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Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts —

Part 1:
Assessment principles

Services et systèmes d'alimentation en eau potable, d'assainissement et de gestion des eaux pluviales — Adaptation des services de l'eau aux impacts du changement climatique —

Partie 1: Principes d'évaluation

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Foreword

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This document was prepared by Technical Committee ISO/TC224, Drinking water, wastewater and stormwater systems and service.

A list of all parts in the ISO 24566 series can be found on the ISO website.

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Introduction

The fact that climate change is occurring is recognized globally. Programmes have been introduced internationally through a number of agreements, commencing in 1992 when the "Earth Summit" produced the United Nations Framework Convention on Climate Change (UNFCCC)[1] as a first step in addressing the climate change problem. Additional agreements have since been reached regarding the responses needed to combat climate change, notably from the 2008 Kyoto Accord[2] to the 2015 Paris Accord of Climate Change[3]. Climate change is the defining issue of the age.

Scientific investigation and confirmation of climate change has been led by the Intergovernmental Panel on Climate Change (IPCC), established by the World Meteorological Organization (WMO) and United Nations Environment Programme to provide an objective source of scientific information. In 2013 the IPCC provided more clarity about the role of human activities in climate change when it released its Fifth Assessment Report[3]. It is categorical in its conclusion that climate change is real and human activities are the main cause.

From shifting weather patterns that threaten food production to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Adapting to these impacts will be more difficult and more costly in future. Climate change is generally described as changes in long-run weather patterns, triggered generally by global warming. These changes result in severe and often unpredictable weather events (e.g. powerful storms, droughts, ice storms, floods) which may be short or long term in their occurrence and local or regional in nature. Their severity deepens: droughts are longer, rainfalls and snowfalls become heavier. These events impact the infrastructures and the operations of water utilities, whether drinking water, wastewater or stormwater systems.

All water system services rely on both natural resources and infrastructure, and regardless of their specific purpose (supply of drinking water, collection and management of wastewater or stormwater) they can be similarly affected by the manifestations of climate change, e.g. sea-level rise, flooding, high winds, excessive snow or rainfalls, droughts.

For example, the need for rapid reaction to flooding due to extreme precipitation (flash floods) has been exacerbated by a large increase in the number of extreme precipitation events, coupled with compaction or degradation of soils, deforestation, loss of ground cover or poor agricultural practices in the watershed. These events have resulted in pluvial flooding in many major cities during the last 10 years. Between now and 2100, flood risk (in terms of expected annual damage) is likely to increase strongly when no adaptive or mitigative measures are taken. The projected increase can be more than two orders of magnitude for storm surge and almost four to eight times for pluvial flooding.[4] These events can and have affected all types of water utilities.

Other IPCC research reports [3] give warning that many global risks of climate change are concentrated in urban areas. The reports summarized indicate that risks are amplified for those lacking essential infrastructure and services or living in poor-quality housing and exposed areas. The key risks, all of which are identified with high confidence, include severe ill-health and disrupted livelihoods for urban and regional populations due to flooding from a range of sources, including pluvial, fluvial, storm surges and coastal flooding or other consequences of climate change, such as forest or bushfires.

Therefore, climate change adaptation is essential in order to make the service areas more robust for future climate developments and to reduce the risk impacts in this respect. Climate adaptive strategies will influence the development of the urban or regional layout. For flooding issues, these can include either storing higher water volumes or managing water flows. Flow-management techniques include returning stormwater channels to more natural, living streams which slow the flow, increase habitat, provide visual amenity and provide cool spaces. Other strategies the water utility can consider include implementing source control measures or encouraging infiltration or evapotranspiration measures. All of these should be undertaken without endangering other critical functions of the city, notably ease of access for people with disabilities and flow of traffic. In selecting the strategies and adaptations to be implemented, the water service should consider the liveability and public health needs of the community or region. Water is able to be used in smarter and better ways to achieve water utility objectives at the same time as helping the community to adapt to climate change. Also relevant to

the management of water utilities is the treatment of water drawn from environmental sources for drinking water purposes, for example runoff into surface water sources or intrusion of salt water into coastal aquifers. Water utilities also need to consider the treatment of stormwater and wastewater prior to discharge into receiving bodies of water to preserve or improve aquatic ecological systems or their potential reuse.

