INTERNATIONAL STANDARD

ISO 14002-2

First edition
2023-05

Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area —

Part 2: **Water**

Systèmes de management environnemental — Lignes directrices pour l'utilisation de l'ISO 14001 afin de prendre en compte les conditions et aspects environnementaux dans le cadre d'une thématique environnementale donnée —

Partie 2: Eau

Reference number
ISO 14002-2:2023(E)

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Published in Switzerland

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 1, *Environmental management systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS S26, *Environmental management*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 14002 series can be found on the ISO website.

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.

Introduction

0.1 Background

Water is a vital element for the functioning of all living systems on earth and therefore also for human life and well-being. Ecosystems and related biodiversity, also seen as natural capital, can only deliver their multiple values and provide their natural services when appropriately preserved, their resilience maintained, and the respective planetary boundaries respected by economy and society. Protection of water resources is an integral part of sustainable development and is essential for achieving the United Nations' Sustainable Development Goals (SDGs)[25], specifically SDG 6 (clean water and sanitation) and SDG 14 (life below water). Furthermore, protection of water resources has an indirect impact on other goals, such as SDG 2 (zero hunger), SDG12 (responsible consumption and production), SDG13 (climate action) and SDG15 (life on land).

Many organizations apply the general ISO 14001 framework to manage their interactions with the environment. This document provides guidance and examples focused on applying the ISO 14001 framework to address water-related environmental aspects and impacts, as well as water-related environmental conditions and dependencies on water that can have an effect on the organization. It supports organizations to plan action(s) in relation to environmental impacts, and to water dependencies and vulnerabilities at their site(s), in the watershed, and in the life cycle of their products and services. This includes strategic planning and taking actions in relation to:

— protecting aquatic ecosystems and ecosystem services as well as related ecosystems contributing to water balance (e.g. forests);

— protecting water supplies and ensuring water availability;

— minimizing the use of water and water consumption;

— protecting and enhancing water quality;

— adapting and responding to water-related environmental conditions, such as seawater rise, changing precipitation patterns, or gradual changes in water availability and quality;

— preparing for foreseeable water-related events, such as flooding and droughts.

This document is designed for compatibility with other standards related to sustainable use and protection of water resources. It is based on ISO 14002-1 and follows the same approach and order as ISO 14001 but does not address every subclause.

0.2 Risk-based approach

The document refers to water-related environmental aspects, environmental impacts, environmental conditions, and the associated water-related risks and opportunities, including those across the life cycle of an organization's products and services, where appropriate. This document enables organizations to address:

— actual and potential adverse or beneficial impacts on water resources and aquatic ecosystems, originating from their activities or their supply chains;

— actual and potential effects on the organization itself, including risks and opportunities related to the dependency on water.

Potential effects on the organization can include acute and chronic physical threats (e.g. from extreme events such as the flooding of an organization's premises, or the accumulation of pollution in an organization's water supply) as well as transitional risks and opportunities related to changes in regulations, technology, the market, or to the organization's reputation, and opportunities for contributions to sustainable development from a life cycle perspective.

The magnitude of water-related risks and opportunities is influenced by various context-related factors (e.g. climatic, geographical, ecological, socio-economic, water footprint of the organization, applicable compliance obligations), including:

— an organization's vulnerability to water scarcity, water quality, changes in ecosystem services, flooding, and climate change;

— the condition or quality of water bodies or aquatic ecosystems an organization has or can have an impact on, or depends upon;

— increasing competition for water use or conflict over safe access to water resources in a particular location;

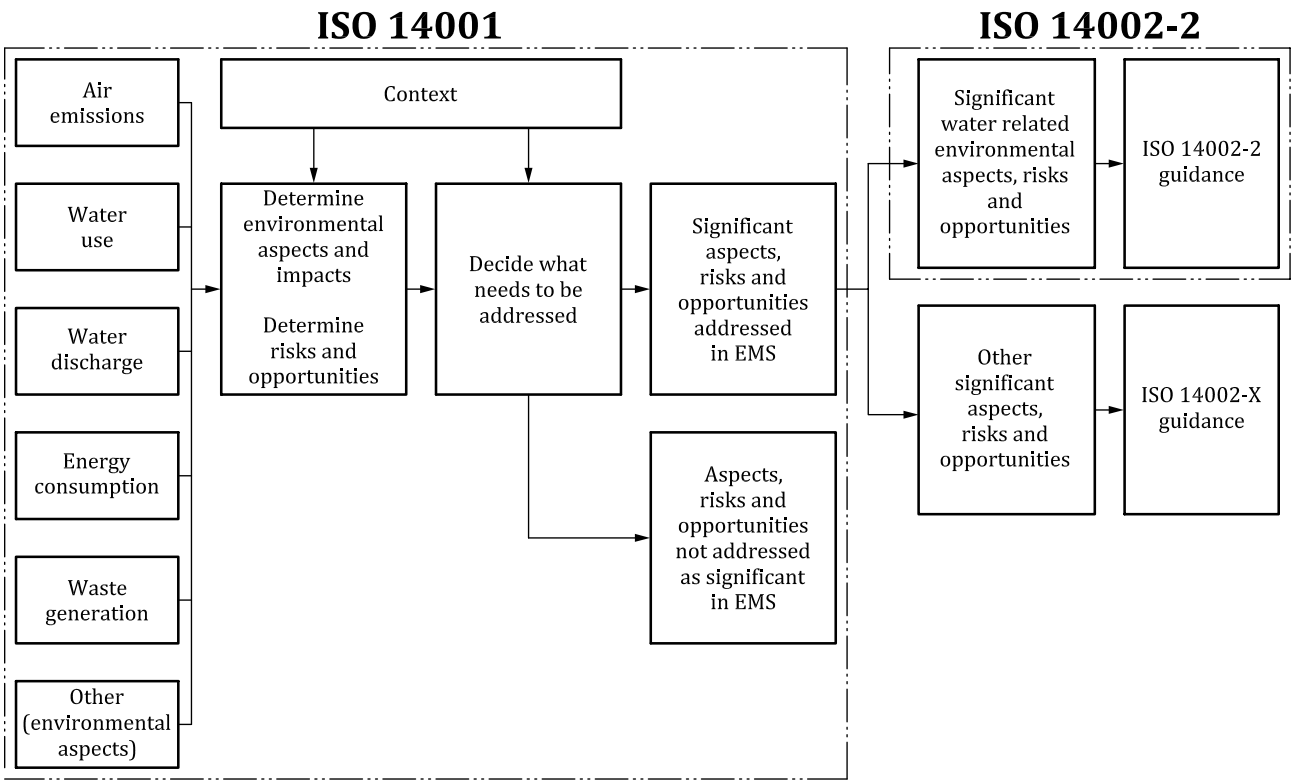
— the condition of infrastructures, including water supply, distribution systems and wastewater treatment.

0.3 Holistic approach to the management of water

An environmental management system according to ISO 14001 requires an organization to evaluate its activities, products and services in order to determine its significant environmental aspects and environmental conditions affecting the organization, as well as relevant risks and opportunities that need to be addressed. This process involves applying a life cycle perspective as part of a comprehensive evaluation of the various impacts an organization can have on the environment and how it depends on it.

An organization that intends to focus its environmental management efforts on water should recognize the interrelations of water with other environmental media and respective ecosystems. It should be aware that the actions it plans and implements to improve water quality or availability can incur adverse impacts on other environmental media like soil and air, or impacts on terrestrial ecosystems. For example, aeration basins or ponds used in wastewater treatment can emit volatile organic compounds to air, and taking action to enhance biodegradation of trichloroethylene in contaminated groundwater can lead to the formation of intermediates or metabolites such as vinyl chloride that are even more hazardous in the ecosystem, and to humans. To avoid such unintended consequences, this document encourages an organization to take a holistic approach when managing water.

Figure 1 shows how ISO 14001 and the parts of the ISO 14002 series can be applied using a holistic approach.



Key

EMS environmental management system

Figure 1 — Interaction between ISO 14001 and the ISO 14002 series

0.4 Using this document to address the environmental topic area of water within an environmental management system

An organization can use this document to help determine how best to address the sustainable use and protection of water resources within an environmental management system. This can be related to, for example:

— specific commitment(s) in the organization's environmental policy, e.g. related to prevention of water pollution, efficient use of water, preservation of aquatic ecosystems and related biodiversity, or sustainable use of marine ecosystem services;

— one or more of its significant environmental aspects or compliance obligations related to water use, water conservation, water pollution, aquatic ecosystems and species, ecosystem services, etc.;

— compliance with applicable legal requirements and permits;

— commitments related to an organization's social responsibility;

— specific risks and opportunities that need to be addressed for water-related environmental conditions or with regard to dependencies on water.

0.5 Case studies

The guidance provided in this document includes four case studies of organizations applying the ISO 14001 framework to address water-related environmental aspects and environmental impacts, environmental conditions, and the associated risks and opportunities that need to be addressed. The organizations in these case studies are fictional, and serve as illustrative examples in diverse contexts, including different industry sectors known to have water-related environmental aspects and environmental impacts, and different geographic locations and environmental conditions. These cases

are provided to illustrate how this document can be applied, with examples from different settings and perspectives, and are not intended as models or templates for applying ISO 14001 or this document.

The first of these cases represents a paper mill and is incorporated in the main body of the document, with examples shown in each clause as appropriate. The other three cases, representing a water utility, a dairy cooperative, and a chemical manufacturing facility, are provided for further reference in Annexes A, B and C. Annex D provides clarification on the usage of some concepts and terminology in this document to enhance user understanding.

