targets, recurring non-compliance and areas requiring management attention. Where significant gaps are identified, responsible institutions shall establish corrective actions, assign responsibilities and timelines, and subsequently verify the effectiveness of the actions taken.

8.3 Performance Indicators

Performance indicators shall provide measurable evidence for assessing implementation and effectiveness of drinking water quality monitoring programmes. Indicators shall be specific, measurable, relevant and capable of being routinely verified using established monitoring and reporting systems. Table 24 shows the performance area and the KPIs.

Performance evaluation shall consider implementation of monitoring plans, compliance with drinking water quality standards, laboratory performance, adherence to reporting schedules, quality assurance performance, implementation of corrective actions, customer complaint resolution and staff competency.

Table 24: Key Performance Indicators for Drinking Water Quality Monitoring and Reporting

Performance Area	Key Performance Indicator	Performance Measure	Means of Verification
Monitoring Programme Implementation	Implementation of planned monitoring activities	% of planned samples collected and analysed	Monitoring plans, sampling and laboratory records
Drinking Water Quality Compliance	Compliance with national drinking water quality standards	% of analysed samples complying with applicable standards	Laboratory and compliance reports
Laboratory Performance	Laboratory turnaround time	Average time between sample receipt and issuance of analytical results	LIMS/laboratory records
Data and Reporting	Timeliness of data/report submission	% of required reports submitted within prescribed timelines	NDWQIS and reporting records
Corrective	Timely	% of corrective actions	CAPA records

Performance Area	Key Performance Indicator	Performance Measure	Means of Verification
Actions	implementation of corrective actions	completed within agreed timeframe	and verification reports
Quality Assurance	Satisfactory QA/QC performance	% of QA/QC results meeting established acceptance criteria	QA/QC, PT and ILC records
Consumer Response	Resolution of water-quality complaints	% of water-quality complaints resolved within established timeframe	Complaint registers and response records
Human Resource Capacity	Staff competency development	% of relevant staff receiving required training/competency assessment annually	Training and competency records
CR-WSP Implementation	Verification of CR-WSP implementation	% of planned CR-WSP verification activities completed	CR-WSP verification reports
Performance Review	Institutional performance review	% of responsible institutions conducting scheduled performance/management reviews	Management review reports

Performance indicators shall be reviewed periodically to ensure their continued relevance to national priorities, regulatory requirements, emerging water quality risks and changes in monitoring systems. Where performance falls below established targets, the responsible institution shall determine the underlying cause and establish appropriate corrective actions.

Performance information shall be incorporated into institutional planning, annual performance reviews, resource allocation and national drinking water quality reporting. The NDWQIS dashboards described in Chapter Five can support this process by providing information on compliance status, laboratory performance, monitoring coverage, corrective actions and high-risk systems.

8.4 Evaluation and Continuous Improvement

Evaluation shall periodically determine the extent to which implementation of these Guidelines is achieving the intended objectives and contributing to improved drinking water quality management and public-health protection. Evaluation shall consider trends in drinking water quality compliance, effectiveness of monitoring programmes, institutional and laboratory performance, effectiveness of corrective actions, adequacy of resources, implementation of CR-WSPs, and effectiveness of coordination and reporting arrangements.

Evaluation findings shall identify achievements, persistent implementation gaps, recurring non-compliance, emerging risks and opportunities for improvement. The findings shall be communicated to responsible institutions and incorporated into management reviews, annual planning, budgeting, capacity-development programmes and revisions of monitoring priorities.

Continuous improvement shall be based on the systematic implementation and follow-up of corrective and preventive actions, strengthening of institutional and laboratory capacity, improvement of monitoring procedures and adoption of appropriate technologies. Monitoring programmes shall be reviewed whenever significant changes occur in water sources, treatment processes, infrastructure, regulatory requirements, monitoring technologies or public-health risks. This retains the substantive requirements currently contained in Section 5.8.4.

Institutions shall also promote innovation through laboratory modernization, digital technologies, research and professional development. Lessons learned from monitoring results, audits, surveillance activities, emergency responses and operational experience shall be documented and incorporated into revised procedures, monitoring programmes and CR-WSPs.

