



**International  
Standard**

**ISO 24512**

**Activities relating to drinking  
water and wastewater services —  
Guidelines for the management  
of drinking water utilities and for  
the assessment of drinking water  
services**

*Activités relatives aux services de l'eau potable et de  
l'assainissement — Lignes directrices pour le management des  
services publics de l'eau potable et pour l'évaluation des services  
fournis*

**Second edition  
2024-02**

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 224, *Drinking water, wastewater and stormwater systems and services*.

This second edition cancels and replaces the first edition (ISO 24512:2007), which has been technically revised.

The main changes are as follows:

- the objectives modified to adjust to current challenges faced by water utilities;
- changes in terms and definitions to reflect the unified terminology of ISO/TC 224 as specified in ISO 24513;
- the list of key performance indicators in [Annex E](#) modified.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

### 0.1 Water issues: global context and policies framework

Water constitutes a worldwide challenge for the 21st century, both in terms of the management of available water resources and the provision of access to drinking water and sanitation for the world's population. In 2000, the United Nations (UN) recognized that access to water is an essential human right and, in conjunction with national governments, set ambitious goals (the “Millennium Development Goals”) to increase access to drinking water and wastewater services, including safe disposal or reuse of residues (hereinafter jointly referred to as “water services”), particularly in developing countries. International conferences on sustainable development and water (e.g. the World Summit on Sustainable Development in Johannesburg in September 2002, the third World Water Forum in Kyoto in March 2003 and the fourth World Water Forum in Mexico City in March 2006) have highlighted this issue, and UN agencies [including the World Health Organization (WHO) and UNESCO] have developed recommendations and programmes to establish a framework in which to advance.

The United Nations' Commission on Sustainable Development (CSD13) has emphasized that governments (referred to as “relevant authorities” in this document) have a primary role in promoting improved access to safe drinking water and basic sanitation through improved governance at all levels and appropriate enabling environments and regulatory frameworks, with the active involvement of all stakeholders. This process should incorporate institutional solutions to make the water sector more productive and the management of water resources more sustainable. In this respect, the ministerial declarations from the Third and Fourth World Water Forum recommended that governments endeavour to reinforce the role of parliaments and local public authorities, particularly with regard to the provision of adequate water services, and recognized that an effective collaboration with and between these actors is a key factor for meeting water-related challenges and goals.

While substantial progress has been made in increasing access to clean drinking water and sanitation, billions of people – mostly in rural areas – still lack these basic services. Worldwide, one in three people does not have access to safe drinking water, two out of five people do not have a basic hand-washing facility with soap and water, and more than 673 million people still practise open defecation<sup>[24]</sup>.

The COVID-19 pandemic has demonstrated the critical importance of sanitation, hygiene and adequate access to clean water for preventing and containing diseases. According to the WHO, handwashing is one of the most effective actions you can take to reduce the spread of pathogens and prevent infections, including the COVID-19 virus. Yet billions of people still lack safe water sanitation, and funding is inadequate<sup>[24]</sup>.

A projected 40 % shortfall in freshwater resources by 2030, coupled with a rising world population, has the world careening towards a global water crisis. Recognizing the growing challenge of water scarcity, the UN General Assembly launched the Water Action Decade on 22 March 2018 to mobilize action that will help transform how we manage water<sup>[24]</sup>.

The UN's Sustainable Development Goal 6, “Ensure availability and sustainable management of water and sanitation for all”, sets targets to be achieved by 2030, including: achieve universal and equitable access to safe and affordable drinking water for all, improve water quality, increase water-use efficiency across all sectors, implement integrated water resources management at all levels and expand international cooperation and capacity building at that<sup>[24]</sup>.

Examples of key issues for effective drinking water and sanitation services policy frameworks are:

- clear definition of the roles of the different stakeholders;
- definition of sanitary rules and organization for assessment of conformity;
- processes to ensure consistency between the policies regarding urban development and water utility infrastructure;
- regulation for water withdrawal and wastewater discharge;
- information to the users and the communities;

- the use of advanced and upcoming equipment and data handling technologies for enhancing the efficiency of the services as stated in the proposed revision of ISO 24510<sup>[Z]</sup>;
- planning for the water utility services to be able to cope with climate change effects on the availability and quality of the water utility resources to maintain service level required, as stated in ISO 24540<sup>[16]</sup>.

## 0.2 Water utilities: general objectives

In addition to public health protection, sound management of the water utilities is an essential element of integrated water resources management. When applied to these utilities, sound management practices will contribute, both quantitatively and qualitatively, to sustainable development. Sound utility management also contributes to social cohesion and economic development of the communities served, because the quality and efficiency of water services have implications for virtually all activities of society.

As water is considered a “social good” and activities related to water services support the three aspects (economic, social and environmental) of sustainable development, it is logical that the management of water utilities be transparent to and inclusive of all stakeholders identified in accordance with the local context.

There is a broad array of types of stakeholders that can play a role in activities related to water services.

Examples of such stakeholders include:

- governments or public agencies (international, national, regional or local) acting with legal or legislative authority;
- associations of the utilities themselves (e.g. international, regional or multinational and national drinking water or wastewater associations);
- autonomous bodies seeking to play an overview role (e.g. organizations concerned, such as non-governmental organizations);
- users and associations of water users.

The relationships between stakeholders and water utilities vary around the world. In many countries, there are bodies that have responsibility (in whole or in part) for overseeing the activities related to water services, whether the utilities are publicly or privately owned or operated and whether they are regulated by relevant authorities or acting in a system of technical self-regulation. Standardization and technical self-regulation are possible ways of ensuring involvement of all stakeholders and meeting the subsidiarity principle.

The aim of water utilities is logically to offer services to everybody in the area of responsibility of the utility and to provide users with a continuous supply of drinking water and the collection and treatment of wastewater (including stormwater), under economic and social conditions that are acceptable to the users and to the utility. Water utilities are expected to meet the requirements of relevant authorities and the expectations specified by the responsible bodies in conjunction with the other stakeholders, while ensuring the long-term sustainability of the service. In a context of scarcity of resources, including financial resources, it is advisable that the investments made in installations be appropriate and that necessary attention be paid to proper maintenance and effective use of the installations. It is advisable that water tariffs generally aim at meeting cost-recovery principles and at promoting efficiency in the use of the resources, while striving to maintain affordable basic access to water services.

It is advisable that the stakeholders be involved in both setting service objectives and service standards and assessing the adequacy and efficiency of service.

## 0.3 City services and quality of life

In many cases, water utilities are service providers of cities. The concept of smart cities has been explored in literature of recent years, while ISO/TC 268, *Sustainable cities and communities*, standardizes the field of sustainable cities and communities to help interested parties measure their performance. ISO 37120<sup>[17]</sup> introduces indicators to measure the performance of cities, some of which relate to water and wastewater. This document intends to complement the indicators and methodologies depicted in ISO 37120<sup>[17]</sup>, while introducing a holistic perspective of the water sector in the smart city.

#### 0.4 Objectives, content and implementation of this document

The objective of this document is to provide the relevant stakeholders with guidelines for assessing and improving the service to users and with guidance for managing water utilities, consistent with the overarching goals set by the relevant authorities and by the international intergovernmental organizations noted previously. This document also intends to provide relevant stakeholders with guidelines to help deal with recent developments in the field of water service management, such as climate change, higher user and regulatory demands and the development of advanced technologies, mainly data mining and analysis, communications and digitization. Newly available technologies can be used and developed to protect against risks that stem from the use of cyber communications. This document is intended to facilitate dialogue between the stakeholders, enabling them to develop a mutual understanding of the functions and tasks that fall within the scope of water utilities.

Using key performance indicators (KPIs) will promote ongoing improvements and eventually initiate the use of new and more efficient technologies, procedures and preventive approaches.

The group of standards addressing water services consists of ISO 24510<sup>[7]</sup> (service-oriented), ISO 24511<sup>[8]</sup> and this document (both management-oriented).

ISO 24510<sup>[7]</sup> addresses the following topics:

- a brief description of the components of the service relating to the users;
- core objectives for the service, with respect to users' needs and expectations;
- guidelines for satisfying users' needs and expectations;
- assessment criteria for service to users in accordance with the provided guidelines;
- examples of performance indicators linked to the assessment criteria that can be used for assessing the performance of the service.

ISO 24511<sup>[8]</sup> and ISO 24536<sup>[15]</sup> address the following topics:

- a brief description of the physical or infrastructural and managerial or institutional components of water utilities;
- core objectives for water utilities, considered to be globally relevant at the broadest level;
- guidelines for the management of the water utilities;
- guidelines for the assessment of the water services with service assessment criteria related to the objectives and performance indicators linked to these criteria.

The performance indicators presented in this document, ISO 24510<sup>[7]</sup>, ISO 24511<sup>[8]</sup> and ISO 24536<sup>[15]</sup> are simply for purposes of illustration, because assessing the service to users cannot be reduced to a single or universal set of performance indicators.

The scope formally excludes the installations inside a user's premises. However, attention is drawn to the fact that the quality of the supplied water (or discharged wastewater) can be adversely impacted between the point of delivery (or, in the case of wastewater, the point of collection) and the point of use (or, in the case of wastewater, the point of discharge) by the installations inside the premises. Some stakeholders, such as relevant authorities, owners, contractors and users, can have a role to play regarding this issue.

Because the organization of water utilities falls within a legal and institutional framework specific to each country, this document does not prescribe the respective roles of various stakeholders, nor does it define required internal organizations for local, regional or national bodies that can be involved in the provision of water services. In particular, this document does not interfere with the free choice of the responsible bodies regarding the general organization and the management of their utilities. This document is applicable to publicly and privately owned and operated utilities alike and does not favour any particular ownership or operational model.

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The guidelines given in this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> focus on users' needs and expectations and on the water services themselves, without imposing a means of meeting those needs and expectations, the aim being to permit the broadest possible use of this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> while respecting the cultural, socio-economic, climatic, health and legislative characteristics of the different countries and regions of the world. It should therefore be understood that, in the short-term, it is not always possible to meet the expectations of local users. This can be due to factors such as climate conditions, resource availability and difficulties relating to the economic sustainability of the water services, particularly regarding financing and the users' ability to pay for improvements. These conditions can limit the achievement of some objectives or restrict the implementation of some recommendations in developing countries. However, this document is drafted with such constraints in mind and, for example, allows for differing levels of fixed networks and the need for on-site alternatives. Notwithstanding the need for flexibility in terms of engineering and hardware, many recommendations in this document, such as consultation mechanisms, are intended to apply universally.

In order to assess and improve the service to users and to ensure proper monitoring of the improvements, an appropriate number of performance indicators or other methods for checking conformity to requirements can be established. The use of performance indicators is only one of the possible support tools for continuous improvement. Stakeholders can select performance indicators from the examples given or develop other relevant performance indicators, taking into account the principles described in this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup>. The performance indicators logically relate to the objectives for which they are defined through the assessment criteria, and are used to measure performance. They can also be used to set required or targeted values. This document does not impose any specific indicator or any minimum value or performance range. It respects the principle of adaptability to local contexts, facilitating local implementation.

While it is in no way intended that this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup>, and more specifically the performance indicators given as examples, be considered as a prerequisite or condition for the implementation of a water policy or for the financing of projects or programmes, they can serve to assess progress towards policy goals and the objectives of financing programmes.