0.6 Benefits

The benefits of applying this document can include:

— supporting the fulfilment of compliance obligations related to water withdrawal, water consumption, water quality and public policies;

— enhancing environmental performance and fostering resilient ecosystems by achieving environmental objectives through the management of water-related environmental aspects;

— protecting the environment through prevention or mitigation of adverse impacts on water resources and ecosystems;

— preventing and mitigating water-related business risks and leveraging opportunities in an organization's operations and its supply chain, in response to changing environmental conditions;

— aligning the environmental management system with the organization's strategic direction, e.g. to support specific environmental policy or organizational commitments related to sustainable use and protection of water resources;

— supporting water-related SDGs;

— contributing to compliance with international agreements and conventions related to water as well as the transition to a circular economy (reduction, replacement and reuse of water).

These benefits can also lead to cost reductions, security of supply and production, better relations with relevant interested parties, improved public image, or the maintenance of a social "licence to operate".

Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area —

Part 2: Water

1 Scope

This document gives general guidelines for organizations seeking to address water-related environmental aspects, environmental impacts, environmental conditions, and the associated risks and opportunities within an environmental management system in accordance with ISO 14001.

The document addresses issues for environmental management related to water quantity and quality, such as water withdrawal, efficient use of water, and water discharge, as well as approaches to cope with water-related events such as flooding and droughts. The document considers the interconnections of water with other environmental media and takes a holistic approach to the management of water due to its impacts on ecosystems, ecosystem services, related biodiversity, as well as human life and well-being.

This document is applicable to organizations irrespective of their size, type, financial resources, location and sector. It is applicable to all types of water and considers a life cycle perspective.

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 14001, *Environmental management systems — Requirements with guidance for use*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14001 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
environmental topic area
area of interest or concern for environmental management in an organization in relation to its surroundings

[SOURCE: ISO 14002-1:2019, 3.1]

3.2
environmental aspect
element of an organization's activities or products or services that interacts or can interact with the environment

Note 1 to entry: An environmental aspect can cause (an) *environmental impact(s)* (3.4). A significant environmental aspect is one that has or can have one or more significant environmental impact(s).

Note 2 to entry: Significant environmental aspects are determined by the organization applying one or more criteria.

[SOURCE: ISO 14001:2015, 3.2.2]

3.3
environmental condition
state or characteristic of the environment as determined at a certain point in time

[SOURCE: ISO 14001:2015, 3.2.3]

3.4
environmental impact
change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's *environmental aspects* (3.2)

[SOURCE: ISO 14001:2015, 3.2.4]

3.5
risks and opportunities
potential adverse effects (threats) and potential beneficial effects (opportunities)

[SOURCE: ISO 14001:2015, 3.2.11]

3.6
life cycle
consecutive and interlinked stages of a product (or service) system, from raw material acquisition or generation from natural resources to final disposal

Note 1 to entry: The life cycle stages include acquisition of raw materials, design, production, transportation/delivery, use, end-of-life treatment and final disposal.

[SOURCE: ISO 14001:2015, 3.3.3]

3.7
water consumption
portion of water use that is neither returned to the original water source after being withdrawn nor available for reclamation

Note 1 to entry: Water consumption refers to water used by an organization.

[SOURCE: ISO 46001:2019, 3.31, modified — Note 1 to entry replaced.]

3.8
ecosystem
dynamic complex of plant, animal and micro-organism communities, and their non-living environment interacting as a functional entity

EXAMPLE Deserts, coral reefs, wetlands, rain forests, boreal forests, grasslands, urban parks, cultivated farmlands.

Note 1 to entry: Ecosystems can be influenced by human activity.

[SOURCE: ISO 14008:2019, 3.1.6]

3.9
ecosystem service
benefit people obtain from *ecosystems* (3.8)

Note 1 to entry: These are generally distinguished into provisioning, regulating, supporting and cultural services. Ecosystem services include the provisioning of goods (e.g. food, fuel, raw materials, fibre), regulating services (e.g. climate regulation, disease control), and non-material benefits (cultural services) (e.g. spiritual or aesthetic benefits). The supporting services are necessary for the production of all other ecosystem services (e.g. soil formation, nutrient cycling, water cycling) and are also referred to as "ecosystem functions".

Note 2 to entry: Ecosystem services are sometimes called "environmental services" or "ecological services".

[SOURCE: ISO 14008:2019, 3.2.11]

3.10
leading indicator
metric that gives an indication of expected performance

[SOURCE: ISO 10014:2021, 3.9]

3.11
lagging indicator
metric that gives an indication of past performance

[SOURCE: ISO 10014:2021, 3.10]

4 Planning actions

4.1 General

An organization that has an interest in the sustainable use and protection of water resources, has significant environmental aspects and impacts related to water, or has identified risks and opportunities that need to be addressed due to effects of changing water-related environmental conditions should undertake a planning process to determine appropriate actions. This process includes a commitment by the organization's leadership, as well as interested parties where relevant, to address water-related interests and concerns, and should involve a review of information and circumstances to:

— gain an understanding of the organization's context in relation to water;

— establish baselines for water-related environmental performance and conditions.

An organization can benefit from taking a broad perspective in this review, considering activities that are connected to the water balance of the organization (i.e. related to water inputs and outputs), its sites or units and other environmental aspects such as releases to soil or emissions to air (e.g. particulate matter, acid rain precursors) that can lead to water pollution.

NOTE ISO 46001:2019, Annex C, provides guidance on preparing a water balance.

4.2 Understanding the organization and its context related to water

4.2.1 Conduct a water-related review

When deciding on appropriate actions, an organization should review and consider its internal and external issues and circumstances in relation to water use, dependency, vulnerabilities and related compliance obligations to be addressed in its environmental management system. This consideration should also include taking a life cycle perspective of an organization's products and services including water-related impacts in their supply chain.

Gathering detailed information, including related strategies, objectives, and targets can be useful.

Important information for a review related to water should include operational and watershed-related information, and information related to the organization's environmental aspects and impacts. This can include, for example:

— information related to the watershed, water source or water body, including:

  — the status of water availability, extraction and limits on access to water (e.g. over withdrawal from water catchment, water conflicts);

  — geographic features or characteristics of the site (e.g. drainage, river basin);

  — sensitivity of ecosystems to changes in water quantity and quality;

  — local water sources, river basin and catchment information (e.g. water balance, water quality, important water-related areas, other water users, governance framework), considering national and transboundary situations;

  — situations that can lead to over-exploitation of aquatic ecosystems (e.g. overfishing, mass tourism, energy production);

— information related to the organization's operations, including:

  — the quantity of water used (water withdrawn, consumed, lost or returned to the original water source);

  — characteristics of wastewater generated (e.g. the level of treatment, treatment capacity, and effluent quality);

  — the quality of water required for the organization's activities;

  — identified water-related events or conditions that can affect the organization (e.g. floods, drought, threats to water quality, consequences of climate change);

  — interested parties and their relevant needs or expectations;

  — specific compliance obligations (e.g. permits, licences, voluntary agreements).

4.2.2 Review water-related environmental aspects and impacts

When deciding on the appropriate actions, an organization should review the environmental aspects of its activities that can have an impact on water (use, quality, conditions) and aquatic ecosystems, and identify those that that are significant and that it will address in its environmental management system. An organization should examine the water inputs and outputs from its activities (e.g. using a water balance chart) as well as its products and services and consider the relevant needs and expectations of its interested parties.

Information related to water inputs and outputs can include:

— current water sources (e.g. water bodies, precipitation, groundwater);

— current water uses (e.g. drinking, cleaning, cooling water, irrigation, industrial process, ingredient of products), water quality and quantity;

— current water reuse, recycling and recirculation;

— current water discharges;

— potential conflicts of water users.

Process flow diagrams and water balance charts for the organization, its sites or its units can help to understand the inputs and outputs of an organization's activities, and the potential water-related environmental aspects.

An organization should also consider its water-related environmental aspects and impacts from all applicable stages of the life cycle of its products and services, including those resulting from the use of its products and services. Product-related environmental aspects and impacts are important inputs to the product design and procurement processes, including use of water in the production phase as well as water that is embedded in the product itself.

NOTE Water embedded in a product can be determined with a water footprint. This can be important for companies in sectors such as agriculture, food and beverage, energy, chemicals, pharmaceuticals, medical devices and cosmetics.

An organization should consider the potential effects originating from the dependency on and vulnerability to water. This can include considerations of:

— nearby water sources the organization relies on and that are impacted by other organizations using the same water source, or by environmental conditions;

— the impact of activities along the supply chain on water resources, if relevant;

— the impact of water consumption and water pollution on the environment including aquatic and terrestrial ecosystems, and local communities.

4.2.3 Determine risks and opportunities that need to be addressed

Taking into consideration the issues identified as part of the context of the organization (see 4.2), including water-related environmental conditions, dependencies on water, as well as compliance obligations, the identified environmental aspects and impacts (see 4.2.2), and the effectiveness of existing control measures, an organization should determine the water-related risks and opportunities and prioritize those to be addressed to achieve the intended outcomes and policy commitments of its environmental management system. This can help to prevent undesired or unintended impacts on the environment or effects on the organization itself.

There are many techniques that can be applied for evaluating water-related risks and opportunities to determine what needs to be addressed. When carrying out the analysis, it can be prudent to involve internal and external interested parties. They can bring information pertinent to the analysis of risks and opportunities, and some of the risks and opportunities can also affect them. An organization can benefit from applying a perspective that takes into account what is important and relevant (material) for its interested parties to determine how and where to prioritize and focus its response and strategy.

Table 1 provides an example of an organization in the paper sector and its priorities for taking action (what needs to be addressed). Annexes A to C provide additional examples in other sectors.