The continuous improvement process should follow a **Plan–Do–Check–Act (PDCA)** approach whereby institutions plan monitoring activities and performance targets; implement the approved activities; assess results against established indicators and requirements; and take corrective or improvement actions based on the findings. This cycle shall be repeated to ensure that drinking water quality monitoring and reporting systems remain responsive to changing risks, institutional needs and national priorities.

REFERENCES

Government of the United Republic of Tanzania. National Water Policy (NAWAPO), 2002, revised 2025.

Government of the United Republic of Tanzania. Water Supply and Sanitation Act No. 5 of 2019 and applicable regulations.

Government of the United Republic of Tanzania. Water Resources Management Act, Cap. 331.

Government of the United Republic of Tanzania. Environmental Management Act, Cap. 191.

Tanzania Bureau of Standards. TZS 789, Drinking (Potable) Water Specification, latest applicable edition.

World Health Organization. Guidelines for Drinking-water Quality, Fourth Edition incorporating the First, Second and Third Addenda. Geneva: WHO, 2026.

World Health Organization. Water Safety Plan Manual: Step-by-step Risk Management for Drinking-water Suppliers, Second Edition. Geneva: WHO, 2023.

ISO/IEC 17025:2017. General requirements for the competence of testing and calibration laboratories.

APHA, AWWA and WEF. Standard Methods for the Examination of Water and Wastewater, latest applicable edition.

Ministry of Water. Water Quality Management and Pollution Control Strategy (WQMPCS), 2011.

Ministry of Water. Guidelines for Climate-Resilient Water Safety Plans for Urban and Rural Water Supplies, 2025.

APPENDICES

Appendix 1: Risk-based operational monitoring program (characteristics and frequencies)

Location	Characteristics/parameters	Monitoring frequency	The rationale for monitoring frequencies
Catchment			
General catchment	Rainfall	Daily	Understand the impact of rainfall on water quality to help predict challenges across a range of rainfall intensities.
	Inspection	Monthly to Daily Frequency depends on the level of access and use permitted in the catchment.	Detect human and animal activities that could cause contamination; Confirm that fences and signs are effective.
Source Water			
Storage dam or raw water reservoir	Temperature and Dissolved oxygen profile	Monthly to weekly	Information for the management of water quality in storage with existing or new management systems.
	General water quality profile	Weekly to event-based	Allow the best quality water to be selected for supply.
	Inspection	Weekly	Detect human and animal activities that could cause contamination.
	Coliform bacteria	Risk-based	Information for changes to water treatment processes to maintain optimal coliform bacteria removal.
	Turbidity	Daily	Information for changes to water treatment processes to maintain optimal turbidity and color removal.
	Color	Weekly to event-based	
River intake	Rainfall	Daily	Understand the impact of rainfall on water quality to help predict challenges under a range of rainfall intensities.
	Turbidity	Daily	Inform changes to water treatment processes to maintain optimal turbidity and color removal.
	Color	Weekly to event-based	
	E.coli	Risk-based	Identify high challenge periods and forewarn downstream processes; identify the local point source of contamination. Intervene in the catchment before the reservoir is affected.
	Pesticides and colour	Risk-based	Feedback to the industry and the source of contamination.
	Other chemicals (e.g. Iron and Manganese)	Weekly (risk-based)	Inform changes to water treatment processes to maintain optimal iron and manganese removal; forewarn of water quality that may cause customer complaints.
Treatment Processes			
Coagulation (inlet to flocculation tank)	pH	Daily	Optimize pH for effective coagulation of selected coagulants when raw water quality changes. Provide alarm if pH is