The objective of this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> is not to lay down systems of specifications supporting direct certification of conformity but to provide guidelines for the continuous improvement and assessment of the service. Use of this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> is voluntary, in accordance with ISO rules.

This document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> are consistent with the principle of the "plan-do-check-act" (PDCA) approach: they propose a step-by-step process, from identifying the components and defining the objectives of the utility to establishing performance indicators, with a loop back to the objectives and to the management, after having assessed the performances. [Figure 1](#) summarizes the content and application of this document. Implementation of this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> does not depend upon adoption of the ISO 9001<sup>[2]</sup> and/or the ISO 14001<sup>[3]</sup> standards. Nevertheless, this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup> are consistent with those management system standards. Implementation of an overall ISO 9001<sup>[2]</sup> and/or ISO 14001<sup>[3]</sup> management system can facilitate the implementation of the guidelines contained within this document, ISO 24510<sup>[7]</sup> and ISO 24511<sup>[8]</sup>; conversely, these guidelines can help to achieve the technical provisions of ISO 9001<sup>[2]</sup> and ISO 14001<sup>[3]</sup> for organizations choosing to implement them.

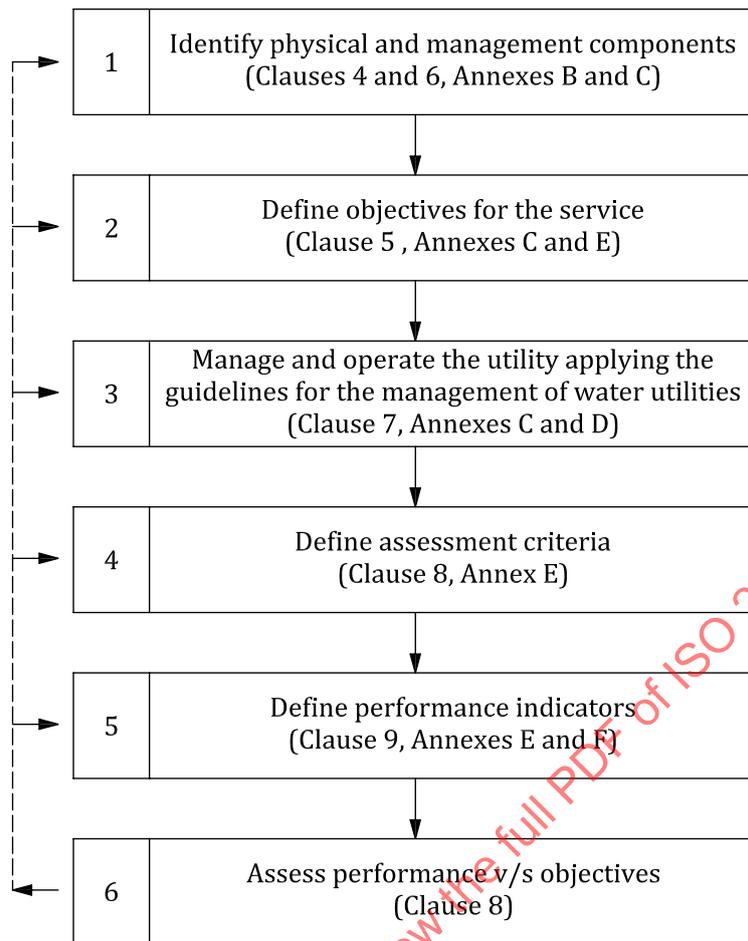


Figure 1 — Implementation actions and sequence

### 0.5 Drinking water supply services

When reading this document, it is important to bear in mind that utilities have constructed infrastructure and facilities that are operated primarily to supply drinking water to users of the service. Many utilities can supply the users either by direct pipe connection or by other means (e.g. trucks, bottles). In broad terms, the social objectives of the service are to promote public health and social and economic development while protecting the environment.

This document only applies to services to and at the point of delivery to the user (which can be different from the point of consumption or use).

The function of utilities is to provide drinking water for civil life, urban activities and industrial or other uses. The supply of drinking water is considered to be a core activity on which society depends and it therefore has a social as well as a public welfare role. Supplying drinking water involves the abstraction of water from the environment and the construction of infrastructure having a lifetime typically stretching over several human generations. This suggests that intergenerational equity and regard must also be a feature of the assessment of the service. Consequently, a water utility, regardless of ownership, is public in nature and will be subject to public scrutiny and policy.

NOTE Intergenerational equity means that current societies or populations do not take actions or ignore current responsibilities that result in unfairly shifting economic or social burdens to future generations.

Operationally, under normal conditions, the broad objectives of a utility are to supply drinking water on a continuous basis. Some utilities cannot provide drinking water on a continuous, 24 h-a-day, 7-days-a-week basis, nor is there an expectation that this will be achieved. Often these utilities are those that cannot deliver safe drinking water. In such cases, an intermittent but scheduled supply can be satisfactory if quantities supplied are sufficient to meet users' reasonable demands.

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The drinking water should be suitable for direct human consumption regardless of the other uses made of the water delivered. Efforts should be made to achieve that quality at all times. Where that is the general expectation, when potability standards are not maintained or achieved, a specific warning to users should be provided.

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# Activities relating to drinking water and wastewater services — Guidelines for the management of drinking water utilities and for the assessment of drinking water services

## 1 Scope

This document provides guidelines for the management of drinking water utilities and the assessment of drinking water services.

This document is applicable to publicly and privately owned and operated water utilities. It does not favour any particular ownership or operating model.

This document addresses drinking water systems in their entirety and is applicable to systems at any level of development (e.g. on-site systems, distribution networks, treatment facilities).

The following are within the scope of this document:

- the definition of a language common to different stakeholders;
- the definition of the components of drinking water supply systems;
- guidelines for the management of drinking water utilities;
- guidelines for objectives, service assessment criteria and related performance indicators, appropriate for the assessment of drinking water services.

The following are outside the scope of this document:

- target values and thresholds for proposed objectives, service assessments criteria and related performance indicators;
- matters relating to the design and construction of drinking water systems;
- matters relating to the management structure of drinking water utilities;
- matters relating to the regulation of drinking water services, including management and operational activities;
- matters relating to regulating the content of contracts or subcontracts;
- installations between point of delivery and point of use.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24513, *Service activities relating to drinking water supply, wastewater and stormwater systems — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24513 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **accuracy**

closeness of agreement between a measure and the accepted reference value

Note 1 to entry: The term “accuracy”, when applied to a set of measures, involves a combination of random components and a common systematic error or bias component.

[SOURCE: ISO 24513:2019, 3.7.10]

### 3.2

#### **assessment**

process, or result of this process, comparing a specified subject matter to relevant references

[SOURCE: ISO 24513:2019, 3.7.12]

### 3.3

#### **community**

one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organizations or groups, having interests in the area where the *service* (3.11) is provided

[SOURCE: ISO 24513:2019, 3.1.8.5]

### 3.4

#### **confidence grade**

assessment of the quality in terms of *accuracy* (3.1) and *reliability*

[SOURCE: ISO 24513:2019, 3.7.13]

### 3.5

#### **coverage**

extent to which the assets of a water utility allow *services* (3.11) to *users* (3.12), within its defined area of responsibility

[SOURCE: ISO 24513:2019, 3.3.38]

### 3.6

#### **drinking water**

DEPRECATED: potable water  
water intended for human consumption

Note 1 to entry: Requirements for drinking water quality specifications are generally laid down by the national relevant authorities. Guidelines<sup>[25]</sup> have been established by the World Health Organization (WHO).

[SOURCE: ISO 24513:2019, 3.2.2.1]

### 3.7

#### **drinking water system**

asset system providing the functions of abstracting, treating, storing, distributing or supplying *drinking water* (3.6)

[SOURCE: ISO 24513:2019, 3.5.12.2]

### 3.8 Geographical Information Systems GIS

in the strictest sense, a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations

[SOURCE: ISO 23611-6:2012, 3.3.1, modified — Note 1 to entry has been deleted.]

### 3.9 indicator

parameter, or a value derived from parameters, which provides information about a subject matter with a significance extending beyond that directly associated with a parameter value

Note 1 to entry: Adapted from OECD works on “Core sets of indicators for environmental performance reviews”<sup>[23]</sup>.

Note 2 to entry: Indicators can refer to context, conditions, means, activities or *performances* (3.10).

[SOURCE: ISO 24513:2019, 3.9.10]

### 3.10 performance measurable result

Note 1 to entry: Performance can relate either to quantitative or qualitative findings.

Note 2 to entry: Performance can relate to the management of activities, processes, products [including *services* (3.11)], systems or organizations.

[SOURCE: ISO 24513:2019, 3.9.1, modified — Note 3 to entry has been deleted.]

### 3.11 service

output of an organization with at least one activity performed between the organization and, in the first place, its *user* (3.12) and, in the second place, a stakeholder

Note 1 to entry: The dominant elements of a service are generally intangible.

Note 2 to entry: Service involves activities and processes within an organization (utility), at the interface with the user, to establish user requirements as well as upon delivery of the service and can involve a continuing relationship.

Note 3 to entry: Provision of a service can involve, for example, the following:

- an activity performed on a user-supplied tangible product (e.g. wastewater);
- an activity performed on a user-supplied intangible product (e.g. processing new connection requests);
- delivery of an intangible product (e.g. the delivery of information in the context of knowledge transmission);
- the creation of ambience for the user (e.g. in reception offices).

Note 4 to entry: A service is generally experienced by the user and can be monitored by one or more stakeholders.

Note 5 to entry: The word “service” in common English can also refer to the entity providing the actions related to the subject in question, as is implicit in such phrases as “bus service”, “police service”, “fire service” and “water or wastewater service”. In this context and usage, “service” implies the entity that is delivering the service, for example “the public transport of passengers”, “the provision of public security”, “fire protection and response” and “delivering *drinking water* (3.6) or collecting wastewater”. If “service” can be understood in this way, “water service” becomes synonymous with “*water utility* (3.13)”

[SOURCE: ISO 24513:2019, 3.3.7]

### 3.12

#### **user**

DEPRECATED: consumer

person, group or organization that benefits from *drinking water* (3.6) delivery and related *services* (3.11), wastewater service activities, stormwater service activities or reclaimed water delivery and related services

Note 1 to entry: Users are a category of stakeholder.

Note 2 to entry: Users can belong to various economic sectors: domestic users, commerce, industry, tertiary activities, agriculture.

Note 3 to entry: The term “consumer” can also be used, but in most countries the term “user” is more frequent when referring to public services. It is not appropriate for wastewater services.

[SOURCE: ISO 24513:2019, 3.1.8.4, modified — in Note 3 to entry "It is not appropriate for wastewater services" has been added.]

### 3.13

#### **water utility**

whole set of organization, processes, activities, means and resources necessary for abstracting, treating, distributing or supplying *drinking water* (3.6), for collecting, conveying, treating, disposing of or reusing wastewater or for the control, collection, storage, transport and use or disposal of stormwater, and for providing the associated *services* (3.11)

Note 1 to entry: Some key features for a water utility are:

- its mission, to provide drinking water services or wastewater services or the control, collection, storage, transport and use of stormwater services, or a combination thereof;
- its physical area of responsibility and the population within this area;
- its responsible body;
- the general organization with the function of operator being carried out by the responsible body or by legally distinct operators;
- the type of physical systems used to provide the services, with various degrees of centralization.