Table 1 — Organizational context and priorities for taking action — Example from Salmo Papers

Circumstances and context	What needs to be addressed (Significant environmental aspects/identified risks and opportunities for the organization)
Salmo Papers (SP) is a manufacturer of graphic paper for periodicals and books that has been in business for over 100 years. The company's environmental management system is ISO 14001 certified. SP operates a paper mill and recycling facility situated on the coast in Northern Europe by one of the finest salmon rivers in the region. The river flows into an ocean fjord with a unique aquatic ecosystem. Both the river and the fjord are areas of outstanding natural value, and SP has adapted their operations to the conditions of the natural environment, even before the enactment of related legislation. Fresh water is sourced from a system of rivers and lakes that is governed by the mill with considerations both to local habitants, and sustaining suitable amounts of freshwater for the wildlife downstream. Impermeable surface areas (rooftops, paved surfaces) at the site collect rainwater during storm events, and this water is discharged to the adjacent river. Water from the river is also used to cool some equipment used in the paper mill. SP discharges to a wastewater treatment plant, with limits on total suspended solids (TSS), biological oxygen demand (BOD), total organic carbon (TOC), and temperature, to ensure that the effluent does not have an adverse impact on aquatic life. The regulatory authority has also established requirements for the monitoring and control of storm water discharge. The owners of SP expect the facility to comply with all environmental laws and regulations, and have established environmental policy commitments to reduce water consumption.	Protection of ecosystems and interests of local communities including preserving aesthetic value for recreational purposes. Wastewater discharge and threats to fresh water quality. Water consumption due to threats from decreasing river water availability. Compliance with legal and other obligations.

4.2.4 Establish a baseline

The organization should establish baselines where appropriate for water-related environmental aspects, environmental impacts and environmental conditions using the information available from its review, as a reference point for comparison of performance. Baseline references can be absolute or can be normalized using variables that affect water use, water consumption or water quality (see also 6.2.2). A baseline reference can be adjusted if needed, for example, following major changes to an organization's processes, operations, facilities, or equipment that affect water use or consumption, or major changes in environmental conditions (see 4.2.5).

4.2.5 Manage change

An organization's environmental aspects, and environmental impacts, its dependencies on water, and the associated risks and opportunities can change (temporarily or permanently) over time as well as its priorities for taking action to address them. The evaluation of risks and opportunities should be reviewed and updated routinely to ensure the environmental management system can achieve intended outcomes, especially following changes in the context of the organization, major changes to its processes, or modification and refurbishments to its facilities or equipment. If changes to the environmental management system are necessary, the change(s) should be planned and implemented

following the organization's processes for planning action, and communicated to those affected by the change(s).

NOTE The following standards and references can be helpful in relation to 4.2:

— ISO 14001:2015, Clause A.4, and ISO 14004:2016, Clause 4, provide additional guidance on the context of the organization.

— ISO 14046 provides principles, requirements and guidance in relation to water footprint assessment, and ISO/TR 14073 provides illustrative examples on the application of ISO 14046.

— ISO 14001:2015, A.6.1.2, and ISO 14004:2016, 6.1.2, provide additional guidance on determining environmental aspects and impacts.

— ISO/TR 14073:2017, Table 7, provides additional guidance on water-related environmental aspects and impacts.

— ISO 26000 provides additional guidance on identification and engagement with interested parties.

— ISO 31000 and ISO 14004:2016, 6.1, provide additional guidance on risk management. IEC 31010:2019, Annex B, provides additional guidance on risk assessment methods.

— ISO 14004:2016, Practical Help Box 11, provides additional examples of approaches to determine risks and opportunities that need to be addressed.

— ISO 46001:2019, Clause 6, provides additional guidance on water review.

— Additional guidance is listed in the Bibliography.

4.3 Determine appropriate actions

When determining appropriate actions to address the identified water-related environmental aspects and environmental impacts, environmental conditions, dependencies on water, and the associated risks and opportunities (see 4.2), an organization can find it helpful to consider a range of options/actions within its environmental management system, in order to optimize its strategy for water management and minimize potential residual adverse effects. Actions can be applied singularly, or in combination, and can include setting environmental objectives, as well as implementing operational controls, support actions related to internal interested parties, or performance evaluation mechanisms.

When determining the appropriate actions, the organization can consider the types of control (see 5.4.2) and a life cycle perspective (see 5.4.3).

Figure 2 illustrates a decision process for identifying a range of actions within an environmental management system.

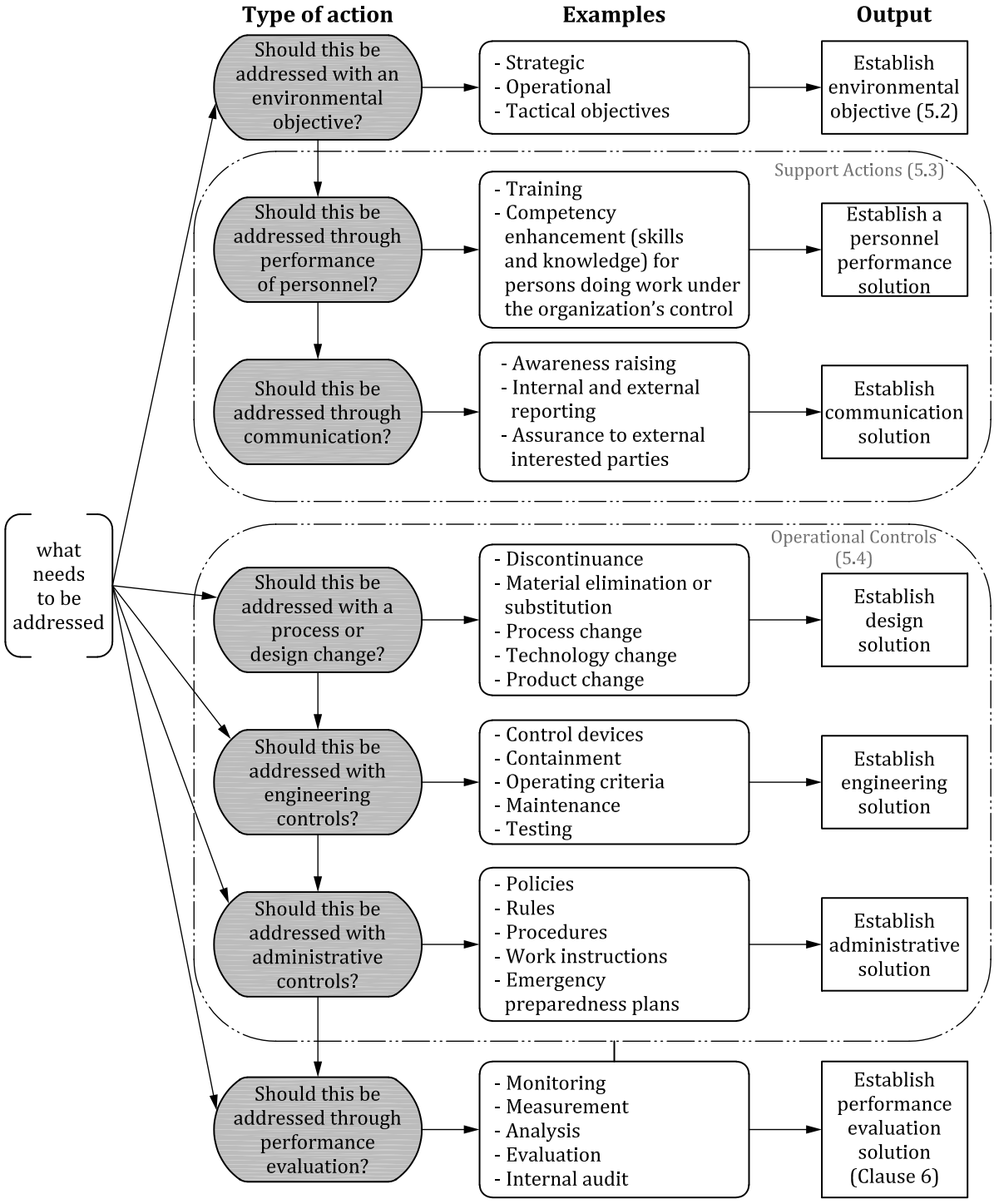


Figure 2 — Decision tree for planning actions for what needs to be addressed

NOTE The following standards and references can be helpful in relation to 4.3:

— ISO 31000 and ISO 14004:2016, 6.1, provide additional guidance on risk management. IEC 31010:2019, Annex B, provides additional guidance on risk assessment methods.

— ISO 14001:2015, A.6.1.4, and ISO 14004:2016, 6.1.4, provide additional guidance on planning action to address significant environmental aspects, compliance obligations, and environmentally-related risks and opportunities.

— ISO 14004:2016, Table A.1, provides additional examples of planned actions to address risks and opportunities.

— Additional guidance is listed in the Bibliography.

5 Taking action

5.1 General

An organization should plan actions based on the risks and opportunities and what needs to be addressed, considering the outputs from Clause 4.