Many adaptive strategies are long-term and potentially very costly initiatives, taking several decades to implement even under the most optimistic circumstances. This requires significant investment and water utilities to work carefully with their stakeholders, customers and communities to determine who pays. It means that water utilities also face critical planning and implementation options. Issues are related to timing as well as speed of delivery and process, leading into decision-making.

There is a need for guidance on the evaluation principles that should be used to assess possible adaptive responses to climate changes that are affecting the effectiveness of the provision of water services. Principle-based guidance can be used to help find the optimum response to the application of scarce investment capital and operating expenditures while meeting social, economic and environmental objectives, as well as other objectives such as shareholder, regulator and customer objectives.

NOTE 1 This was identified by ISO/TC 224 in the development of ISO 24536.

NOTE 2 The subject of climate change has also been considered by CEN in respect to both services and products. See CEN-CENELEC Guide 32.

Since these responses involve public investment funds and operating costs, the applied funds should be well-managed and accountable to the public. Investments in private systems should equally be well-managed and accountable to the investors. In either situation, the careful and consistent assessment of the impacts and effects of climate change should be identified, discussed and set out in a way that enables them to be standardized for common application in all aspects of response planning and implementation

The World Bank has estimated that, globally, almost USD 3 trillion is needed just to meet Sustainable Development Goal (SDG) 6 – Ensure availability and sustainable management of water and sanitation for all.[5] This does not account for adapting existing infrastructure to climate change.

Evaluation principles for assessing possible adaptation responses can and should be identified, discussed and set out. Standardization of these principles will enable them to become commonly available for application in all circumstances.

Standardization of these principles will also facilitate the achievement of sound investments in a transparent manner by decision-makers and provide confidence to stakeholders, whether of public or private water systems.

Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts —

Part 1: Assessment principles

1 Scope

This document identifies and sets out principles for integrating climate change impacts into the planning and design activities of water utilities for the provision of water services. It also includes methodologies to assess the principles in the context of climate change and to provide examples of adaptations made.

NOTE Discussion of impacts and strategies for responses for stormwater, drinking water and wastewater utilities are intended to be set out in ISO 24566-2:—[1], ISO 24566-3:—[2] and ISO 24566-4:—[3], respectively, with examples of adaptations that have been made.

2 Normative references

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

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

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
acute
immediate or short-term consequences

Note 1 to entry: Adapted from ISO 19869:2019, 3.5.1, "acute hazard".

1) Under preparation. Stage at the time of publication: ISO/DIS 24566-2:2023.

2) Under preparation. Stage at the time of publication: ISO/NP 24566-3:2023.

3) Under preparation. Stage at the time of publication: ISO/NP 24566-4:2023.

3.2
adaptation to climate change
DEPRECATED: climate change adaptation
process of adjustment to actual or expected *climate* (3.4) and its effects

Note 1 to entry: In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.

Note 2 to entry: In some natural systems, human intervention can facilitate adjustment to expected climate and its effects.

Note 3 to entry: Adaptations to *climate change* (3.5) can be of a temporary or short-term nature, intended to respond only to the event in question. Such limitations can be repeated should that event reoccur.

[SOURCE: ISO 14090:2019, 3.1, modified — Note 3 to entry added.]

3.3
chronic
continuing over a long time period or recurring at low levels frequently

[SOURCE: ISO 26367-2:2017, 3.2, modified — "generally used in reference to human health effects" removed from the definition.]

3.4
climate
statistical description of weather in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years

Note 1 to entry: The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization.

Note 2 to entry: The relevant quantities are most often near-surface variables such as temperature, precipitation and wind.

[SOURCE: ISO 14090:2019, 3.4]

3.5
climate change
change in *climate* (3.4) that persists for an extended period, typically decades or longer

Note 1 to entry: Change in climate can be identified, for example by using statistical tests, by changes in the mean and/or the variability of its properties.

Note 2 to entry: Climate change might be due to natural processes, internal to the climate system, or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

[SOURCE: ISO 14090:2019, 3.5, modified — Note 1 to entry revised.]

3.6
governance
system of directing and controlling

[SOURCE: ISO/IEC 38500:2015, 2.8]

3.7
hazard
potential source of harm

Note 1 to entry: The potential for harm can be in terms of loss of life, injury or other health *impacts* (3.8), as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.