Note 2 to entry: Drinking water utility addresses a utility dealing only with drinking water; wastewater utility addresses a utility dealing only with wastewater; stormwater utility addresses a utility dealing only with stormwater.

Note 3 to entry: When it is not necessary, or it is difficult to make a distinction between responsible body and operator, the term “water utility” covers both.

Note 4 to entry: In common English, “water service” can be used as a synonym for “water utility”, but this document does not recommend using the term in this way.

[SOURCE: ISO 24513:2019, 3.3.1]

## **4 Components of drinking water supply systems**

### **4.1 General**

A drinking water supply system generally comprises four components:

- water source (see 4.3);
- intake and transport (see 4.4);
- treatment, if necessary, and if appropriate, disposal of residues (see 4.5 and 4.7);
- storage, transport and distribution (see 4.6).

The drinking water supply system extends only to the point-of-delivery to the user. Installations from the point-of-delivery to the point-of-use are excluded.

## 4.2 Types of drinking water supply systems

The systems can be centralized or on-site.

Schematic presentations showing the elements or components of drinking water systems and the relations between the various components are shown in [Annex A](#).

The supply can be continuous or intermittent; the water may be delivered continuously by pipe to the users or intermittently by some other means (e.g. truck, bottle). In addition, the utility may be linked to other utilities allowing the exchange (import or export) of raw or treated water.

In some simple systems, the treatment facility component may not be present, depending on the quality of the raw water, or the facility may include only a disinfection component. In more complex drinking water systems, there may be multiple sources, multiple pumping stations and reservoirs in the transport system, multiple stages to the treatment facility and processes and pumping and re-treatment stations in the distribution system, including re-treatment activities at treated water reservoirs.

## 4.3 Water source

Any water, either groundwater or surface water, can be a water source. Surface water sources include streams, rivers, lakes or reservoirs. Seawater and reclaimed wastewater are increasingly important as water sources. Groundwater is water contained within the geological formations accessed by springs, wells or boreholes.

Water utilities generally should use the water that is available to them. Groundwater sources are normally less exposed than surface water to microbial and other hazards. Large utilities may have a number of independent water sources.

## 4.4 Intake and transport

The water intake system normally requires pumping stations to abstract water from the groundwater or a surface source and to transport the water to the treatment facility, if any. Some utilities may have the advantage of a water source that allows the use of gravity fed transport systems. The transmission mains may have in-system storage reservoirs. To protect the water from microbiological hazards, disinfection systems may be used.

Where the force of gravity is strong, utilities should install pressure reducing valves and can install hydro-electric generators to take advantage of the gravitational force.

## 4.5 Treatment

Drinking water treatment facilities can vary from basic systems, providing disinfection, to multiple processes, providing clarification (e.g. coagulation, flocculation and filtration steps) with pH adjustment as necessary for optimal treatment and processing. Mechanical filtration using micro-filtration or reverse osmosis technology is also increasingly being used (e.g. for desalination of brackish or saline water sources). A final stage of treatment is often used to provide disinfection and inactivation of pathogens and to ensure disinfection residuals exist in the distribution system. More advanced technologies can be employed as necessary and appropriate.

Residues may be produced at a number of stages in the water treatment process (see [4.7](#)).

Some utilities with extremely high-quality water sources may not have any treatment facilities.

## 4.6 Storage, transport and distribution

Drinking water entering the distribution system passes through a series of pipes whose diameter diminishes as the volume of the water supplied decreases and the distance from the treatment facility increases, i.e. from water mains or trunk mains to the smaller water pipes connected to users. In some cases, the final distribution of drinking water may be by truck or some other means. The distribution system may have storage reservoirs located at key points to take advantage of natural physical topography, for reasons of balancing supply over peak and non-peak periods of demand or for emergency situations.

It may be necessary to install re-disinfection facilities in larger distribution networks to ensure the safety of the drinking water to be delivered.

It may be necessary to install pumping stations to maintain adequate pressure throughout the distribution system.

Valving and metering equipment should be installed throughout the distribution system for control purposes and to facilitate leak detection (see ISO 24528<sup>[14]</sup>) and repairs to such systems while maintaining maximum possible services.

Metering equipment is frequently installed at the point of delivery for the purposes of measuring consumption and billing based on consumption.

In order to properly manage the storage, transport and distribution functions of water supply, service providers should ensure that they have appropriate water quality and quantity monitoring, measuring and sampling systems within the water network and that appropriate control facilities are in place.

Effective use of monitoring, sampling and remote-control facilities should be operated using appropriate software systems to analyse, process and provide feedback within the control systems. Redundancy in these systems is necessary along with back-up systems that are protected from cyber intrusions.

## 4.7 Disposal of residues

Residues may be produced at a number of stages in the water treatment process. Disposal of large volumes of untreated sludge can pose a threat to the environment.

Since the cost of disposal of residues is volume related and residues normally contain a large amount of water, they are generally dewatered to reduce the volume.

The options for disposal, depending on quality and local requirements, are:

- transfer to a treatment facility;
- return to source water body;
- deposit at landfill sites;
- reuse, if possible.

## 5 Objectives for the water utility

### 5.1 General

**5.1.1** The responsible body, in conjunction with its operator(s), if relevant, should establish for the water utility:

- the objectives;
- all related requirements (mandatory or self-established);

- a service assessment policy, taking into account the variety of assessment tools available, such as audits, conformity assessment, relevant service assessment criteria and related performance indicators with targeted, maximum or threshold values.

5.1.2 All these elements should take into account:

- legal requirements;
- land and urban planning and human settlement policies established by the relevant authorities;
- expectations of the users and other stakeholders;
- possibilities of integration into the water utility of technical developments occurring in related wastewater services;
- the physical and management components of the water utility;
- affordability for customers (see ISO 24510<sup>[7]</sup> for guidance).

Figure 2 gives an example of possible relationships among stakeholders for establishing objectives, and also shows the relationships between objectives, service assessment criteria and performance indicators.

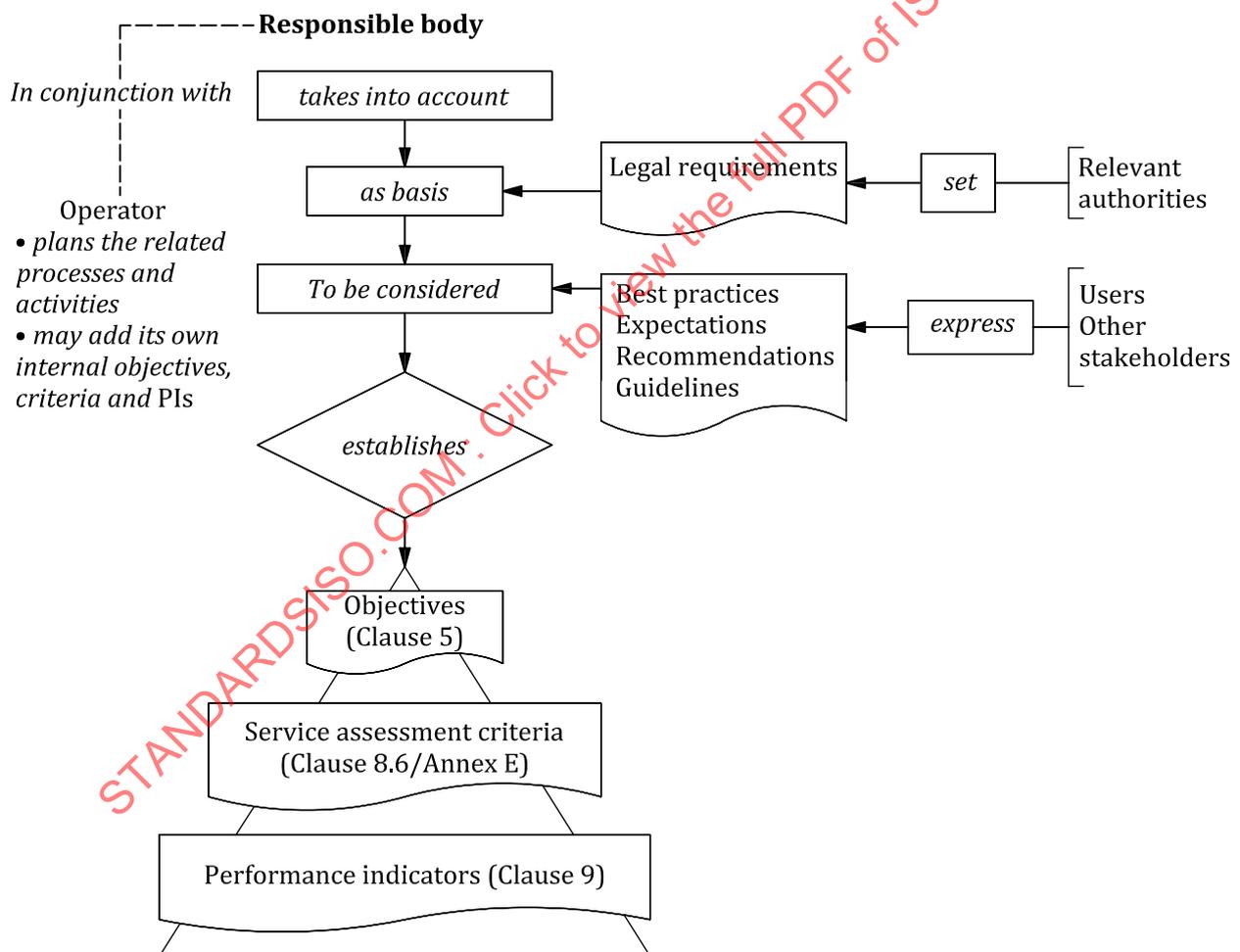


Figure 2 — Example of relevant relationships among stakeholders for establishing objectives, service assessment criteria and performance indicators

5.1.4 The management of a drinking water utility should include:

- formulation of objectives and service assessment criteria;

— evaluation of the performance.

**5.1.5** The objectives specified in [5.2](#) to [5.10](#) are considered the principal objectives for water utilities. Examples of service assessment criteria related to these objectives can be found in [8.6](#) and in [Annex D](#). Possible actions that a water utility can undertake to achieve these objectives are shown in [Table B.1](#).

## 5.2 Protection of public health

An objective of a water utility should be to ensure a sufficient supply of safe and agreeable drinking water.

“Sufficient supply” means a quantity of drinking water in accordance with the applicable public health standards or guidelines, taking into account the WHO Sanitation Guidelines<sup>[25]</sup>.

“Safe” drinking water means water that has a quality in accordance with the applicable public health standards or guidelines, taking into account the WHO Drinking Water Guidelines<sup>[26]</sup>. Drinking water quality is normally expressed in terms of microbiological, chemical or radiological parameters by laboratories meeting the requirements of ISO/IEC 17025.

NOTE National and regional regulations can apply.

“Agreeable” drinking water means drinking water that is aesthetically acceptable (e.g. in terms of taste, odour or colour).

In addition to being safe, it is important that the drinking water is of sufficient supply and agreeable to those who consume or use the water (i.e. aesthetically acceptable), as the user can otherwise be inclined to go to unsafe water sources.

## 5.3 Meeting users’ needs and expectations

An objective of a water utility should be to ensure activities meet users’ reasonable needs and expectations.

For guidelines on users’ needs and expectations, see ISO 24510<sup>[7]</sup>.

## 5.4 Provision of services under normal and emergency situations

An objective of a water utility should be to ensure that, under normal conditions, drinking water is available on a continuous basis.