Subclauses 5.2 to 5.5 provide guidance on types of action that can be taken. Table 2 provides examples of planning actions to address water-related risks and opportunities in an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 2 — Planning — Example from Salmo Papers

What needs to be addressed (Significant environmental aspects/ identified risks and opportunities)	Types of action				Description of planned actions
	Environmental objective	Operational Control	Performance	Support	
Protection of ecosystem, interests of local communities, and catchment-level collaboration	X		X		Recognizing the importance of preserving the aquatic ecosystems downstream, SP leadership decides to set an objective to maintain current (baseline) salmon population levels and species diversity. SP conducts a study on ecosystem population and diversity to establish the baseline. The study is made in cooperation with a local association for the conservation of nature. The results also help to identify contaminant and thermal discharge thresholds that protect the ecosystem. The SP leadership also decides to conduct periodic sampling and evaluation of downstream aquatic organism populations and diversity. The results of these periodic evaluations are used to assess the potential impacts of SP operations on the downstream aquatic ecosystems. Also recognizing the importance of the ecosystem to the salmon population, SP leadership decides to monitor and evaluate the migration of salmon in the river. The monitoring is carried out in cooperation with the local sport fishing club.
Wastewater discharge and threats to fresh water quality		X			SP leadership determines that a significant environmental impact on the river can occur from wastewater and cooling water discharges from the SP operations. SP leadership decides that treatment of the SP process wastewater prior to discharge is needed to address this risk of significant environmental impact and to ensure that water contaminant and temperature thresholds are not exceeded. The wastewater treatment operational control is established to remove levels of contaminants that exceed established thresholds for parameters including BOD, TOC and TSS. An operational control is also established for cooling water to monitor turbidity and divert this flow to wastewater treatment in case of threshold exceedance.
Water consumption due to threats from decreasing river water availability	X	X			River water level measurements show a significant negative trend over the last decade which can lead to a reduced amount of water available for consumption by SP in the future. Water consumption is therefore an important area of risk for SP leadership and they establish an objective to reduce the amount of water used per tonne of paper produced. This objective includes establishing operational controls to reuse river water multiple times in the paper-making process before discharging to on-site treatment. Leadership also recognizes that water conservation is particularly important during periods of low water flow in the river. More efficient water use also represents an opportunity to lower costs to the organization for water pumping and treatment prior to discharge back to the river.
Compliance with compliance obligations		X	X	X	In addition to compliance obligations related to wastewater and water quality, based on leadership's environmental policy commitment, operational controls are established to ensure compliance with the facility's storm water discharge permit. The storm water operational controls include procedures for:

Table 2 *(continued)*

What needs to be addressed (Significant environmental aspects/ identified risks and opportunities)	Types of action				Description of planned actions
	Environmental objective	Operational Control	Performance	Support	
					— periodic inspections of impervious areas for evidence of contaminants that can pollute storm water run-off from the facility; — documented observations of storm water quality during rain events for evidence of potential contamination; — employee training on established controls, and competence evaluation to prevent storm water contamination.

5.2 Environmental objectives

An organization should establish specific and relevant environmental objectives that are consistent with its environmental policy commitments and the identified significant environmental aspects and risks and opportunities related to sustainable use and protection of water resources. The environmental objectives should also be achievable and include related targets that are measurable and time-bound. Environmental objectives can be strategic, tactical or operational. Objectives can be achieved via direct and indirect influence (see the example in Annex A).

Figure 3 provides an explanation of the different types and levels of environmental objectives that can be established.

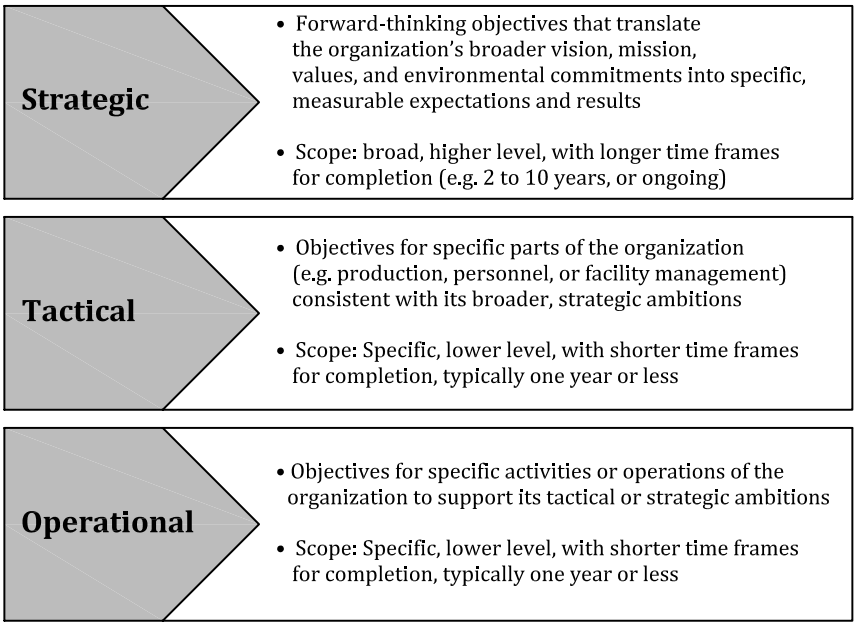


Figure 3 — Types of environmental objectives

Targets related to the environmental objectives can be qualitative or quantitative, and can involve absolute or relative targets or measures of performance. An absolute target is not normalized or measured in relation to the activity, and can be expressed as a desired level, number or state to be achieved. Performance toward achieving a relative target involves measurement relative to another measurement, such as establishing a baseline for current or past performance and comparing future

performance to the baseline using a relative indicator, or a change in the quantity of water used relative to units of production.

The environmental objectives should be supported by detailed action plans to enable the organization to achieve them. They should be monitored by appropriate performance indicators (see 6.2.2). Table 7 in 6.2.2 provides examples for environmental objectives and related performance indicators.

5.3 Support actions

The organization should provide the necessary support in a manner that the organization can achieve its intended outcomes for the environmental management system. This can include the following:

— Providing adequate resources to support the implementation of its environmental management system and for carrying out actions to achieve the organization's environmental objectives related to water use and protection.

— Determining, developing and maintaining the competence of persons doing work under the organization's control to have adequate knowledge, skills and qualifications in order to carry out work in accordance with the organization's environmental objectives.

— Ensuring that persons doing work under the organization's control have an awareness of how their work can affect water use, water consumption or water quality, ecosystems, related environmental objectives, impacts of deviating from operational controls, and their role in achieving the organization's environmental objectives.

— Communicating and encouraging internal and external dialogue with relevant interested parties in relation to the management of water use and water discharge and related impacts on the environment, the status of environmental objectives and performance indicators. This can include promoting good practices of pollution prevention and consumption of water within the local community, actions to enhance awareness (externally), participating in roundtables, initiatives or other programmes aiming at sustainable water management, and peer and stakeholder engagement.

— Establishing and controlling water-related documented information to ensure that processes and actions are controlled and conducted as intended, and that the intended outcomes are achieved.

In the context of managing the environmental impact of water use and water consumption, the support activities can also be integrated with the management of other environmental topic areas.

5.4 Operational controls

5.4.1 General

To reduce variability, achieve intended outcomes and enhance performance with regard to sustainable use and protection of water resources, including ecosystems, an organization should apply relevant operational control(s) on the organization's activities.

Effective management of water resources in a watershed can include cooperation with other organizations that rely on the same water sources as well as with interested parties, such as the local population, local authorities or nature conservation organizations.

5.4.2 Types of control

When planning action (see 4.3), including measures to achieve environmental objectives, the organization can consider a hierarchy of control approach to minimize its actual and potential adverse impacts its water use and discharge has on the environment, including water resources and ecosystems, and to minimize actual and potential adverse effects from dependencies on water. Operational controls in the upper tiers of the hierarchy aim to address environmental impacts, dependencies and associated risks and opportunities at the source through elimination or substitution (pollution prevention).

Alternatively, engineering or administrative control can be applied to address how operations are implemented.

NOTE In some contexts, specific controls can be specified in compliance obligations.

These types of pollution prevention approaches and types of control are described as follows:

— Elimination: elimination of products, operations or environmental aspects of operations that pose a threat to the environment, e.g. eliminating the activity, use of water in the process, or the use of chemicals or materials that can contaminate water in the process.

— Substitution: substitution with a less harmful process, e.g. sustainable aquaculture or fisheries or with less hazardous materials in a process to reduce the severity of adverse impacts, e.g. replacing the process technology with one that recycles and reuses all water in the process, or consumes less water or uses less hazardous materials.

— Engineering: engineering controls target implementation of operations and generally involve the use of equipment or technology to control the way an operation is carried out, e.g. applying technological controls to minimize water consumption or contaminant levels in effluent; controls to detect and isolate environmental impacts; and ground water protection systems.

— Administrative: administrative controls include plans, rules, procedures, instructions, training and inspections that can be used to direct the way people work or conduct activities within specified requirements or criteria, e.g. applying procedural controls to minimize, detect and isolate environmental impacts.

Controls can be applied individually or in combination, e.g. administrative controls can be used to support engineering controls, to make sure that the engineering controls are consistently applied and working properly.

5.4.3 Life cycle perspective

In addition to applying operational controls over the organization's activities, operational controls can also be applied with regard to a life cycle perspective if relevant. To take a life cycle perspective in managing the use and protection of water resources, an organization should consider the relevant stages of the life cycle of products that use or discharge water, or that otherwise have or can have an impact on water resources. The organization should identify environmental aspects and impacts related to water in those stages over which it has control or influence and incorporate management of these aspects and impacts as appropriate into its environmental management system processes (e.g. determine relevant requirements, ensure processes are adequately controlled or influenced in order to minimize adverse impacts).

When addressing significant water-related environmental aspects and environmental impacts, dependencies on water and the associated risks and opportunities, collective action can also be considered over the life cycle of an organization's products and services.

Table 3 provides examples of applying a life cycle perspective in an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 3 — Application of a life cycle perspective — Example from Salmo Papers

SP focuses on post-consumer recycling as end-of-life treatment as part of a life cycle perspective.
The SP paper mill is an important channel for wastepaper that would otherwise be disposed of in a landfill. The paperboard generated by the paper mill is then reused in many other forms of cardboard packaging and other similar uses. The fibre in this cardboard can also be recycled many more times back into new fibreboard after its use in packaging.
Most of the water used in the paper recycling process is itself recycled back to the pulping process and can be reused many times before it is treated and released back into the environment.

5.4.4 Emergency preparedness and response

Emergency preparedness and response with regard to water-related environmental conditions such as floods, drought, supply and discharge disruptions, and impacts on water quality such as spills and contaminations are also part of good operational control. Organizations should plan for emergency situations by:

— identifying the potential water-related emergency situations that can have an effect on the organization and its activities, or adverse impacts on the environment;

— determining risks and opportunities associated with water-related emergency situations as part of its planning process (see 4.2);

— identifying uses of water that can be affected by the water emergencies;

— where appropriate, establishing a response plan(s) or procedure(s) for addressing the identified actual and potential adverse effects (threats) and reducing the impact of water-related emergencies, including coordination with other interested parties such as first responders and the local emergency planning committee;

— at planned intervals, testing and reviewing the effectiveness of the emergency response plan(s) and procedure(s).

