A Framework for Freshwater Ecosystem Management

Overview and guide for country implementation

Volume 1

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A Framework for Freshwater Ecosystem Management

Volume 1: Overview and guide for country implementation

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Acknowledgements

The Framework for Freshwater Ecosystem Management series has been developed over several years and has involved more than 60 contributors: authors, reviewers and coordinators. This work was initiated by a decision by the United Nations Environment Programme's Governing Council in 2013 and a first progress report was provided at the United Nations Environment Assembly (UNEA) in 2014.

Volume 1 of the series draws heavily on Volume 4, 'Scientific background for regional consultations on developing water quality guidelines for ecosystems', which was prepared through a collaboration between UN Environment, United Nations University – Institute for Environment and Human Security, and the Global Water System Project. It was produced for the second UNEA in 2016 to inform the first interm draft documents of this series. Based on feedback from countries received during UNEA-2 and the ensuing regional consultation period, the original framework has evolved and been refined since the creation of the 'Scientific Background'. Volume 1 was developed (in 2017) at the same time as the baseline for the 2030 Agenda for Sustainable Development. The process of updating this work takes into account feedback from countries: that the work should align with Agenda 2030 and the Sustainable Development Goals, and should be aimed towards assisting countries in setting up their own national standards, rather than prescribing a set of globally applicable water quality standards for ecosystems. For a more detailed description of the development process, see Annex 1. For a full list of contributors to the series, see Annex 2.

The Working Group for Volume 1 was led by the UN Environment–DHI Centre for Water and Environment (Paul Glennie, lead author, and Peter Koefoed Bjørnsen); under guidance from the Freshwater Unit of the Ecosystems Division at UN Environment (Joakim Harlin and Lis Mullin Bernhardt, with support from Emmanuel Ngore and Yeonju Jeong); with inputs from Neels Kleynans (formerly Department of Water Affairs, South Africa), Deborah Chapman and Stuart Warner (University of Cork, Ireland, GEMS/Water); Birguy Lamizana (Global Programme of Action for the Protection of the Marine Environment from Land Based Activities / UN Environment); and Chris Dickens of the International Water Management Institute (IWMI).

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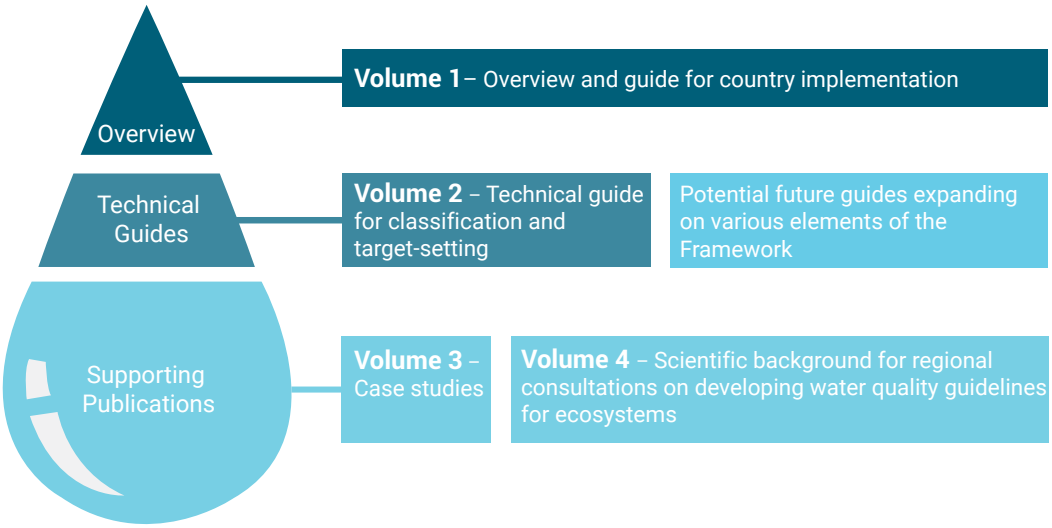
Preface: A Framework for Freshwater Ecosystem Management

The UN Environment 'Framework for Freshwater Ecosystem Management' series presents a holistic management framework to guide country-level action to sustainably manage freshwater ecosystems. It builds on the decision by the UN Environment Programme (UNEP) Governing Council to develop water quality guidelines for ecosystems (Decision 27/3, 2013).