Drinking water is essential for public health and societal development and sustainability. Continuity of supply is equally essential. From time to time, the water supply may be interrupted by planned or emergency events. Risk management activities should be undertaken to minimize this possibility. However, where an emergency condition applies, emergency plans and response actions should be initiated.

The objective should also be to provide drinking water to critical customers or critical service areas during emergency situations and to restore service as quickly as possible when interruptions have occurred.

Critical customers (e.g. hospitals, schools) include those who may not be able to be evacuated to areas where safe water supply is still available; critical service areas may include areas of governance or transportation corridors. The continuity of service, quantity and the safety of drinking water should be restored as quickly as possible after interruptions have occurred. Provision of drinking water in emergency conditions may involve alternative distribution mechanisms or obtaining water from adjacent unaffected supply services.

ISO 24518<sup>[11]</sup>, ISO/TS 24520<sup>[12]</sup> and ISO 24527<sup>[13]</sup> can assist in determining responses to emergency situations.

## 5.5 Sustainability of the water utility

An objective for a drinking water utility should be to ensure that the assets are maintained and provide capacity to meet current and future needs.

Drinking water utilities represent major social investments. It is expected they will provide service over many decades. Natural, social and environmental changes will occur in this period, affecting water source availability and drinking water demand. Ensuring the sustainability of the water utility over time is an important objective.

The water utility should maintain and, when necessary, replace assets in order to keep the drinking water service reliable through time.

The water utility should react to changes in the natural and social environments, such as water source availability and drinking water demand, taking into consideration the most current research and appropriate technology.

## 5.6 Promotion of sustainable development of the community

An objective for a water utility should be to promote the sustainable development of the community.

“Sustainable development” means the ability of the community to grow and prosper within the environmental resources available to it, without limiting the use of those resources by future generations.

The water utility should:

- contribute to and implement sustainable water resources management policies and practices, such as efficient use of water, recycling, reuse and pollution prevention through elimination or separation of pollutants at their sources;
- contribute to development planning and resource allocation through consultation, provision of information and analysis in conjunction with appropriate institutions;
- contribute to public health and safety;
- contribute to fire protection (where a utility is responsible for providing an adequate water supply for this purpose);
- implement information and education of the community on these topics, notably on the efficient use of water and pollution prevention.

## 5.7 Protection of the environment

An objective for a water utility should be to minimize adverse environmental impacts and remediate tangible adverse effects to the environment caused by the utility.

Adverse environmental impacts are generally caused by the following:

- consuming energy;
- generating environmental pollutants, emitting gases, noise and odours and improperly managing residues and other wastes;
- contaminating water sources and watershed and abstraction areas, impairing freshwater quality and quantity in rivers, lakes and groundwaters and aquatic ecosystems;
- changing flow regimes and constructing barriers to fish migration;
- depleting water sources, which affect quality or quantity of groundwaters or surface waters and their ecosystems.

The utility should have proactive monitoring programmes to assess the impacts on the environment and should activate mitigation plans, as required.

## 5.8 Climate change

An objective of the water utility should be to prepare for climate change, including:

- how climate change phenomena can damage the physical installations of the utility;
- whether climate change phenomena can affect the effectiveness of the treatment processes and the quality of the water;
- defining changes in water flow and flow distribution due to climate change;
- how climate change will affect the availability and quality of the water sources.

## 5.9 Higher user and regulatory demand

An objective of the water utility should be to respond to rising user and regulatory demand, including:

- more stringent demands by users regarding, for example, the continuity of services and shortening of service interruptions;
- more stringent standards for the quality of the water and the quality of the service;

while considering the impact of these demands on consumer pricing.

## 5.10 Available technologies

An objective of the water utility should be to take advantage of available technologies relating to:

- water supply and process technologies;
- data mining and analysis;
- communications and digitation;
- protection against risks stemming from the use of cyber communications;
- protection against risks stemming from pathogens and chemicals.

Attention should be given to the potential adoption of future resilient technologies.

# 6 Management components of a water utility

## 6.1 General

Management of a water utility may have the following components (see [Annex C](#)):

- activities and processes;
- resources;
- assets;
- customer relations;
- information;
- environment;
- risks;
- user and regulatory demands;
- available technologies;

- maintenance.

The management components should also take into account a business approach, including interactions with potential partners and stakeholders and the possibility of trade-offs.

## 6.2 Activities and process management

There are many individual activities and processes within a water utility. These may be undertaken at all levels within the hierarchy of the organization. Examples of activities and processes to be managed include:

- policy-making;
- strategy formulation;
- procedures development;
- internal and external coordination;
- operations and controls;
- risk management, including all aspects and climate change.

## 6.3 Resources management

Water utilities have many resources. Examples of the resources to be managed include:

- personnel (human resources);
- material and equipment (non-fixed assets, e.g. spare parts, vehicles and chemicals);
- financial resources (revenues, expenses, reserves and investments);
- natural resources (e.g. land and water rights);
- obligations to stakeholders and customers.

## 6.4 Asset management

Water utilities have tangible and intangible assets. Examples of asset management include:

- maintaining a system inventory;
- monitoring and documenting data on the condition of the system;
- taking a long-term view;
- planning, maintaining or rehabilitating the system;
- optimizing depreciation and reinvestment;
- identifying and managing risk;
- ensuring security of the assets of terrorism and cyber threats.

All of these actions should aim at ensuring the serviceability of the assets.

Guidance on asset management of drinking water distribution networks and waterworks can be found in ISO 24516-1<sup>[9]</sup> and ISO 24516-2<sup>[10]</sup>, respectively.

## 6.5 Customer relations management

A water utility exists to provide service to its users. Customer relations management is critical to the success of the utility. Examples include:

- identifying user needs and expectations;
- striving to meet user needs and expectations;
- registering and handling complaints;
- accounting and billing;
- communicating, educating and disseminating information.

For further guidance, see ISO 24510<sup>[2]</sup>.

## 6.6 Information management

In all drinking water utilities, information management is important and is often a feature of a regulatory control programme, with information needing to be communicated transparently within the utility as well as to relevant authorities, users and other stakeholders. Examples of the steps in information management include:

- acquisition;
- evaluation;
- registration;
- protection;
- updating;
- communicating;
- archiving;
- data dissemination;
- information security and backup.

## 6.7 Environmental management

Environmental management is an essential part of operating a water utility and is fundamental for planning its further development.

Examples of environmental management include:

- improving step-by-step the water supply system;
- taking a long-term view;
- taking into account population and urbanization development;
- examining the possibilities for water demand management and water reuse;
- minimizing impacts of construction and repair activities (e.g. noise and community disruption);
- safeguarding public health;
- protecting the water source.

The environmental impacts addressed cover more than exclusively water-related issues and may be permanent or temporary.

## 6.8 Risk management

Risk management comprises proactive approaches taken to ensure the continuity of the service and the protection of public health and is of great importance. Risk management covers:

- a) emergency situations, caused for example by technological failures, natural disasters (e.g. earthquakes, extreme weather events), criminal acts of vandalism or terrorism or other accidents;
- b) qualitative and quantitative aspects linked to chronic or permanent situations, such as insufficient supply systems, regular pollution or conflicts between users (e.g. agriculture, industry).

Examples of risk management steps are set out in WHO recommendations for Water Safety Plans<sup>[26]</sup> and include:

- conducting hazard analyses;
- establishing and monitoring critical points of control;
- developing standard operating procedures;
- providing and implementing scheduled preventive maintenance programmes;
- maintaining on-hand inventories of materials and critical equipment;
- developing and exercising contingency and emergency plans.

## 7 Guidelines for the management of water utilities

### 7.1 General

The task of the water utility is to abstract, treat and distribute water and to treat, reuse or dispose of its residues in an acceptable manner, addressing all the components of the management of the water utility as described in [Clause 6](#) in order to fulfil the objectives as stated in [Clause 5](#).

The organization's management structure should be designed to ensure the correct, effective and efficient planning, implementation, monitoring and checking of all tasks, processes and activities. It should encompass the full range of services or functions provided. For effective management of a water utility, it is recommended that utilities establish an integrated management system that encompasses all the management components and fields of the water utility.

Process management of and within water utilities should be carried out using the four-point “plan-do-check-act” scheme, as follows:

- plan: establish the objectives and processes that should deliver results, taking into account legal, responsible authority and customer requirements and utility policies;
- do: implement the processes;
- check: monitor and measure processes and product against policies, objectives and requirements for the product and report the results;
- act: take actions to continually improve process performance.

Centralized, decentralized and on-site water systems should be monitored and improved to aid the protection of water sources and of the receiving environment from pollution, and to ensure maximum recovery and reuse of process water and residues.

Consideration should be given to the multi-barrier approach or drinking water safety plans as follows:

- a) Drinking water sources should be protected and the abstraction should be sustainable.
- b) Water treatment should result in an appropriate quality of drinking water.
- c) The drinking water distribution system should be planned, constructed, operated and maintained in order to minimize changes in the drinking water quality and to deliver drinking water in accordance with the normal demand of users (quantity and pressure); in particular, the entry of pollutants and microorganisms from outside should be prevented as far as possible.
- d) Drinking water storage should ensure the protection of the drinking water quality and ensure appropriate supplies during fluctuations in demand or supply, including adequate supply of water for fire protection (where applicable).
- e) The residues should have minimum impact on the environment.

Since a water utility exists to serve its users, special consideration should be given to achieving user satisfaction. For further guidance, see ISO 24510<sup>[2]</sup>.

For possible actions to achieve the objectives of a water utility, see [Annex B](#).

For possible actions to improve the management of a water utility, see [Annex C](#).

## 7.2 Organization

### 7.2.1 General

The water utility should establish and document a management system comprising its hierarchy and organizational structure, responsibilities and workflow.

Periodic reviews of the management system should be carried out to ensure proper application and continual improvement.

Managers and supervisors should check for conformity the hierarchy and organizational structure, responsibilities and workflow, and all legal or other requirements. If they detect non-conformity, immediate remedial action should be taken. Attention should be paid to the security of the data management system including any automated operational system against cyber security issues.

Management capability appropriate to the organization is required.

Adequate financial capability and funding should be provided to meet the day-to-day operational, sustainable, long-term capital and socio-political requirements.

Consideration should be given to developing and making the best use of staff expertise.

At all levels, there should be sufficient staff with the necessary specialized education and training. An environment of continuous education and training should also be established.

### 7.2.2 Organizational structure and responsibilities

The water utility should define all tasks, competencies and the ensuing responsibilities relating to its activities. The management structure and organization should be clearly defined to establish and delegate responsibilities and to ensure that all activities are covered and completed correctly.

In addition to the person or persons in charge of checking and supervision, the water utility should have at its disposal a sufficient number of qualified staff. The number of staff required for the individual tasks and activities should correspond to the type and size of the water utility, the condition and size of the distribution system and any outsourced activities. The potential unavailability of staff due to holiday leave, sick leave and in-service training, as well as staff required for the proper control of fault and emergency situations, should be taken into account.

### 7.2.3 Organization of work flow

The water utility should define the sequence of all essential operations required for the proper performance of its tasks, processes and activities based on its hierarchical organization, ensuring that both internal cooperation and the interfaces resulting from the integration of third-party organizations are organized in a harmonious manner. More detailed working instructions (e.g. standard operating procedures and operation and maintenance manuals) should be given whenever required, that should ensure the proper and expert handling of individual activities, adhering to applicable and generally accepted requirements or practices.