Extreme weather events, including storms and droughts, are expected to be more likely under climate change. Given the high level of uncertainty regarding when and how the effects of climate change and socio-economic factors will manifest in the future, it is challenging for organizations to understand how water-related risks and opportunities can evolve and potentially affect their operations and supply chains. Yet an organization can benefit from considering such risks and opportunities and addressing them in its emergency preparedness and response planning.

Some examples of emergency preparedness and response planning in relation to the use and protection of water resources include:

— implementation of preventive activities and controls to mitigate incidents that can have adverse impacts on groundwater, surface water, marine water or other aquatic ecosystems, or related adverse effects on the organization, e.g. chemical storage protocols and weekly inspections for chemical compatibility; containment; monitoring for leak detection and water quality control; and protection from rain and run-off to reduce the risk of spills or releases that can migrate into the watershed;

— implementation of controls to address water-related consequences that can occur during an incident or during the incident response, e.g. following a response protocol to identify and apply containment for stormwater drainage and run-off pathways during spill response, and capturing water used to decontaminate response personnel and equipment in order to prevent run-off;

— training of emergency response personnel followed by response drills and consultation to ensure that response protocols are adequate, and personnel have the necessary competence to protect water resources;

— identification of potential situations that would require external expertise in relation to water resources or aquatic ecosystems, and including or engaging such expertise as needed in response protocols.

Table 4 provides examples of emergency preparedness and response actions in an organization in the paper manufacturing sector. Annexes A to C provide additional examples in other sectors.

Table 4 — Emergency preparedness and response actions — Example from Salmo Papers

During the planning phase of the organization's environmental management system, the paper mill identified a significant environmental aspect associated with process upsets that can result in spills of pulp being delivered into the cooling water for the paper machine, which can lead to contamination in the river. To address this potential emergency, the paper mill installed a turbidity meter in the cooling water prior to discharge to the river. When the turbidity of the cooling water exceeded a certain threshold, the water is automatically diverted to the facility wastewater treatment facility. The emergency plan also takes into account the potential contamination of the river due to flooding of part of the factory area during heavy stormwater events.

5.5 Performance action

An organization can plan performance-related actions to address significant environmental aspects and risks and opportunities. Performance action can include, for example:

— monitoring and measurement relative to specific indicators, parameters or characteristics;

— observations or inspections to ensure awareness of current conditions and allow for intervention if needed;

— analysis, evaluation or auditing to identify water-related trends.

Guidance on performance indicators and evaluation of performance relative to environmental objectives and actions taken to address risks and opportunities is provided in Clause 6.

5.6 Unintended consequences of actions taken

An organization should be aware that actions can have unplanned reactions or unintended consequences. All actions taken should be reviewed in a timely manner with regard to resulting changes in uses of water, environmental impacts associated with water or other environmental media, and any foreseeable emergency situations. These unintended consequences can also be delayed, e.g. with respect to groundwater.

The organization should address these potential consequences as appropriate, including changes needed in the environmental management system. When unintended consequences occur, it can be necessary for the organization to take further action to correct, remediate, prevent or eliminate adverse impacts on the environment or undesired effects on the organization.

Table 5 provides examples of identifying and addressing unintended consequences in an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 5 — Identifying and addressing unintended consequences — Example from Salmo Papers

SP sets a target to increase recycled paper content as one of its ISO 14001 environmental objectives. While this is not water related, wastepaper delivered to the paper mill for recycling often must be stored outside for extended periods of time. This results in the scrap paper bales being exposed to rain during the summer and snow during the winter. This results in run-off that can contaminate surface water if not properly managed.

NOTE The following other standards and references can be helpful in relation to Clause 5:

— ISO 14001:2015, A.6.2, and ISO 14004:2016, 6.2, provide additional guidance on setting environmental objectives and planning actions to achieve them.

— ISO 14001:2015, Clause A.7, and ISO 14004:2016, Clause 7, provide additional guidance on support actions, including establishing necessary competence, enhancing awareness and communication.

— ISO 14001:2015, Clause A.8, and ISO 14004:2016, Clause 8, provide additional guidance on identifying operational controls as well as planning for emergency preparedness and response.

— ISO 14040 and ISO 14044 provide principles, requirements and guidelines for life cycle assessment.

— ISO 14006 provides guidance on life cycles perspectives in the design stage within an environmental management system.

— ISO 14046 provides principles, requirements and guidelines related to water footprint assessment of products, processes and organizations based on life cycle assessment.

— ISO 14004:2016, 6.2.4, provides examples of environmental performance indicators.

— ISO 14090 offers guidance on adaptation to climate change, which can help organizations with preparedness for such events. Reference [24] indicates how specific clauses of ISO 14090 can be utilized to support ISO 14001.

— ISO 46001 provides guidance for the use of water efficiency indicator. (See also the annexes of ISO 46001:2019.)

— Additional guidance is listed in the Bibliography.

6 Evaluating the effectiveness of actions

6.1 General

An organization should evaluate if and to what extent the actions taken related to water withdrawal, water use and water quality as well as the use of aquatic ecosystems are effective. This can include evaluating effectiveness in the following areas:

— improving environmental performance and achieving environmental objectives;

— fulfilling compliance obligations;

— addressing identified water-related risks and opportunities.

In addition to evaluating effectiveness, an organization can also evaluate the cost-efficiency and the cost-savings related to the actions taken.

6.2 Monitoring, measurement and analysis

6.2.1 General

An organization can obtain the necessary information to evaluate the effectiveness of actions taken from monitoring, measurement and data analysis. Methods can include sampling, observation and auditing techniques applied to assess aquatic system conditions, as well as an organization's water withdrawal, use, treatment and discharge or related management processes.

An organization should decide on what needs to be monitored or measured, and when, who carries out the monitoring activities, which methods are applied, what data quality is necessary and how the data are to be analysed to support the evaluation. Monitoring, measurement and analysis should take into account feedback from interested parties, including the information needs and expectations of intended users (e.g. operational management, strategic management, and other internal and external interested parties). This can include reporting of the results.

Monitoring programmes can also consider the dynamic complexity of the problem at hand, including the possibility of delayed unintended consequences of actions. This can be a factor in the effects on groundwater resources in particular, but also applies to the complex effects on integrated resources, such as soil, water and biodiversity.

Table 6 provides examples of monitoring, measurement and analysis based on the information required by interested parties, in an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 6 — Monitoring, measurement and analysis — Example from Salmo Papers

Interested party	Information needs/expectations	Monitoring, measurement and analysis actions	Frequency
Local community, local association for the conservation of nature and sport fishing club	Confidence that the SP operations do not have an adverse impact on the downstream aquatic ecosystem (fish populations and diversity)	Periodic evaluations, including: — benthic sampling — aquatic plant surveys — fish population surveys — species diversity surveys	Twice annually, spring, and autumn (fall)
Regional regulatory authority issuing permits for wastewater discharge	Wastewater sampling and analysis that demonstrates compliance with regulatory permit limits	Monitoring and measurement of: — daily flow rates — TOC, temperature — BOD, TSS — cooling water turbidity	 Twice daily Continuous Weekly Continuous
Local regulatory authority with requirements to control stormwater discharge to surface waters	Evidence of control of stormwater	Inspections during dry conditions Observations during rain events Monitoring effectiveness of corrective actions taken	Weekly During rain events, bi-annually As applicable

6.2.2 Indicators of performance

Evaluating the effectiveness of actions involves comparison of the current situation or state with the original or baseline state, or with the desired or intended state, such as with a target specified in an environmental objective. To enable this comparison, an organization should identify and track progress against relevant, fundamental indicators of performance, or key performance indicators (KPIs). An organization can also apply a KPI to identify trends, or to benchmark internally or with other organizations.

Applying KPIs can provide useful information for decision-making or reporting. KPIs can be applied at different levels of the organization (e.g. site, system, process, facility) and refer to different reporting periods (e.g. real-time, quarterly, yearly). KPIs can involve simple or complex measurements, for example:

— simple, absolute measures of the characteristics of environmental aspects, environmental conditions or relevant management processes, independent of other factors;

— relative measurements that express or normalize one factor in relation to another;

— composite measurements in the form of an index or scale that incorporates multiple factors.

A comprehensive set of lagging and leading indicators can be useful for evaluating performance at operational as well as strategic levels of management, as follows:

— Lagging indicators focus on outcomes and represent results of an organization's activities, e.g. water withdrawal rates or effluent water quality. These offer important system feedback for continual improvement after the fact, but typically cannot be influenced or changed in real time.

— Leading indicators are more input-oriented, focusing on in-process elements of the environmental management system that can be influenced more proactively to improve outcomes, e.g. the number of employees with competency in water conservation or pollution prevention.

KPIs should be selected to allow for comparison of performance over time, in relation to the established environmental objectives and related targets. Baseline performance can be used as a reference point for this comparison. Since organizations are not always able to influence all the variables related to performance, they can sometimes need to take appropriate action to allow for this comparison (e.g.

normalizing performance metrics to units of production, or consideration of variables such as seasonal changes that can affect water use).

Table 7 provides examples of environmental objectives and corresponding performance indicators for an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 7 — Environmental objectives and performance indicators — Example from Salmo Papers

Environmental objective	Performance indicators (leading and lagging)
Maintain current (baseline) salmon population levels and species diversity.	Lagging: Completion of study with baselines identified for aquatic species population, richness and diversity in the downstream aquatic ecosystem. Quantities and types of fish (monitored annually), including: — number of salmon migrating upstream; — richness and diversity: total number of species in the community; Water quality: contaminant levels and cooling water temperature. Leading: The baseline setting will determine the leading indicator(s) for future monitoring.
Reduce water consumption by 10 % over the next year by re-use of water in the paper production process compared to last year's baseline.	Leading: Concentration of TSS in process water (to enable re-use). Lagging: Litres of wastewater discharged per tonne of paperboard produced.