Note 2 to entry: In this document, the term usually refers to *climate*-related (3.4) physical events or trends or their physical impacts.

Note 3 to entry: Hazard comprises slow-onset developments (e.g. rising temperatures over the long term) as well as rapidly developing climatic extremes (e.g. a heatwave or landslide) or increased variability.

[SOURCE: ISO 14090:2019, 3.7]

3.8
impact
effect on natural and human systems

Note 1 to entry: In the context of *climate change* (3.5), the term "impact" is used primarily to refer to the effects on natural and human systems of extreme weather and *climate* (3.4) events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructures due to the interaction of climate change or hazardous climate events occurring within a specific time period and the *vulnerability* (3.14) of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts and sea level rise, are a subset of impacts called "physical impacts".

Note 2 to entry: Impacts on services and infrastructures (see Note 1 to entry) can include effects on operations.

[SOURCE: ISO 14090:2019, 3.8, modified — Note 2 to entry has been added.]

3.9
mitigation
human intervention to reduce Green House Gas (GHG) emissions or enhance GHG removals

[SOURCE: ISO Guide 84:2020, 3.1.4]

3.10
risk
combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO/IEC Guide 51:2014, 3.9, modified — Note 1 to entry has been removed.]

3.11
service area
local geographic area where an organization has the legal or contractual responsibility to provide a service

Note 1 to entry: The service area can be established, for example, by political boundaries (e.g. citywide utility); by legislative action (e.g. formation of a utility district); or by interjurisdictional agreements (e.g. intercity agreements to provide wastewater services)

[SOURCE: ISO 24513:2019, 3.3.9]

3.12
strategy
organization's approach to achieving its objectives

[SOURCE: ISO 30400:2022, 3.1.6, modified — "organization's" has been added at the start of the definition.]

3.13
sustainability
state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs

Note 1 to entry: The environmental, social and economic aspects interact, are interdependent and are often referred to as the three dimensions of sustainability.

Note 2 to entry: To achieve sustainability, the economy needs to comply with social and environmental needs.

Note 3 to entry: Sustainability is the goal of sustainable development.

[SOURCE: ISO Guide 82:2019, 3.1, modified — New Note 2 to entry has been added, the previous Note 2 to entry has been relabelled as Note 3 to entry.]

3.14
vulnerability
propensity or predisposition to be adversely affected

Note 1 to entry: Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of a capacity to cope and adapt.

[SOURCE: ISO 14090:2019, 3.15]

4 Objectives

The careful and consistent consideration of climate change is essential for water services, whether it is for infrastructure rehabilitation, construction or operational practices. The selection of a response to the impacts of climate change should follow the assessment of the likely efficacy of the response alternatives and their potential impacts on the socio-economic objectives of the utility.

The primary objective of this document is to set out the principles for making such assessments, which should lead to selecting the optimal response approach to the climate change in question. The process should follow the principles set out in ISO 14090. An additional objective of this document is to help to guide water utilities to develop appropriate and timely climate change adaptation responses that suit their context. Examples of such responses include:

— ensuring the delivery of best practices for water system infrastructure management through planning, development, innovation and operation;

— integrating urban drainage systems into landscape design as part of the initial design phase;

— implementing water system operating systems and management that are economically and environmentally viable in the long term, including monitoring and early-warning systems;

— enhancing resilience to global warming through adaptive measures, such as creating functional, energy- and water-efficient, low-carbon, climate-resilient water services;

— increasing potential for sustainable land development and management by working with water basin managers and organizations to promote or provide appropriate water services and by-products or infrastructure for flood management for landowners;

— providing treatment of water and wastewater flows for potential reuse to reduce demand and increase reliability of long-term water supplies or to reduce impacts on receiving aquatic ecosystems;

— supporting healthy aquatic ecological systems.

5 Principles for response approaches

The response approach to climate change adaptation should follow the principles set out in ISO 14090, which include:

— change-orientated perspective (preparing, supporting and facilitating organizational changes as necessary at all levels);

— flexibility (continually reviewing, responding and adapting to new conditions, information methods and responses as they emerge);

— mainstreaming and embedding (integrating changes into organizational processes, policies, strategies, plans and procedures, and implementing changes);

— robustness (using appropriate methodological approaches and information sources that are relevant to decisions and actions);