There should be a clear definition of the type, scope and level of detail of the organization of workflow, including the qualification level and in-service proficiency of the employees in charge of handling all tasks and activities. Attention should be given also to employee work-life balance, ensuring adequate time for family matters.

### 7.2.4 Operational documents and records

Tasks and activities should be documented and the documents should be retained to furnish proof that the tasks and activities have been carried out properly and expertly.

Managers and supervisors should check these records at regular intervals.

All supervision and checking activities should be documented.

If not stated otherwise in national legal provisions, license permits and official directions or the nationally generally accepted requirements or practices, every document should be kept on record for a defined period.

Secure retention or backup of such documents should be ensured in case of emergency or loss.

Examples of documents and records include:

- system plans and documentation (including control systems);
- operating instructions, logbooks and work rules;
- financial records;
- employee records, including training and occupational health and safety records;
- test records, proof of maintenance;
- records of water, effluents and residue quality and quantity;
- contractual and legal affairs.

## 7.3 Planning and construction

Planning the development and construction of the water system should be based on a long-term comprehensive strategy for protecting human health and the natural and built environment, due consideration to the needs of future generations and ensuring long-term sustainability of operations. Disaster countermeasures should ensure the safety of the entire system, not just that of a single facility. Planning involves improving the water system step by step, taking into account:

- local climatic conditions (climate change);
- population changes and urbanization development;
- the evolution of users' expectations;
- changes in legal and other requirements;
- the mitigation of service interruptions;
- damage to facilities in emergency situations, such as disasters and accidents;

- water supply backup systems;
- facility efficiency, economic efficiency;
- reconstruction and renewal of water facilities, based on long-term financial balance;
- the safeguarding of public health and the protection of the environment, including the water source.

The construction of drinking water system components should be carried out in an economic and environmentally compatible manner. In all cases in which the abstracted water does not have the necessary quality level at all times, it should be treated to meet the qualities of drinking water. Unwanted changes to the drinking water quality level caused by drinking water treatment should be minimized in accordance with technical standards.

Within the framework of this supply concept, all necessary approval and notice procedures should be carried out, interest in land and rights of way should be secured, technical design should be determined and the financing of all measures should be safeguarded.

In the case of contracting, the water utility should determine and verify the contractor's professional suitability and willingness to perform the work.

In construction projects, the water utility should ensure that construction management and supervision, as well as the acceptance of contracted work, are carried out properly. Within the framework of acceptance of contracted work, it should be verified by suitable testing that the construction was done properly.

## 7.4 Operations and maintenance

### 7.4.1 General

Operations and maintenance concerning the assets (including their assessment) of the drinking water supply system include:

- a) abstraction;
- b) treatment of raw water;
- c) distribution of drinking water to point of delivery;
- d) reduction in process water and the treatment and reuse of such process water;
- e) the safe transportation and disposal or reuse of residues.

The operator should develop a plan for an operations and maintenance strategy, covering both proactive and corrective or reactive maintenance activities. Proactive maintenance should be performed based on the condition of the assets or at scheduled intervals to prevent, minimize or delay failures or shutdowns that result in unplanned maintenance activities, or to ensure continued, efficient asset operation and to prolong asset life. Corrective or reactive maintenance includes maintenance performed following a failure or shutdown and involves activities necessary to repair or restore assets or systems of assets to a satisfactory condition or level of performance.

The activities and responsibilities of the water operator should include the following aspects:

- planning;
- operations;
- operational efficiency controls;
- maintenance (inspection, servicing, repair, including particularly leak management and rehabilitation);
- making and maintaining water facilities ledger;

- conducting soundness diagnosis and creating a preventative maintenance, renovation and renewal plan based on the evaluation of the soundness diagnosis;
- monitoring of source water, drinking water and residue quality and quantity through testing from laboratories meeting the requirements of ISO/IEC 17025;
- commissioning (stopping, testing, re-commissioning and decommissioning);
- troubleshooting (during and outside normal hours of work);
- documentation and record keeping;
- emergency response.

## 7.4.2 Technical activities

### 7.4.2.1 Water sources

In liaison with the relevant authority, catchment zones should be defined for the protection of water sources and adequate constraints should be imposed in order to protect the quality of the raw water. Any water rights, licenses and easements should be listed in the land registers.

Where permitted, the water utility should manage the immediate protection zone around the withdrawal facilities (intakes or boreholes), maintaining fences that prevent access by unauthorized persons, and ensuring that the premises are kept clean and that the surrounding land is kept in good condition, without the use of fertilizer or herbicides.

In liaison with the relevant authority, water quality improvement, monitoring and response to accident should be implemented.

In order to respond to the decline in water supply capacity due to climate change, water utilities should make efforts to develop water resources or back-up water resources for droughts.

### 7.4.2.2 Water treatment facilities

The management of treatment and other processes within the water utilities should be undertaken in a manner that optimizes the use of equipment and resources involved.

Each unit of the water treatment facilities should be operated in accordance with its specifications. The proper operation of the treatment facilities may require in particular:

- monitoring and adjusting the treatment process and the type and quantity of chemicals used to the characteristics of the water or residues;
- ensuring the regular supply of treatment products, their correct storage and maintenance of equipment and dosing devices;
- disposal of waste and by-products;
- optimizing the process efficiency;
- establishing and monitoring critical points of control.

### 7.4.2.3 Drinking water transportation and distribution systems

Drinking water can be transported and distributed by different means (e.g. pipelines, road tankers), designed to ensure appropriate capacity, and instrumented and operated to maintain appropriate quality. The transportation and distribution system may include temporary storage and subsequent pumping. The distribution system should be capable of preventing backflow at the point of delivery, in order to reduce the risk of contamination.

Leak detection and repair programmes should be implemented in order to protect the drinking water against any possible hygienic risks and to prevent any deterioration in the hydraulic efficiency of the network, taking into account the utility's economic and environmental constraints.

Depending on conditions, such as sedimentation in pipes or internal corrosion, maintenance or rehabilitation campaigns (e.g. cleaning) should be implemented in order to prevent deterioration in water quality and to restore the original capacity of the pipes.

Metering at strategic points in the drinking water supply system, i.e. at the different stages of drinking water production (e.g. withdrawal, treatment plants) and distribution (e.g. main lines, storage outflows, points of supply), should be performed in order to manage the drinking water system and facilitate leak detection or other unauthorized water use.

In order to prevent any loss or deterioration of the quality of the treated drinking water, drinking water storage should be kept in good condition. The storage should therefore be controlled and cleaned and rehabilitated as necessary.

Each component of the drinking water storage, distribution and transportation facilities should be operated in accordance with its standard operating procedure.

The proper operation of the storage, distribution and transportation facilities for drinking water may include the following:

- monitoring the quantity of water being supplied;
- monitoring the quality of the water by scheduled sampling and analysis at specified strategic locations in the distribution and storage facilities for public health assurance;
- carrying out surveillance programmes against drinking water theft to ensure recovery of cost through charges;
- carrying out surveys for detecting leakage and losses;
- carrying out rehabilitation programmes on components, ensuring the required level of hygiene as well as technical and economic viability;
- carrying out inspection and maintenance.

There should be a regular assessment of the condition and functioning of all assets (components) in order to optimize maintenance, repair and rehabilitation programmes.

A tool, such as a mathematical model of the network, should be used in order to assess the transfer capacities of the network under real or simulated hydraulic situations.

#### 7.4.2.4 Emergency provisions

The quality and continuity of the drinking water service to users is a priority for protecting public health and the environment. The water utility should therefore be prepared to take the necessary steps to deal with emergency situations. Emergency situations can include technological failures (e.g. pipe failures, information system failure), natural disasters (e.g. earthquakes and severe weather events), criminal acts of vandalism and terrorism and pandemics.

Emergency plans covering all these situations should be developed. When drinking water does not meet potability standards, a specific warning to users should be provided. When service is interrupted, the service should be restored as soon as possible. Special attention should be given to the needs of critical customers or critical service areas and the need for fire protection (where applicable).

For emergency situations, in order to minimize the negative impacts on the water service, the water utility should have an emergency response plan. In addition, water utilities should have a business continuity plan that stipulates operations which should be continued, restarted and started including a priority list.

Water utilities should cooperate with each other so that they can provide comprehensive backup in an emergency.

It is recommended that the emergency plan be tested and simulation exercises conducted in order to train the operating personnel in managing emergency situations. Experience of previous crises and simulation exercises should be documented.

On the basis of the risks previously analysed and classified, preventive actions should be assessed, economically evaluated and an appropriate response initiated.

### **7.4.3 Support activities**

#### **7.4.3.1 Purchasing equipment, materials and products**

Procedures should be established for both the procurement and stockpiling of all materials, equipment and products.

Clear and precise specifications should be produced and conformity assessed.

Appropriate equipment should be available to employees to carry out the tasks and activities.

The maintenance of drinking water quality requires the use of chemically, microbiologically and sanitarly satisfactory additives and construction materials, paints and coatings for all surfaces coming into contact with drinking water.

The physical demands placed on the pipeline during installation and operation should be taken into account in the choice of materials.

These requirements should be fulfilled in both the procurement and stock-keeping processes for all such materials and components.

Unless the water utility has outsourced stand-by service (for failures or faults) to third-party companies, vehicles equipped with the most important tools and aids should be kept ready for immediate dispatch in case of disruptions.

The water utility should ensure that all tools and aids are in perfect working condition throughout their service life. To this end, status and functionality tests should be carried out at regular intervals.

#### **7.4.3.2 Contractual and legal affairs**

All rights permits and contracts (e.g. supply contracts, customer contracts, service agreements) should be managed properly. Specific attention should be paid to material requirements, abstraction and discharge consents or permits, rights to lay water mains, easements for treatment, storage and disposal facilities.

#### **7.4.3.3 Accounting or billing**

The accounting system should take into account all costs, which may include environmental and resource costs. If charged for the provision of water, fees may reflect the full or partial costs of the water services in accordance with applicable social policies. The calculation of the fee should be transparent.

#### **7.4.3.4 Human resources**

The water utility should continually secure engineers with specialized knowledge and experience in the operation of water facilities.

The water utility should make sure that all employees are qualified for the tasks to be carried out and should provide routine performance planning and evaluation.

Employees should be capable of accomplishing the tasks assigned to them. Furthermore, specially instructed, experienced or expert staff should be available to carry out special activities in accordance with applicable

provisions and generally accepted technical rules for the prevention of accidents. Before assigning a task, it should be shown that the relevant qualification requirements are met.

The utility management should be responsible for providing sufficient and suitable in-service training and instructions to maintain the qualification.

#### 7.4.3.5 Protection of labour

The water utility should provide a safe environment, appropriate equipment (e.g. personal safety equipment) and work procedures. The personnel concerned should receive instruction on worker safety, with routine follow-up training as appropriate. Attention should be paid to the occupational health for all personnel with respect to specific risk in operating water systems (including outsourced personnel).

The protection of labour is especially important with the effects of climate change.

#### 7.4.3.6 Outsourcing (partial work)

When outsourcing work, the overall responsibility remains with the water utility. Consequently, the utility should specify that the third-party involved:

- meets all the necessary personnel and material requirements;
- is capable of ensuring the proper monitoring and checking of its own activities;
- has at its disposal staff of suitable skills, reliability and efficiency, who have the technical and expert knowledge required to perform the tasks in question;
- reports reliably and regularly on its activities and the conditions of its contract.