NOTE The following other standards and references can be helpful in relation to Clause 6:

— ISO 14001:2015, Clause A.9, and ISO 14004:2016 Clause 9, provide additional guidance on performance evaluation, including monitoring measurement, analysis and evaluation.

— ISO 14007 provides additional guidelines for determining environmental costs and benefits including guidance on cost efficiency and cost savings.

— ISO 14008 specifies the methodology for monetary valuation of environmental impacts and related environmental aspects.

— ISO 14031 provides guidelines for environmental performance evaluation and examples of KPIs. It differentiates between environmental condition indicators and environmental performance indicators. Environmental performance indicators can relate to management or operational performance.

— ISO 46001 provides guidance on increasing water efficiency and the use of alternative water sources.

— ISO 14033 provides information on quantitative environmental information.

— Additional guidance is listed in the Bibliography.

7 Improvement

Based on the evaluation results (see Clause 6), an organization should address gaps in the effectiveness of the actions taken, and any identified nonconformities, including their causes, requiring corrections and corrective actions. It should determine opportunities for improvement and implement the necessary actions to achieve its water-related intended outcomes. Opportunities for improvement are not necessarily limited to the management of water, and can also be related to environmental impacts on soil, air, biodiversity and other resources.

Actions to address opportunities for improvement can include, for example:

— engaging with other organizations for lessons learned and experience gained relative to sustainable use and protection of water resources;

— building on its success relative to sustainable use and protection of water resources to address other environmental topic areas;

— periodically reviewing its context and strategy (see 4.1 and 4.2.1), and risks and opportunities (see 4.2.3) to identify emerging needs, expectations or concerns that should be addressed in the environmental management system.

Table 8 provides examples of improvement efforts for an organization in the paper sector. Annexes A to C provide additional examples in other sectors.

Table 8 — Improvement efforts — Example from Salmo Papers

Based on the results of the environmental management system, SP reduced the amount of water discharged per tonne produced by 54 %.
Based on the observation of storm water contamination from outside bale storage, the organization implemented a project to eliminate outside storage of bales by placing a roof to cover the temporary bale storage area.

Annex A
(informative)

Example of a public water utility — Ames Community Water system

The example given in this annex is in the form of a case study of a fictional public water utility, Ames Community Water (ACW). The case provides a set of example objectives and actions (see Tables A.1 to A.8) that can be taken in a particular context, to illustrate an organization's use of ISO 14001 to address water-related environmental aspects, environmental impacts and environmental conditions, dependencies on water, and the associated risks and opportunities in water production and distribution.

Table A.1 — Organizational context and priorities for taking action

Circumstances and context	What needs to be addressed (Significant environmental aspects and identified risks/opportunities for the organization)
ACW is a small public water utility that provides drinking water for 3 000 residents in drought-prone Ames Valley in the United States. ACW's source is the Central Hills Aquifer, which also provides irrigation for over 2 million acres of farmland. ACW has a strong commitment to preserving the integrity of its water supply, and to protecting public health, but faces challenges due to aging equipment and infrastructure, as well as environmental conditions. The organization has traditionally had relatively informal operations, but the general manager believes the rigor and structure of a formalized environmental management system can help them to be more proactive in dealing with the challenges they face.	Water resource use and availability. Threats to the integrity and viability of the water supply from salination and aquifer drawdown conditions. Threats to the integrity and safety of water distribution system, i.e. potential for disruption or contamination of water supply due to soil conditions, aging equipment and infrastructure. Opportunities to enhance consumer confidence.

Table A.2 — Planning action — Example from Ames Community Water system

What needs to be addressed (Significant environmental aspects/identified risks and opportunities)	Type of action				Description of planned actions
	Environmental Objective	Operational control	Performance	Support	
Use of water resources	X			X	ACW decides to establish a formal objective to reduce water resource use. In order to achieve this, they plan to promote water conservation in the region through consumer education and by establishing a rebate programme for consumers that rewards private households for installation of low-flow toilets and implementation of "water-smart" landscaping, e.g. evapotranspiration and infiltration of water by gardening, green roofs and grass paving blocks.
Threats to the integrity of the water supply from salination and aquifer drawdown conditions		X	X		ACW wants to be able to take action to prevent loss of integrity of the water supply, and decides to implement a monitoring programme, including standard operating procedures that establish operating criteria and methods for periodic monitoring of: — depth to groundwater throughout the aquifer, to balance residential and agricultural water use; — salinity in the aquifer, to detect increasing levels of saltwater intrusion.
Threats to the integrity and safety of water distribution equipment and infrastructure	X		X	X	ACW decides to set a formal objective to establish a distribution system replacement programme, including inspection of distribution pipeline over a three-year period and replacement of any deteriorating or damaged sections. They also develop standard operating procedures for management of change within the system to ensure that changes in materials of construction are evaluated for compatibility with the water supply prior to introduction into the distribution system.
		X		X	ACW is also concerned about cybersecurity and potential effects on infrastructure and the local community, and decides that it needs to take action to raise awareness among employees and let them know what to do in the case of a cyberattack. ACW also develops a response protocol in the case that its system is compromised.
Opportunities to enhance consumer confidence		X	X	X	Public health concerns can harm ACW's reputation. ACW decides to communicate externally with consumers through an annual newsletter that addresses the quality of the water supplied to residential customers as well as what the utility is doing to ensure a safe and sustainable water supply. ACW already has a compliance obligation to report on the quality of water it distributes, but wants to go a step further to communicate on the safety of the water supplied and the sustainability of the aquifer. ACW also has a system for continuously monitoring the quality of water in its distribution system and has emergency plans to distribute safe water in cases where water quality in the system is compromised.

Table A.3 — Application of a life cycle perspective — Example from Ames Community Water system

ACW recognizes that water consumption in the community can have an adverse impact on environmental conditions and water availability, and focuses on the use stage of the life-cycle of its product. ACW implements a consumer education programme to raise awareness related to water conservation, and encourage consumers to conserve through an incentive programme, which offers rebates to consumers who install low-flow toilets and implement "water-smart" landscaping.

Table A.4 — Emergency preparedness and response actions — Example from Ames Community Water system

ACW communicates with employees on cybersecurity-related risks, and trains them on response procedures in the case of a cyberattack. ACW also develops a response protocol in the case that its system is compromised, and conducts an annual drill to test response capabilities and improve them where needed. ACW has identified a list of critical equipment, and maintains a backup inventory to avoid disruption of service in the case of critical equipment failure or damage. ACW established and regularly tests a back-up generator to provide power in the case of a power grid failure. ACW also has a system for continuously monitoring the quality of water in its distribution system and has emergency plans to distribute safe water in cases where water quality in the system is compromised.

Table A.5 — Identifying and addressing unintended consequences — Example from Ames Community Water system

ACW adds chemicals to the water supply to make it safe to drink. The chemicals are transported via an underground conveyance system, and ACW installs double-walled piping as a control to prevent release into the environment. The use of the double-walled piping has an unintended consequence, which is when one of the pipes was damaged, the chemical solution gradually filled the space between the primary and secondary containment pipes, overflowed the system, and caused a spill. Since the piping was double walled, ACW did not think there was a need for monitoring or additional containment.

Table A.6 — Monitoring, measurement and analysis — Example from Ames Community Water system

Interested party	Information needs/expectations	Monitoring, measurement and analysis actions	Frequency
Regulatory authorities, local community, farmers	Assurance of water availability, balance of residential and agricultural water use	Depth to groundwater throughout the aquifer Salinity in the aquifer	Daily
Regulatory authorities, local community	Assurance of system integrity, condition of pipeline Assurance of water quality	Inspection of distribution pipeline Monitoring of water quality	10 % of pipeline per month until complete Continuously

Table A.7 — Environmental objectives and performance indicators — Example from Ames Community Water system

Environmental objective	Performance indicators (leading and lagging)
Reduce residential water use by 10 % each year for the next five years (compared to previous year). This will be achieved by implementing consumer education and rebate programmes for the Central Valley region by the end of year one. NOTE Due to climate fluctuations and intermittent droughts that can lead to increased agricultural use of water, a per cent reduction target for all water use is not practical.	Leading: Per cent completion for programme implementation; number of individuals that have applied for the rebates. Lagging: Reduction in average daily usage for residential water (litres per capita/day); water extraction rate in cubic meters per year.
Reduce water losses by 50 % over the next three years, by establishing an infrastructure and equipment replacement programme to reduce water loss in the distribution systems. This includes inspection of all pipelines in the first year, and scheduled replacement of deteriorating or damaged sections in years two and three.	Leading: Per cent completion of pipeline inspection across the system; per cent completion of replacement according to the schedule. Lagging: Per cent of water lost through leakage; reduction in the number of supply interruption incidents; reductions in water-extraction rate.

Table A.8 — Improvement efforts — Example from Ames Community Water system

As noted in Table A.5, ACW identified an opportunity for improvement to its conveyance system to monitor the interstitial space to ensure that the double wall does not lead to leakage, and installed a containment system to receive overflow.

Annex B
(informative)

Example of a dairy cooperative — Pavitra Dairy Ltd.

The example given in this annex is in the form of a case study of a fictional dairy cooperative, Pavitra Dairy Ltd (PDL). The case provides a set of example objectives and actions (see Tables B.1 to B.8) that can be taken in a particular context, to illustrate an organization's use of ISO 14001 to address water-related environmental aspects, impacts and conditions, dependencies on water, and the associated risks and opportunities in the food and agricultural sectors.