Location	Characteristics/parameters	Monitoring frequency	The rationale for monitoring frequencies
			outside set limits.
Flocculation (last compartment)	Floc characteristics	Daily to Event-based	Optimize flock characteristics for effective clarification or filtration when changes occur to raw water quality or operating conditions.
Clarifier (clarified water outlet)	Turbidity	Daily	Confirm coagulant dose, pH correction, flocculation, and clarifier operations are optimized when changes occur to raw water quality or operating conditions.
	Color	Daily to Event-based	Provide an alarm if turbidity is above the set limits.
	Visual observation of the flock or the flock blankets	Daily to Event-based	Assess if the adjustment is needed to improve the stability of the clarification process.
Filtration (Individual or combined filtered water)	Turbidity	Daily	Provide an alarm if filtrate turbidity is above the set maximum and trigger for initiating filter cleaning to avoid turbidity breakthrough.
	Filter Head loss	Daily	
Filtration (Combined filtered water post-pH correction)	pH	Daily	Confirm target pH range is maintained. Provide alarm if pH is outside target limits for effective disinfection and corrosion control.
	Aluminium (If aluminium-based coagulant is used)	Weekly	Assess inadvertent carry-over of aluminum from sub-optimal flocculation pH.
Chlorine Disinfection	Free Chlorine Residual	Daily	Provide alarm if chlorine residual is outside set limits for maintaining the integrity of water quality during reticulation and for reticulation hygiene.
UV Disinfection	UV dose rate	Daily	Confirm UV system is operating satisfactorily. Provide alarm if below minimum set dose.
Distribution System			
Disinfection (at various locations in the reticulation system selected carefully during monitoring design)	Chlorine residual	Daily	Confirm total chlorine target or free chlorine residual target range is achieved.
Service Reservoirs and tanks	Integrity from contamination	Quarterly to semi-annual or risk-based	Confirm roof/hatches are effective against ingress of contaminants.
Consumers	Customer complaints	Ongoing	Clusters complaints of turbidity, objectionable taste and odor, and illness allow the investigation to identify the cause (s) of water quality problems.

Appendix 2: Standard Field Sampling Form

Section / Field	Information to be Completed / Options
A. Administrative Information	
Form No.	
Version No.	
Sampling Programme/Plan Reference	
Institution/Organization	
Region	
District/LGA	
Ward	
Village/Mtaa	
Water Supplier/Operator	
Water Supply Scheme/System	
Sampling Purpose	☐ Routine Monitoring ☐ Verification ☐ Surveillance ☐ Incident Investigation ☐ CR-WSP Verification ☐ Other: ______
Sampling Officer/Team	
Contact Details	
B. Sample and Sampling Point Identification	
Unique Sample ID	
Sampling Point Code	
Sampling Point Name	
Sampling Point Description	
Coordinates GPS	Latitude:_________ Longitude:
Source/Facility Name	
Population Served, where applicable	
Sampling Point Category	☐ Source/Intake ☐ Raw Water ☐ Treatment Unit ☐ Treated Water/Plant Outlet ☐ Storage Tank/Reservoir ☐ Transmission Main ☐ Distribution Network ☐ Public Tap ☐ Borehole ☐ Spring ☐ Shallow Well ☐ Vended/Private Supply ☐ School ☐ Health Facility ☐ Household/POU ☐ Other: ______
Source Type	☐ River ☐ Lake ☐ Dam/Reservoir ☐ Spring ☐ Borehole ☐ Shallow Well ☐ Other: ______
Supply Type	☐ Piped ☐ non-piped ☐ Vended/Private
Treatment Provided	☐ None ☐ Chlorination ☐ Conventional Treatment ☐ Filtration ☐ UV ☐ Other: ______
Sampling Date and Time	
E. Environmental and Sanitary Observations	
Weather	☐ Sunny ☐ Cloudy ☐ Rainy ☐ Windy ☐ Other
Flooding	☐ Yes ☐ No
Drought/Low Source Level	☐ Yes ☐ No
Construction/Maintenance Nearby	☐ Yes ☐ No
Anthropogenic activities Nearby (e.g Agricultural, Livestock Sewage/Wastewater, Solid Waste Disposal, Mining/Industrial)	☐ Yes ☐ No: If yes, mention
Leakage/Pipe Burst Observed	☐ Yes ☐ No
Overall Sanitary Condition	☐ Good ☐ Fair ☐ Poor
Other Significant Observations	
F. Operational Conditions	