In the interests of stakeholder concerns about transparency, care should be taken in the provisions of the contract to maximize public access to the terms of the contract.

#### 7.4.3.7 Outsourcing (business operation)

When outsourcing business operation, the overall responsibility remains with the water utility. The water utility should monitor the operation status by the operating company, confirm the achievement status of the required level and evaluate it. The water utility should regularly publish monitoring evaluation results to stakeholders to ensure business transparency. The water utility should specify that the operating company involved:

- can achieve the required level;
- can fulfil its social responsibilities;
- can enhance customer service;
- secures an effective governance system and internal control system;
- can take appropriate measures in the event of a disaster.

#### 7.4.3.8 Protection of the environment

Environmental management is an essential part of operating and maintaining a water utility and should include a long-term strategy for environmental protection. The environmental impacts of operations and maintenance activities cover more than just water-related issues and may be permanent or temporary.

In addition to the items mentioned in (7.3), environmental management includes minimizing the impacts of operations, maintenance, construction and repair activities (e.g. noise and community disruption) and protecting public health and safety as well as the water source.

For sustainable water supply, the water utility should implement measures to deal with climate change (e.g. recycling of resources, energy-conservation measures, renewable energy use, effective use of water resources).

Environmental management should take into account environmental protection, by improving the water system step by step, taking into account:

- the increasing population and urbanization;
- the possibilities for water management;
- the safeguarding of public health and the protection of water sources;
- the interests of future generations.

In undertaking environmental protection plans, the utility should take into account climate change issues.

#### 7.4.3.9 Public awareness and communications

The water utility should utilize a variety of media and tools (e.g. online) to develop and implement:

- activities to raise public awareness regarding the importance, costs and operations of water supply services;
- the provision of information on water sources, purification, water distribution processes and water quality management;
- programmes to communicate with the public regarding levels of service, user needs, water conservation and the economic, social, environmental or sustainable aspects of drinking water services;
- the provision of information on the possibility of suspension of water supply that can occur in the event of a disaster.

#### 7.4.3.10 Technological innovation or technological development

In order to improve and review the management of water facilities, the water utility should secure and promote investment in technological development and research in response to changes of environment.

## 8 Assessment of water services

### 8.1 General

Assessment as a process should be managed to achieve a clear and precise purpose and refer to the objectives outlined in [Clause 5](#). The following should be established as part of a comprehensive policy (see [8.2](#)):

- the goal and scope of the assessment (see [8.3](#));
- the parties involved in the assessment (see [8.4](#));
- the methodology of assessment (see [8.5](#));
- the necessary service assessment criteria (see [8.6](#));
- the resources necessary to conduct the assessment (see [8.7](#));
- the production of output and recommendations for the use of the output ([8.8](#));
- the reliability and credibility of the data to be used in the assessment;
- the consistency of the data collected for the assessment and the methods to collect it for the consistency of the output.

How and by whom the assessment information is to be used should also be identified.

If not precisely specified, the assessment can cause confusion or conflicts among the parties involved.

There is a great variety of types of assessment, depending on the characteristics listed previously.

**EXAMPLES** Environmental performance assessment, including climate change, conformity assessment relating to best practice, risk assessment, audits, financial and human resources aspects.

The output of this process (i.e. assessment as a result) should facilitate the further decision-making process for the stakeholder requesting the assessment.

## 8.2 Assessment policy

The responsible body should establish a comprehensive policy for the assessment of the service.

A sound assessment policy is a key component of the continuous improvement of the service. It should give a general framework for the assessment. It facilitates the determination of the actual situation and how strategic planning and decision-making influences performance.

The assessment policy should address the overall efficiency and effectiveness of the strategic planning and decision-making activities. It should be designed to encompass all of the various management systems and procedures and include self-assessment in the management component.

It should assist in the measurement of achievements of the various functions and activities performed for providing the services, closing the cycle and linking:

- the set of objectives stipulated in [Clause 5](#);
- the guidelines for satisfying users' needs and expectations in [5.3](#);
- the selected assessment criteria in [5.1.3](#).

Assessment should be designed and implemented as a tool for promoting the development of collective learning and feedback to decision-making.

## 8.3 Goal and scope of the assessment

The general goal of assessment is to check if the water service objectives concerning the users have been met. Objectives for the service to users are defined in [Clause 5](#).

The goal and scope for a specific assessment should be clearly defined.

This document does not deal with the assessment of the management of the utility.

Service assessments should be focused on service performance, on the satisfaction of users and on meeting applicable requirements and the objectives for the service, but not on the means used or the detailed organization implemented for meeting the objectives.

**NOTE** Regulations can apply.

Part of the assessment of water services deals with the assessment of service to users. For service to users, assessment should focus on the interface between the utility and the user (e.g. measuring user satisfaction). Assessment of service to users should involve effectively the users in the process. More guidance for identifying users' expectations and their criteria for assessing the quality of the service is given in ISO 24510<sup>[7]</sup>.

With regard to assessment of water services (in addition to the assessment of service to users), the general recommendation is to focus on the service performance. Nevertheless, some activities do not fit well with direct measurement of their performance. In such cases, indirect assessment of the performance can be accomplished through the evaluation of some management systems (e.g. risk management, security management, asset management).

## 8.4 Parties involved in the assessment

The responsible parties and all other parties (e.g. the assessment team) involved in the assessment should be clearly defined. Their responsibilities, their role in the process and the framework of operation for each party should be specified.

When the responsible body and the operator(s) are not the same legal body, assessment procedures, if not fixed by legal requirements from the relevant authorities, should be agreed to in advance to provide coherent assessment results from all involved parties, in accordance with respective rights and responsibilities. Concerning service to users, the responsible body and its operator(s) should take a consistent position relevant to the assessment procedures concerning service to users.

## 8.5 Methodology of assessment

Due to the diversity of legal, institutional and managerial systems governing water services, this document does not present detailed service assessment procedures. However, this document should be used to configure assessment procedures appropriate to local conditions.

The selection of the assessment tools should fit the assessment goals and scope. Performance indicator systems are one of these tools (see [Clause 9](#)).

NOTE In some cases, specifications for assessments can be required by relevant authorities or by financial investors.

Assessment methodology and procedures should be:

- developed with a capacity for repeated measurement to determine trends;
- periodically reviewed to check their efficiency and effectiveness, paying attention notably to avoidance of duplication;
- flexible to adjust to changes in goals, framework, assessment criteria and indicators as new insights are gained;
- weighing the reliability, consistency and effectiveness of the data to be used in the assessment, including plans to upgrade data that is not available, accurate or accessible enough.

Some types of assessment procedures may be already standardized. In such cases, it is recommended that the relevant standards be used.

EXAMPLE Review ISO 9000:2015<sup>[1]</sup>; environmental performance evaluation ISO 14031:2021<sup>[4]</sup>.

If, at a geographically relevant level (country, region and city), specifications are established for the water services, then these specifications may also include provisions concerning assessment processes (e.g. user satisfaction). See [Annex D](#).

## 8.6 Service assessment criteria

The necessary service assessment criteria should be selected in accordance with the objectives and requirements of interest as determined by stakeholders, taking into account local conditions.

Each service assessment criteria should be discussed in order to establish the optimal output – that is the most representative, realistic, specific, efficient in the measuring technology and procedure, in representing the specific criteria, and financially acceptable.

Service assessment criteria are the link between objectives and performance indicators. The following example shows, for one of the objectives proposed in [Clause 5](#), possible service assessment criteria. More examples are given in [Annex E](#).

It should be noticed that a service assessment criterion can be related to more than one objective.

EXAMPLE

Objective: protection of public health.

An objective of a drinking water supply service is to ensure a sufficient supply of safe and agreeable drinking water.

Possible service assessment criteria include:

- meet public health and drinking water quality standards;
- meet threshold or minimum microbiological, chemical and radiological quantities;
- maintain system integrity;
- maintain acceptable aesthetic (taste, odour and colour) criteria.

## 8.7 Resources to conduct the assessment

The responsible party for the assessment should ensure that the necessary resources, including human, financial, organizational and required information technology, are available, including the search for possible procedures and technological measuring systems for the establishment of the optimal output. The team with the responsibility for carrying out the assessment should be clearly defined. This team should be empowered to specify and steer the assessment process within the given framework (e.g. goals, scope, resources, parties involved, methodology, outputs).

## 8.8 The production of output and recommendations for the use of the output

The output of assessment should be a report about the assessment process and its results. It should include additional guidelines for the use of these outputs. The output should make transparent the distinction between the defined targets and the actual service and make achieved levels of performance publicly available.

# 9 Performance indicators

## 9.1 General

Performance indicators are used to measure the efficiency and effectiveness of a utility in achieving its objectives (particularly those identified in [Clause 5](#)), e.g. resilience of the utility to climate change effects and water security and anti-cyber issues. The use of key performance indicators can provide water utilities with tools to define, measure, grade and rank their performance, while aiming towards a higher standard, preparing programmes to achieve the new standard (including the initiation and implementation of new technologies) and more.

Performance indicator systems should be considered as a key assessment tool among the various existing assessment tools (see [Clause 8](#)).

Performance indicators should be used within the context of a comprehensive service assessment system. This system should include, among other tools, a coherent set of indicators and the related components that allow for a clear definition of these performance indicators and assist in their interpretation.

## 9.2 Performance indicator systems

### 9.2.1 Key components of a performance indicator system

A performance indicator system comprises a set of the following key components:

- performance indicators;
- context information;
- variables;

- programme of actions and periodic follow-up.

In addition, specific targets for each indicator should be established and routinely monitored, tracked and adjusted as needed.

### 9.2.2 Performance indicators

Individual performance indicators should be unique and collectively appropriate for representing the relevant aspects of the service in a true and unbiased way.

Each performance indicator should:

- be clearly defined, with a concise and unequivocal interpretation;
- be assessed from variables that are easily and reliably measured, at a definite frequency of collection report and audit and at a reasonable cost;
- contribute to the expression of the level of actual performance achieved in a certain area;
- be related to a specified geographical area (and, in the case of comparison analysis, for the same geographical area);
- be related to a specific time period (e.g. annual, quarterly);
- allow for a clear comparison with targeted objectives and simplify an otherwise complex analysis;
- be verifiable;
- be simple and easy to understand;
- be objective and avoid any personal or subjective appraisal.

Performance indicators are typically expressed as ratios between variables. These ratios may be commensurate (e.g. %) or non-commensurate (e.g.  $\$/\text{m}^3$ ). In the case of non-commensurate ratios, the denominator should represent one dimension of the system (e.g. number of service connections; total water main length; annual costs). This allows for comparisons through time or between systems.

Variables that can vary substantially in time (e.g. annual extraction, discharge volumes), particularly if not under the control of the utility, should be avoided as denominators in the indicator ratios. An exception can be made when the numerator varies in the same proportion as the denominator.

A clear processing rule should be defined for calculating each indicator. The rule should specify all the variables required and their algebraic combination. The variables may be data generated and managed within the utility (utility data) or externally (external data). In either case, the quality of the data should be assessed (see 8.3) and verified. The interpretation of the performance indicators should not be carried out without taking into account the context, particularly if it is based on comparisons with other cases. Therefore, complementary to the performance indicators, the context information should consider also the characteristics of the system and the region in which the services are provided.

Additional information on performance indicators and grading systems for performance indicators are provided in [Annexes D, E and F](#).