Table B.1 — Organizational context and priorities for taking action

Circumstances and context	What needs to be addressed (Significant environmental aspects and identified risks/opportunities for the organization)
PDL is a dairy cooperative that represents over 3 million milk producers in the Neva River basin in north-western India. PDL has been in business for over 75 years, and helped to make India one of the world's largest producers of packaged milk and milk products. The organization is committed to providing the highest quality milk products while preventing environmental degradation, and was an early adopter of ISO 9001 and ISO 14001. The region is dry most of the year, and water is scarce outside of the monsoon season. The Neva is the lifeline of the region, and protection of the river and estuarine resources is critical for biodiversity, human health, and the agricultural industry. PDL seeks to continually improve its water management practices, and works with member farms to reduce waste and protect water quality. PDL uses water for cleaning containers and equipment, as well as for treating animal waste. In addition, milk products are pasteurized using ultra-high temperature (UHT) steam. Detergents, BOD and suspended solids in wastewater can pose a threat to water quality. Run-off from farmland can contain manure and ammonia, which can affect water quality and lead to eutrophication in the river and estuarine systems.	Wastewater discharge and run-off that can pollute groundwater and/or river water. Compliance with legal requirements for water discharge. Accessibility of clean water for milk production and processing. Meeting customer expectations for product quality. Enhancing environmental management practices in farms in the supply chain.

Table B.2 — Planning action — Example from Pavitra Dairy Ltd

What needs to be addressed (Significant environmental aspects/identified risks and opportunities)	Type of action				Description of planned actions
	Environmental objective	Operational control	Performance	Support	
Wastewater discharge that can affect river water quality Compliance with legal requirements		X	X	X	Production plant wastewater is treated using ultrafiltration to remove solids and BOD prior to discharge, to meet legal requirements and protect water quality. Operators must complete extensive training and perform treatment, equipment maintenance, and effluent monitoring and measurement according to the wastewater treatment manual. To reduce the risk of thermal pollution from UHT processes, the temperature of the non-contact cooling is monitored and appropriate actions are taken before it can be discharged. PDL is also exploring opportunities to recover excess heat.
Meeting customer expectations for product quality		X	X	X	PDL maintains high standards for cleanliness and hygiene, and establishes operational control procedures for production and wastewater treatment operations, as well as quality assurance monitoring of the product before and after processing. To ensure the protection of water resources, milk producers and dairy personnel are trained on operational controls. Laboratory equipment is calibrated regularly, and preventive maintenance is scheduled and completed by competent personnel.
				X	PDL publishes an annual report on its performance, and this is made available to customers on its website.
Accessibility of clean water for milk production		X	X		PDL implements water efficiency measures and controls across its operations, and has implemented water reclamation in its production plant for cleaning water. PDL has established a procedure for monitoring water efficiency.
Agricultural run-off that can pollute groundwater and river water Enhancing environmental management practices in farms in the supply chain	X	X	X		Water is collected and treated to remove ammonia at farms with concentrated animal feeding operations (CAFOs), following established procedures. PDL has also set an objective to introduce modernized liners for manure lagoons over the next year, along with lagoon management practices, monitoring and inspections.
		X	X	X	PDL works with producers to develop lagoon management procedures and monitoring and inspection protocols, and provides training for workers.

Table B.3 — Application of a life cycle perspective — Example from Pavitra Dairy Ltd.

Animal feeding operations can be a major source of environmental degradation, especially in relation to manure storage. Nitrate pollution from producer farms in the supply chain has been one of the greatest challenges for PDL in its efforts to protect water quality in the Neva River basin. Recognizing this, PDL engages with producers in the cooperative to implement best management practices for manure, and regularly monitors nitrate levels in the river. PDL works with producers to establish operating criteria, train employees on operational controls, and implement monitoring and inspection protocols for manure management.

Table B.4 — Emergency preparedness and response actions — Example from Pavitra Dairy Ltd.

PDL identified power failure in its processing and treatment facilities as an emergency situation that can result in adverse effects on product quality, product waste, and release of pollutants to groundwater and surface water. In order to prepare for and be able to respond to such a situation, PDL installed an emergency backup power system, and developed emergency response procedures for operating the backup system. The backup generators are regularly started and operated to ensure that they will start when needed. Employees at the facility also conduct drills and coordinate efforts with the local power utility at least annually to ensure they are prepared in the case of an actual emergency. This ensures that product quality can be maintained and environmental impacts are adequately controlled.

Table B.5 — Identifying and addressing unintended consequences — Example from Pavitra Dairy Ltd.

In its efforts to protect water quality in the river basin, PDL took action with its producers to install modernized liners for manure lagoons. This controlled the nitrogen released to the soil and groundwater; however, the change in storage practices did not account for interactions of the nitrogen cycle. The diversion of nitrogen from the other pathways resulted in an unintended increase in volatilization and emissions of nitrogen and ammonia to the air. After discovering this, PDL provided farmers with floating covers for the lagoons to control emissions and minimize air pollution. PDL is considering the feasibility of incorporating anaerobic digesters at some of the larger farms to capture methane and convert it to biofuel that can be used on the farms.

Table B.6 — Monitoring, measurement and analysis — Example from Pavitra Dairy Ltd.

Interested party	Information needs/expectations	Monitoring, measurement and analysis actions	Frequency
Regulatory authorities, farmers, local communities	Assurance of water quality in the Neva river and estuarine areas	Monitoring and measurement of solids, BOD and temperature of wastewater treatment discharge; measurement of nitrates in groundwater and surface water downgradient of manure lagoons. Inspection of lagoon systems.	Daily Weekly
Consumers	Assurance of product quality	Monitoring and measurement of milk product characteristics for microbiological quality assurance at processing plant intake, as well as after processing.	Daily/continuous
Farmers, regulators		On-farm monitoring of somatic cell count to detect mastitis and potential for microbial contamination.	Daily
		Assurance of access to clean water for milk production; monitoring of water use (per unit), including water used in washing equipment to identify opportunities to reduce use of water.	Daily

Table B.7 — Environmental objectives and performance indicators — Example from Pavitra Dairy Ltd.

Environmental objective	Performance indicators (leading and lagging)
Reduce phosphates and nitrates in farm run-off by 90 % by the third quarter of next year. This involves the use of manure as agricultural land topdressing and creating manure lagoons for later use of the manure. Land application practices can be improved to apply manure away from river banks and through the construction of manure lagoons, installing liners for manure lagoons, and sustainable lagoon management. Work with producers to develop lagoon management procedures and monitoring and inspection protocols. Train workers on safe land application practices, procedures and protocols.	Leading: Per cent completion of liner installations and the number of workers trained on the safe land application practices; per cent implementation of procedures and protocols. Lagging: Reduced concentration of phosphorus and total nitrogen in the Neva River.

Table B.8 — Improvement efforts — Example from Pavitra Dairy Ltd.

Even with enhanced manure management practices in place, nutrients that can have an adverse impact on water quality are still present in farm run-off due to the use of manure as a fertilizer on farm fields. PDL plans to investigate and test feed management options to reduce the amount of nutrients in animal waste, including phase feeding that adjusts feed to animal needs and age, and amino acid supplements. PDL will also investigate options for the use of liquid manure and other fertilizers to avoid excess of nitrogen compounds and subsequent contamination of surface waters and groundwater.

Annex C
(informative)

Example of a chemical facility — AB Chemical

The example given in this annex is in the form of a case study of a fictional chemical supplier, AB Chemical (ABC). The case provides a set of example objectives and actions (see Tables C.1 to C.8) that can be taken in a particular context to illustrate an organization's use of ISO 14001 to address water-related environmental aspects, impacts and conditions, dependencies on water, and the associated risks and opportunities in chemical manufacturing.

Table C.1 — Organizational context and priorities for taking action

Circumstances and context	What needs to be addressed (Significant environmental aspects/identified risks and opportunities for the organization)
ABC is a supplier of dyes and other chemicals used in different industry sectors including the clothing industry. Key raw materials are anthraquinone derivates for the production of vat dyes such as Indigo. The company also manufactures surface treatments and coatings of consumer goods. In the process, metallic compounds are used including chromium trioxide. Some products are also used as intermediates for pharmaceutical products. Water used in the production process is obtained from the local municipal water supply and from several on-site wells. A small fraction of water is withdrawn from a small river adjacent to the facility. Increased calcium concentrations can occur when using a higher relative amount of water from the wells. The company operates a wastewater treatment facility that discharges effluent to a small river adjacent to the facility. The small river enters a bigger river approximately 20 km downstream, which then flows for approximately 100 km where it enters the ocean. Several municipalities located on the big river use it as a drinking water supply after treating it through filtration and chlorination. Process cooling water is treated in cooling towers and then discharged to the small river under permit from the local environmental regulatory agency. The smaller and bigger rivers are located in the southern part of Europe where significant seasonal reductions in flow is experienced in the summer months. The small river is a sensitive ecosystem especially in the summer months when flow rate is low.	Protection of local communities downstream using treated river water for drinking water supply. Avoidance of harm from trace quantities of specific biological active compounds in the wastewater discharge and risk to biodiversity. Potential decrease in quality of the mix of well water and surface water (rising calcium concentrations) that can affect manufacturing processes. Compliance with cooling water thermal discharge permit limits. Minimizing the threat to water quality in the river during low flow periods and opportunities to maintain a positive water balance.