Section / Field	Information to be Completed / Options
Treatment Plant Operating	☐ Yes ☐ No ☐ N/A if yes Specify ....
Chlorine Dose	______ mg/L
Recent Pipe Repair	☐ Yes ☐ No
Recent Treatment/ Power Failure	☐ Yes ☐ No
Recent Supply Interruption	☐ Yes ☐ No
Reservoir/Tank Condition	
Other Operational Remarks	
Sanitary Risk Score	______ / ______
Risk Category	☐ Low ☐ Medium ☐ High ☐ Very High
Critical Hazards Observed	
Immediate Corrective Action Required	☐ Yes ☐ No
Corrective Action Report No., if applicable	
G. Field Measurements	
Temperature	Result: ______ °C; Instrument ID: ______
Colour	☐ Yes ☐ No
Odour	☐ Yes ☐ No
pH	Result: ______; Instrument ID: ______
Turbidity	Result: ______ NTU; Instrument ID: ______
Free Residual Chlorine	Result: ______ mg/L; Instrument ID: ______
Electrical Conductivity	Result: ______ µS/cm; Instrument ID: ______
Total Dissolved Solids	Result: ______ mg/L; Instrument ID: ______
Other Parameter	Parameter: ______ Result: ______ Unit: ______
Instrument Calibration/Performance Check	☐ Satisfactory ☐ Unsatisfactory
H. Laboratory Samples Collected	
Microbiological Sample	Sample/Bottle No.: ______; Bottle Type/Volume: ______; Preservative: ______
Physicochemical Sample	Sample/Bottle No.: ______; Bottle Type/Volume: ______; Preservative: ______
Heavy Metals Sample	Sample/Bottle No.: ______; Bottle Type/Volume: ______; Preservative: ______
Organic/Pesticide Sample	Sample/Bottle No.: ______; Bottle Type/Volume: ______; Preservative: ______
Other Sample	Parameter Group: ______; Bottle No.: ______
Sample Type	☐ Grab ☐ Composite ☐ Other: ______
QA/QC Sample	☐ Routine ☐ Field Duplicate ☐ Field Blank ☐ Trip Blank ☐ Other
I. Sample Collection and Preservation	
Appropriate Container Used	☐ Yes ☐ No
Sterile Bottle Used for Microbiology	☐ Yes ☐ No ☐ N/A
Sodium Thiosulphate Used for Chlorinated Microbiological Sample	☐ Yes ☐ No ☐ N/A
Required Preservative Added	☐ Yes ☐ No ☐ N/A
Sample Cooled Immediately	☐ Yes ☐ No ☐ N/A
Protected from Light	☐ Yes ☐ No ☐ N/A
Sampling/Preservation Deviation	☐ Yes ☐ No; If yes, explain: ______
J. Sample Transportation	
Date & Time Dispatched	

Section / Field	Information to be Completed / Options
Transport Method	
Cooler/Transport Container ID	
Temperature at Dispatch	______ °C
Laboratory Arrival Time	Expected ………………. Actual ………………………
Sample Damage/Leakage Observed	☐ Yes ☐ No
Protected from Direct Sunlight	☐ Yes ☐ No
L. Field Assessment and Immediate Action	
Abnormal Result/Condition Identified	☐ Yes ☐ No
Potential Public-Health Risk	☐ Yes ☐ No ☐ To be Determined
Immediate Action Taken	
Confirmatory/Repeat Sampling Required	☐ Yes ☐ No
Water Supplier/Responsible Officer Notified	☐ Yes ☐ No; Specify Date ……………and Time ……………
Emergency/Incident Report Initiated	☐ Yes ☐ No; Report No.: ______
Corrective Action Report Initiated	☐ Yes ☐ No; Report No.: ______
M. Sample Handover / Chain of Custody	
Number of Samples Handed Over	
Samples Handed Over By	Name: ______ Signature: ______ Date/Time: ______
Samples Received By	Name: ______ Institution/Laboratory: ______
Date/Time Received	
Condition of Samples on Receipt	☐ Satisfactory ☐ Unsatisfactory
Remarks on Receipt	
N. Sampling Officer Certification	
Sampling Officer Name	
Designation	
Institution	
Signature	
Date and Time	
General Remarks	