### 9.2.3 Variables

Each variable should:

- a) fit the definition of the performance indicator or context information it is used for;
- b) refer to the same geographical area and the same period of time or reference date as the performance indicator or context information it will be used for;
- c) be as reliable and accurate as the decisions made based on it require.

Some of the variables are external data and mainly informative, and their availability, accuracy, reference dates and limits of the corresponding geographical area is generally out of the control of the utility. In this case, variables should also:

- whenever possible, be collected from official sources, which include information on the accuracy and reliability of the variable(s);
- be essential for the performance indicator assessment or interpretation.

#### 9.2.4 Context information

Context information defines inherent characteristics of a system that are relevant for the interpretation of the performance indicators. There are two possible types of context information:

- information describing pure context and external factors that are not under the control of the utility (e.g. demographics, topography, climate);
- characteristics that can only be influenced by management decisions in the long term (e.g. age of the infrastructures).

### 9.3 Quality of the information

The quality of the data should reflect the importance of the assessment being conducted.

A scheme providing information on data quality is needed so that users of the performance indicators and context information are aware of the reliability of the information available. The value of the performance indicators can be questionable without this scheme.

The scheme should consider, for example, the data format report, scaling of instruments involved in the process, the control and audit of the updating of the data, accuracy and reliability.

The confidence grade of a performance indicator can be assessed in terms of its accuracy and reliability. The accuracy accounts for measurement errors in the acquisition of input data. The reliability accounts for uncertainties in evaluating the reliability of the source of the data.

An example of a confidence-grading scheme is presented in [Annex F](#).

### 9.4 Example of a performance indicator

Performance indicators are relevant to service assessment criteria to which they link. The following shows, for one of the objectives proposed in [Clause 4](#), possible performance indicators relevant to one of the service assessment criteria shown in [8.6](#). More examples are given in [Annex E](#).

Objective: protection of public health.

An objective of a water utility should be to ensure a sufficient supply of safe and agreeable drinking water.

Possible service assessment criteria: safe drinking water.

Performance indicator: meeting or exceeding drinking water quality requirements.

An example of a possible performance indicator related to this assessment criteria is:

Performance indicator: quality of supplied water (%)

Definition: percentage of the total number of treated water tests performed that comply with the applicable standards or legislation

Processing rule:  $[\text{compliant aesthetic tests (number)} + \text{compliant microbiological tests (number)} + \text{compliant physical-chemical tests (number)} + \text{compliant radioactivity tests (number)}] \times 100 / [\text{treated water quality tests carried out (number)}]$

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Comment: Each jurisdiction should establish requirements or guidelines for safe drinking water and use acceptable methods of measurement. This performance indicator can also apply to individual parameters, including microbiological, chemical, radioactivity and aesthetic requirements or guidelines. This indicator should be assessed on an annual basis. It may also be assessed for periods shorter than one year, but special care is required in result interpretation when used for internal or external comparisons.

International Water Association (IWA) code: QS18

NOTE 1 Other performance indicators can be established and can include (but are not limited to) the following: “Aesthetic test compliance” (%; IWA code: QS19); “Microbiological test compliance” (%; IWA code: QS20).

NOTE 2 The example presented here uses a short version of how to deal with and calculate a performance indicator. See [Annex E](#) for a more extensive example of how to deal with and calculate a performance indicator.

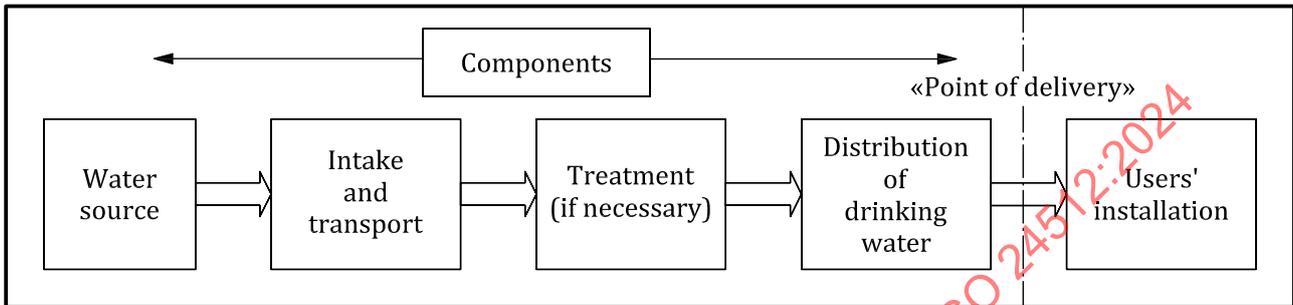
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## Annex A

### (informative)

## Schematics of drinking water supply systems

There are four essential elements or components of a drinking water supply system, as shown in [Figure A.1](#).



**Figure A.1 — Basic schematic of a drinking water supply system**

These components can be recognized in a typical on-site system, such as may be found in private water supply systems of rural residences and buildings, with the following:

- a well;
- a pump;
- piping to connect the well to the building;
- (possibly) some sort of point-of-entry or point-of-use treatment system, such as a water softener or filter;
- a plumbing system connected to a series of taps located in the building or, in some cases, to a stand pipe for common use within a village.

They can equally be recognized as elements of a central water supply system, as may be found in communities ranging from villages to cities, and even regional water supply systems supplying several communities in a given geographic area. In this case, the distribution system includes a broader distribution system of treated water mains connected to serviced buildings within the community.

[Figure A.2](#) illustrates such a system and indicates that there may be connections between such a system and other systems, which may be undertaken for a series of operational or security reasons.

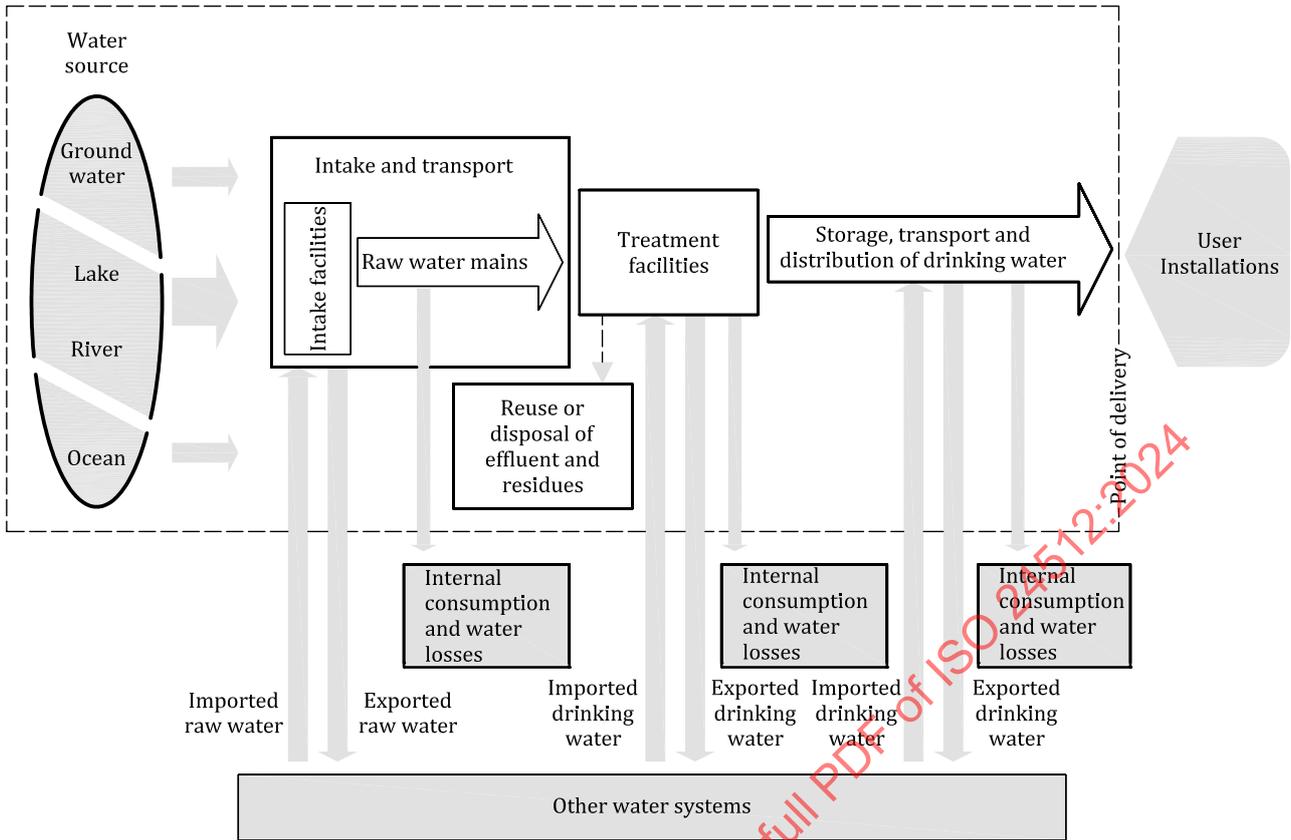


Figure A.2 — Example of a centralized drinking water supply system

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**Annex B**  
(informative)

**Possible actions to achieve the objectives of the water utility**

In order to achieve the objectives described in [Clause 5](#), care should be taken not to give the “means to achieve an objective” the status of being an “objective”. For example, “having a well-trained labour force” can be an objective, but it can alternatively be a means to achieving an objective such as “producing safe drinking water” or “having a sustainable water utility”.

For most objectives, a series of related action steps can be developed, as illustrated in [Table B.1](#).

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**Table B.1 — Water utility objectives and examples of possible actions**

Water utility objective	Examples of possible actions
Protection of public health (see 5.2)	<ul style="list-style-type: none"> <li>— provide drinking water that is potable at the point of delivery to the user</li> <li>— provide drinking water that is aesthetically acceptable at the point of delivery to the user</li> <li>— provide sufficient drinking water to meet the public health and sanitation needs of the user</li> </ul>
Meeting users' needs and expectations (see 5.3)	<ul style="list-style-type: none"> <li>— see ISO 24510<sup>[7]</sup></li> </ul>
Provision of services under normal and emergency situations (see 5.4)	<ul style="list-style-type: none"> <li>— provide a continuous supply of drinking water</li> <li>— provide an adequate pressure of drinking water</li> <li>— manage factors affecting the reliability of service</li> </ul>
Sustainability of the water utility (see 5.5)	<ul style="list-style-type: none"> <li>— ensure access to water resources</li> <li>— provide an adequate system capacity</li> <li>— maintain the substance and capacity of water resources with regard to sustainability</li> <li>— operate and maintain or replace the assets to maintain a good condition</li> <li>— have an appropriate, safe and qualified labour force</li> <li>— establish a pricing mechanism that is fair to customers and provide appropriate revenue flows</li> <li>— establish tariff structures that provide for recovery of all drinking water supply costs</li> </ul>
Sustainability of the water utility (see 5.5)	<ul style="list-style-type: none"> <li>— contribute to sustainable integrated water resources management policies and practices, including protection of water sources</li> <li>— reduce environmental pollution through the reduction of gas, noise and odour emissions and the discharge of effluents from drinking water supply facilities</li> <li>— select, where possible, materials of construction for assets or additives for treatment systems and infrastructure construction methods that are environmentally benign</li> </ul>

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Table B.1 (continued)

Water utility objective	Examples of possible actions
Protection of the environment (see 5.7)	<ul style="list-style-type: none"> <li>— optimize various energy consumptions</li> <li>— minimize the generation of environmental pollutants, the emissions of gases, noise and odours from drinking water facilities</li> <li>— manage residues and other wastes</li> <li>— contribute to and implement sustainable integrated water resources management policies and practices</li> <li>— protect water abstraction areas from contamination</li> <li>— contribute to development planning and resource allocation through consultation, provision of information and analysis in conjunction with appropriate institutions</li> <li>— protect water resources, freshwater quality and quantity in rivers, lakes and groundwaters</li> </ul>
Climate change (see 5.8)	<ul style="list-style-type: none"> <li>— follow the current information about climate change's impact on water sources that can affect water systems</li> <li>— study the potential risks to the water systems associated with climate change phenomena</li> <li>— monitor changes in water flow and flow distribution due to climate change</li> </ul>
Higher user and regulatory demand (see 5.9)	<ul style="list-style-type: none"> <li>— study the trends in the demands by users regarding the quality and changes in the services provided to users and prepare to respond to those trends</li> <li>— keep track of the plans for changing or adding to the regulatory requests by authorities, such as the health and environmental authorities, and prepare to satisfy these new or changed requests</li> </ul>
Available technologies (see 5.10)	<ul style="list-style-type: none"> <li>— implement data mining and analysis (geographic information system for mapping and management purposes)</li> <li>— implement communications and digitation (central command and control)</li> <li>— implement protection against risks stemming from the use of cyber communications</li> </ul>

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**Annex C**  
(informative)

**Possible actions related to the management of the water utility**

The possible actions illustrated in [Table C.1](#) are developed from the possible actions shown in [Table B.1](#), related to the management components of the water utility.