Table C.2 — Planning action — Example from AB Chemical

What needs to be addressed (Significant environmental aspects/identified risks and opportunities)	Type of action				Description of planned actions
	Environmental objective	Operational control	Performance	Support	
Protection of local communities downstream using treated river water for drinking water supply. Avoidance of harm from trace quantities of specific biologically active compounds in the wastewater discharge and risk to biodiversity.	X	X	X		Communities downstream of the facility use river water as a drinking water source for residents. Chemicals discharged from the manufacturing facility wastewater treatment plant can be a potential contamination source mainly due to an emergency situation. The organization decides to establish an environmental objective, controls, and a monitoring and measurement plan to ensure that certain pollutants are minimized in facility wastewater and neither threaten downstream drinking water supplies nor the biodiversity of the river. It is planned to increase the volume of the fire water retention ponds.
Potential decrease in quality of well water and surface water quality (rising calcium concentrations) that can affect manufacturing processes.	X	X	X		The surface treatment and coating manufacturing is sensitive to the amount of calcium present in the process feedwater. Too much calcium affects the ability of the coating to adhere to the surface to which is ultimately applied by the customers. The organization decides to create an environmental objective and monitoring and measurement plan to ensure well and river water used in the manufacturing process is maintained at acceptable calcium levels through on-site pretreatment if required.
Compliance with cooling water thermal discharge permit limits.	X	X	X		The local environmental regulatory agency discharge permit is issued to ensure that cooling water discharged to the small river does not adversely affect the small river ecosystem. The organization establishes an objective and measures to ensure the permit temperature limits are not exceeded, including protocols for monitoring of temperature. This includes an operational control to add well water to reduce the temperature to a safe level that will not violate the permit conditions if water temperatures begin to approach permit limits, while also respecting permit limits for water withdrawal.
Minimizing the threat to water quality in the river during low flow periods and opportunities to maintain a positive water balance.	X	X	X		The organization decides to establish objectives and measures to ensure that a net positive water balance to the small river is maintained, and quality of the wastewater does not have an adverse impact on biodiversity nor the water quality of the small river during periods of low river flow. This includes an operational control to supplement the flow in the small river with water that comes from the on-site wells. ABC ensures that the increased use of well water respects the limits of its permit for water withdrawal.

Table C.3 — Application of a life cycle perspective — Example from AB Chemical

ABC establishes controls in the design stage of the life cycle of its products from the coating department, to contribute to water conservation. The product design makes it possible to reduce the flow rate, and therefore the amount of water used by the consumer. This includes hot water, and thus also reduces consumer energy use. This is also taken up by the department of colour production, since water conservation and prevention of pollution is very important for the dyeing industry. Controls also include close interaction with the partners of the dye industry to further optimize the colours to reduce water consumption and minimize pollution from the later dyeing process. Supply chain considerations are of importance as well, due to the use of heavy metals and their origin, potentially even for further tiers up to the mining of raw materials. Regular supplier audits are in place according to best practices.

Table C.4 — Emergency preparedness and response actions — Example from AB Chemical

ABC identifies control of fire water run-off to its stormwater system as part of its emergency response plan, as follows. The stormwater system flows into the nearby river and, without spill containment procedures, can have adverse impacts on the flora and fauna of the aquatic system or the groundwater itself. ABC trains response personnel on its procedures and how to use the system in an emergency, in order to reduce the potential for contamination of the stormwater system and the groundwater. In addition, ABC identifies emergency response procedures in the case of chemical spills or leakages, with similar risk scenarios to that of the fire water run-off. The volume of the fire water retention pond will be increased. The building itself is constructed to be able to capture all spills or leakage in containment, and the respective contaminated water is then externally treated by a specialized company with a physical chemical treatment option. As part of its emergency preparedness efforts, ABC conducts an annual joint exercise with the local fire brigade regarding one of these critical scenarios.

Table C.5 — Identifying and addressing unintended consequences — Example from AB Chemical

Due to the water saving programme, several pipes have experienced lower flow rates leading to blockage via sedimentation. This not only caused a maintenance issue, but also required significant fresh water for rinsing. An assessment was done and based on that, water with very low contamination was approved for use to regularly clean the respective wastewater pipelines. The treatment itself remains unchanged in the biological treatment facility of the site. However, much less fresh water is used and this contributes to a reduction of the use of well water and therefore the total water consumption. The reduction of total water consumption can lead to excess thermal discharges to the small river, especially during low flow periods. To avoid these unintended consequences, ABC continuously monitors the temperature of the river, the temperature of the water released into the river and the temperature of the water entering the wastewater facility of the site.

Table C.6 — Monitoring, measurement and analysis — Example from AB Chemical

Interested party	Information needs/expectations	Monitoring, measurements and analysis action	Frequency
Regulatory authorities, with requirements for water use, and wastewater discharge	Monitoring data Groundwater status and temperature of the wastewater released. Amount of wastewater as well as key data of the composition of released wastewater.	TOC, BOD salt content, heavy metals, undissolved solids and many more. Groundwater level tracking and temperature control of the wastewater released in relation to the river water.	Annual report and continuous measurement
Investors	Detailed non-financial reporting with additional information on investments for avoidance/reduction of environmental impact.	Environmental performance-related non-financial reporting and KPI setting.	At least once a year but with regular updates on the internet
Customers	General sustainability relevant programme as well as some details on specific parameters including assurance not to contain certain by-products.	Customer rating of environmental performance of the products provided by ABC. Review/update of product-related environmental aspects.	Annually Annually, and after changes to products or processes
Neighbourhood	General information on what is done at the site, “behind the fence”. Information about emergency measures which sometimes need to apply.	Standard reporting. Monitoring of groundwater level and river temperature, and publication for interested parties; communication of information on social media and through “open house” days.	Regular monitoring and reporting Continuous update, but at least every five years Annual open house

Table C.7 — Environmental objectives and performance indicators — Example from AB Chemical

Environmental objective	Performance indicators (leading and lagging)
Ensure a net positive water balance as follows. Reduce process water use by 20 % in the next year, while ensuring that this does not lead to a negative impact on the river because of high water temperatures in summer time. Therefore, reduce the small portion of water withdrawn from the river to zero, while still keeping the same quantity of well water. NOTE As this would lead to a relative increase of calcium in the production process, additional measures to reduce the calcium concentrations of the well water are required (e.g. ion exchange).	Leading indicators: — increase of water recycled/water used in the process (litres recycled/litres used per day) — temperature of the river (°C) Lagging indicators: — total water use in year X (m^3) and comparison over time — water extraction from the wells compared to wastewater (m^3) — temperature of the wastewater entering the wastewater treatment facility (°C)
Minimize trace quantities of specific biologically active compounds in the wastewater discharge to biological no effect levels at the river level within the next 24 months.	Leading indicator: Involvement of employees including improvement programmes (number of persons trained on operational control procedures and trainings per year). Improvement proposals per year on pollution prevention topics. Lagging indicator: Concentration of certain compounds in the wastewater discharge or the river water (in µg/l).
By the end of the year, establish a monitoring programme for calcium, with pre-treatment to ensure well water used in the manufacturing process is maintained at acceptable calcium levels.	Leading indicator: Daily calcium measurement, maximum level of calcium in mg/ l. Lagging indicator: Full implementation of the programme, by end of year.
Ensure full compliance with permit limits for the temperature of the water leaving the site. (Compliance temperature 30 °C.) This includes an operational control to add well water if water temperatures begin to approach permit limits, in order to reduce the temperature to a safe level that will not violate permit conditions, while also respecting permit limits for water withdrawal.	Leading indicator: Full implementation of the operational control to ensure the temperature is well below the permit limit (28 °C). Temperature of the wastewater at the entry of the biological treatment facility. Lagging indicator: Temperature of the wastewater at the exit of the site.

Table C.8 — Improvement efforts — Example from AB Chemical

In order to reduce use of freshwater for rinsing, ABC assessed and approved the use of grey water for cleaning pipelines. This will reduce use of well water and reduce impact on groundwater levels. The amount of waste sent to the landfill per tonne of material was reduced by 90 %. Water consumption was reduced by 10 % although the total production volume has increased in the last 10 years by 50 %. Due to the solvent recycling, the total amount of chemicals consumed per tonne of material was significantly reduced. The amount of sludge sent to landfill was reduced by 50 % by improvement of the biological process in the wastewater treatment facility (oxygen use and other optimizations). The sludge can now be incinerated and will be used in future for a cement factory. ABC is setting up a programme to improve wastewater treatment and recycling of process water, while still ensuring compliance with the permitted temperature level at all times.

Annex D
(informative)

Clarification of concepts

In addition to the terms and definitions given in Clause 3, clarification of selected concepts is provided as follows to prevent misunderstanding:

— The use of the word “any” implies selection or choice.

— The words “appropriate” and “applicable” are not interchangeable. “Appropriate” means suitable (for, to) and implies some degree of freedom, while “applicable” means relevant or possible to apply and implies that if it can be done, it needs to be done.

— The word “consider” means it is necessary to think about the topic but it can be excluded; whereas “take into account” means it is necessary to think about the topic but it cannot be excluded.

— “Continual” indicates duration that occurs over a period of time, but with intervals of interruption (unlike “continuous” which indicates duration without interruption). “Continual” is therefore the appropriate word to use when referring to improvement.

— The word “effect” is used to describe the result of a change to the organization. The phrase “environmental impact” refers specifically to the result of a change to the environment.

— The word “ensure” means the responsibility can be delegated, but not the accountability.

— This document uses the term “interested party”; the term “stakeholder” is a synonym as it represents the same concept.

— The usage of “identify” and “determine” is intended to harmonize with the standardized management system terminology. The word “determine” implies a discovery process that results in knowledge.

— The phrase “intended outcome” is what the organization intends to achieve by implementing its environmental management system. The minimal intended outcomes include enhancement of environmental performance, fulfilment of compliance obligations and achievement of environmental objectives. Organizations can set additional intended outcomes for their environmental management system. For example, consistent with their commitment to protection of the environment, an organization can establish an intended outcome to work towards sustainable development.

— The phrase “person(s) doing work under the organization’s control” includes persons working for the organization and those working on its behalf for which the organization has responsibility (e.g. contractors).

— Where the term “ecosystem(s)” is used, it should be understood as “ecosystem(s) and related biodiversity”.

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ICS 13.020.10; 03.100.70; 13.060.01

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