Appendix 3: Corrective Action Report Template

Field	Information / Details
Corrective Action Report No.	
Institution/Water Supplier	
Water Supply Scheme/System	
Region/District	
Date Non-Compliance Identified	
Source of Finding	☐ Monitoring ☐ Laboratory Analysis ☐ Sanitary Inspection ☐ Surveillance ☐ Audit ☐ Incident/Complaint ☐ Other: _______
Sample/Report Reference No.	
Description of Non-Compliance/Problem	Briefly describe the water-quality exceedance, operational failure, sanitary risk or other problem identified.
Parameter/Issue Identified	
Result/Observation	
Applicable Standard/Requirement	TZS 789/latest applicable requirement: ___________________
Risk/Compliance Category	☐ Minor ☐ Significant ☐ Critical/Public-Health Risk
Immediate Action Taken	Describe immediate measures taken to control the problem and protect consumers.
Cause of the Problem	State the identified or probable cause/root cause.
Corrective Action Required	State the action required to eliminate the cause and restore compliance.
Preventive Action, if required	State measures required to prevent recurrence.
Responsible Person/Unit	
Target Completion Date	
Date Action Completed	
Status	☐ Open ☐ In Progress ☐ Completed
Verification of Effectiveness	Describe follow-up sampling, inspection, operational check or other evidence used to confirm effectiveness.
Verification Result	☐ Effective/Compliance Restored ☐ Partially Effective ☐ Not Effective
Further Action Required	☐ No ☐ Yes — specify: ___________________
Supporting Evidence/Attachments	☐ Laboratory Results ☐ Sampling Record ☐ Photographs ☐ Inspection Report ☐ Maintenance Record ☐ Other: _______
Prepared by	Name: ___________ Designation: ___________ Signature: _______ Date: _______
Verified by	Name: ___________ Designation: ___________ Signature: _______ Date: _______
Approved/Closed by	Name: ___________ Designation: ___________ Signature: _______ Date: _______
Closure Status	☐ Closed ☐ Remains Open
Remarks	

Appendix 4: Monthly reporting format

Sampling Points	Parameters Recommended										
	Temperature	Free Residua Chlorine	Turbidity	pH	Electric conductivity	Total Dissolved Solids	Iron	Fluoride	Nitrate	Nitrite	Aluminum (If coagulants is used)	E. Coli
Units	*°C*	*mg/L*	*NTU*		*µS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*CFU/100mL*
Limits	*Refer TZS 789, latest edition*											

Key note: *The table above provides a minimum indicator for water quality monitoring. However, A relevant authority may require reduced or additional tests.*

Appendix 5: Costing Worksheet for Drinking Water Quality Monitoring

Cost item	Unit	Quantity	Unit Cost	Annual Cost	Funding Source
Sampling travel/transport					
Field consumables/PPE					
Laboratory reagents/standards					
External laboratory/PT/ILC					
Equipment calibration/maintenance					
Data/LIMS/NDWQIS					
Training/competency					

Field	Required content
Incident classification	Level 1, 2 or 3
Detection	Date/time, location, parameter/event, initial result
Extent and population	Affected system/area and estimated population
Immediate actions	Isolation, treatment adjustment, flushing, alternative supply, advisory
Notification	Authorities notified, time, responsible officer
Verification	Resampling locations/results and operational checks
Closure	Criteria met, advisory lifted, lessons and preventive actions

Required field	Minimum information
Sample identification	Unique sample ID; supply/system; sampling point code
Sampling details	Date/time; GPS/location; source/system type; sampler
Field observations	Weather; sanitary condition; operational status; FRC/turbidity where relevant
Laboratory transfer	Preservation; container; transfer date/time; sender/receiver signatures; condition on receipt
Analysis and compliance	Method; analyst; result; unit; applicable limit; compliance verdict; corrective action/reference

Supply/System	Population Served	Parameter Group	TZS 789 Minimum Frequency	Risk-Based Additional Frequency	Planned Samples	Responsible Unit

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