**Table C.1 — Management components and examples of possible actions**

Management components of the drinking water system	Examples of possible actions
Activities and process management (see <a href="#">6.2</a> )	<ul style="list-style-type: none"> <li>— establish corporate objectives</li> <li>— establish corporate strategies</li> <li>— develop and implement strategic, tactical and operation plans</li> <li>— identify regulatory requirements</li> <li>— ensure coordination between processes</li> <li>— establish operational procedures</li> <li>— ensure protection of automated systems from cyber terrorism</li> </ul>
Resources management – personnel (human resources) (see <a href="#">6.3</a> )	<ul style="list-style-type: none"> <li>— secure and maintain health and safety of personnel</li> <li>— employ appropriate personnel for the jobs considering their technical competences and skills</li> <li>— ensure that personnel comply with laws, by-laws or regulations</li> <li>— provide training for personnel to improve their abilities</li> <li>— assign qualified personnel</li> <li>— instruct personnel to act in good faith in relation to customers</li> <li>— ensure that human resources are able to maintain a satisfactory work load or private time balance</li> </ul>
Resources management – financial (costs and benefits) (see <a href="#">6.3</a> )	<ul style="list-style-type: none"> <li>— develop a clear and fair service charge structure that accounts for local economic considerations and revitalization efforts considering affordability to users</li> <li>— develop applicable revenue sources to ensure cost recovery and long-term sustainability of drinking water infrastructure and services</li> <li>— ensure long-term functionality of systems while considering cost-effectiveness</li> <li>— maintain sound finances in accordance with the long-term management projections</li> <li>— analyse management conditions using appropriate methods while considering regional characteristics</li> <li>— implement cost-effectiveness measures</li> <li>— ensure accounting systems and financial plans are secure against cyberattacks</li> </ul>

Table C.1 (continued)

Management components of the drinking water system	Examples of possible actions
Assets management (see 6.4)	<ul style="list-style-type: none"> <li>— maintain an up-to-date asset inventory (technical and financial)</li> <li>— define performance targets for the main types of assets</li> <li>— define asset condition assessment protocols</li> <li>— record failure and repair events</li> <li>— record asset investment and maintenance costs</li> <li>— forecast new asset needs and corresponding costs</li> <li>— ensure that automated systems are protected from cyberattack</li> </ul>
Customer relations management (see 6.5)	<ul style="list-style-type: none"> <li>— identify and meet customer needs</li> <li>— respond to users' complaints swiftly and appropriately</li> <li>— provide users with communication opportunities to express their opinions</li> <li>— give consideration to people in neighbouring communities to gain their support</li> <li>— organize events promoting the drinking water facilities</li> <li>— participate as volunteers in local events</li> <li>— provide understandable and transparent information for users</li> </ul>
Information management (see 6.6)	<ul style="list-style-type: none"> <li>— identify data needs and data flows related to management and to service assessment</li> <li>— define data collection protocols</li> <li>— establish data updating protocols</li> <li>— ensure information integration and protection</li> </ul>

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Table C.1 (continued)

Management components of the drinking water system	Examples of possible actions
Environmental management (see 6.7)	<ul style="list-style-type: none"> <li>— contribute to sustainable integrated water resources management policies</li> <li>— act as a responsible stakeholder in watershed or river basin institutions</li> <li>— promote integrated water resources management in drinking water projects</li> <li>— protect water quality in receiving water bodies</li> <li>— consider the impacts of climate change and the need to protect future generations</li> <li>— protect and conserve water sources for drinking</li> <li>— operate drinking water systems with consideration for the global environment</li> <li>— educate users on environmental management concerns and also on not discharging substances adversely affecting the environment</li> <li>— promote energy efficiency and minimize consumption of energy in drinking water systems</li> <li>— optimize the use of renewable energy in drinking water systems</li> <li>— comply with local rules and regulations and consider user requirements</li> <li>— ensure customers comply with requirements for connection to drinking water systems</li> </ul>
Risk management (see 6.8)	<ul style="list-style-type: none"> <li>— conduct risk analyses</li> <li>— develop standard operating procedures</li> <li>— provide and implement scheduled preventive maintenance programmes</li> <li>— maintain inventories of materials and critical equipment</li> <li>— develop and exercise contingency and emergency plans</li> </ul>

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## **Annex D** (informative)

### **Examples of an assessment methodology for deciding on the implementation and calculation of performance indicators for water utilities, objectives and related performance indicators**

#### **D.1 Example of an assessment methodology for deciding on the implementation and calculation of performance indicators for water utilities**

- a) Identify key topics which should be complied with based on measurable performance indicators, such as:
- relevant regulation of water and drinking water quality, asset maintenance, customer service etc.,
  - relevant stakeholders' demands.
- b) Identify key topics that are recommended as measurable performance indicators.
- c) Identify general goals for each topic.
- d) Identify and grade benefits and risks from each goal.
- e) Identify the stake holders for each goal.
- f) Define – preferably via teams – the different alternatives for performance indicators to each goal and relevant type of set of data, considering:
- existing data in the system, its accuracy, accessibility, and quality;
  - procedures and technologies for the collection of the data;
  - costs, simplicity, human resources effectiveness, etc.
- g) Form a suggested frame and calculation formula for each performance indicator, considering:
- means of collection;
  - frequency of collection;
  - format of data to be reported;
  - normalization of the performance indicator;
  - means to keep or upgrade the accuracy and reliability of data;
  - systems to control, monitor, verify and audit all of the above.
- h) Form a suggested plan for the implementation of the process, showing:
- human resources;
  - responsibilities;
  - technologies for the collection of the data;
  - data reporting formats, frequencies and formulae to calculate performance indicators, maintenance procedures for equipment, systems and processes;

- monitor and audit procedures;
  - costs;
  - benefits and risks;
  - timetable for the implementation of each procedure and technology;
  - timetables for output achievements analysis that include data analysis, calculating the variables and outputs of each performance indicator formula, and for the setting of each achievement desired for the next output achievement analysis.
- i) Approve the decisions taken from the suggested plan with stakeholders.
- j) Implement the approved plan.
- k) At the first output achievement analysis, set a suggested output achievement for the next analysis and a specific plan designed to reach each output achievement, considering:
- feasibility of the desired achievement;
  - costs;
  - timetables, responsibilities, teams;
  - priorities and risks;
  - technological options;
  - regulation and stakeholder demand;
  - crisis preparedness;
  - customer expectations;
- l) Approve the plan with relevant stakeholders.
- m) Implement the approved plan.
- n) Monitor and audit the plan.
- o) Add, change and improve each segment of the plan in order to constantly improve the performance of the utility with new technologies, procedures, customers, stakeholders, regulation demands, etc.

## **D.2 Examples of objectives that can be considered as a platform for performance indicators for water utilities and examples of performance indicators related to each one of these objectives**

- a) Environment:
- minimum water underground losses;
  - minimum upper ground water bursts;
  - minimum water loss.
- b) Public health:
- minimum nonconformities from standard requirements of drinking water;
  - maximum online quality monitoring.
- c) Service level:

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- maximum responding time for telephone, email and frontal waiting time;
- minimum time of water stop-of-service per customer.
- d) Systems or infrastructure:
  - maximum data for GIS layers;
  - age of infrastructure lower than its existence period;
  - maximum automation in control systems and sensors.
- e) Crisis preparedness: minimum nonconformities in crisis preparedness external audit.
- f) Climate changes: existence of long-term master plan that considers climate changes and the degree of its execution.
- g) Cyber protection:
  - maximum cyber defence systems;
  - minimum score at successful cyber-hacking attempts at exercise level.
- h) Sustainability: maximum annual refill of water sources, optimal use of water per customer.
- i) Redundancy: maximum redundancy for water sources and for treatment and distribution of water.
- j) Monitoring and audit level: maximum execution of monitoring, event detection, and internal and external audits plan, including water demand analysis and tracking.
- k) System operation: carbon emission savings, repayable operation to avoid failures.
- l) Human resources:
  - maximum professional knowledge for each utility worker on relevant topics;
  - maximum redundancy in organizational knowledge, efficient use of human resources.
- m) Transparency: maximum approved data accessible for customers.
- n) Safety:
  - minimum accidents and near accidents;
  - minimum nonconformities in safety internal and external audits.

## Annex E (informative)

### Examples of service assessment criteria related to the water utility objectives, performance indicators related to assessment criteria and service assessment criteria related to components of a drinking water system

#### E.1 Examples of service assessment criteria related to the water utility objectives

##### E.1.1 General

Drinking water objectives from [Clause 5](#) are stated, followed by example service assessment criteria. Many service assessment criteria may be applicable to more than one objective.

The examples given in this annex represent a direct relationship between objectives and assessment criteria.

##### E.1.2 Protection of public health

An objective of a water utility should be to ensure sufficient supply of safe and agreeable drinking water (see [5.2](#)).

Possible assessment criteria:

- meet public health and drinking water quality standards;
- meet threshold or minimum microbiological, chemical or radiological quantities;
- maintain system integrity;
- maintain acceptable aesthetic (taste odour and colour) qualities.

##### E.1.3 Meeting users' needs and expectations

An objective of a water utility should be to ensure activities meet users' reasonable needs and expectations (see [5.3](#)).

Possible assessment criteria: see ISO 24510<sup>[Z]</sup> for guidance.

##### E.1.4 Provision of service under normal and emergency situations

An objective of a water utility should be to ensure that under normal conditions drinking water supply is available on a continuous basis (see [5.4](#)).

The objective should also be to provide drinking water to critical customers or critical service implementation areas during emergency situations and to restore service as quickly as possible when interruptions have occurred (see [5.4](#)).

Possible assessment criteria:

- access to the service;
- maintenance of a positive pressure in the distribution system;
- maintenance of a positive pressure that is greater than minimum requirements;