The Framework supports national and international goals related to freshwater ecosystems, such as relevant Aichi Biodiversity Targets and Sustainable Development Goal (SDG) targets. An overview of the series, which currently consists of four volumes, is provided below:

The Freshwater Ecosystem Management series

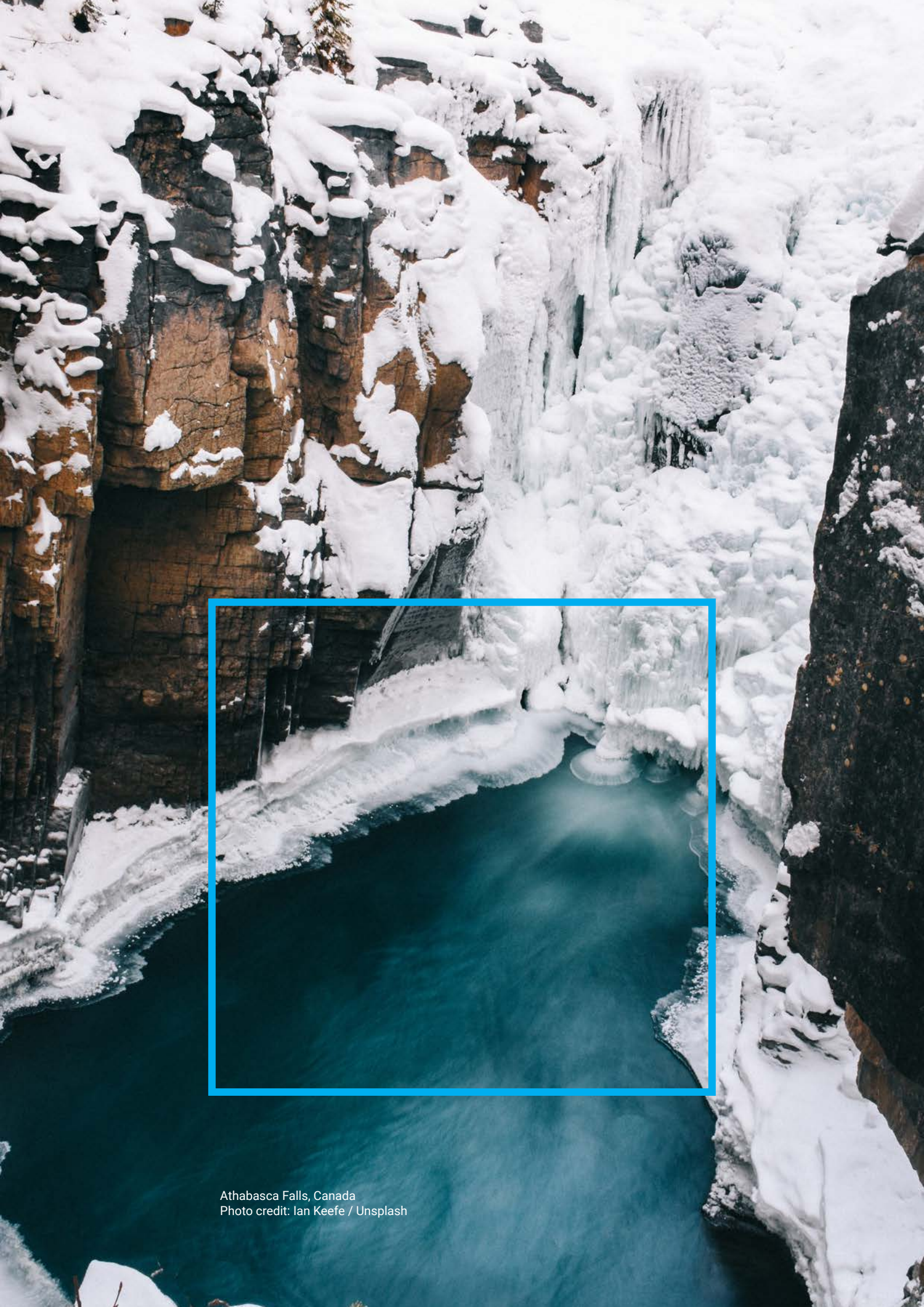


Volume 1 provides an overview of the Framework, and places it in the context of supporting Agenda 2030. It is intended for a wide audience, including decision makers, practitioners, scientists, non-governmental organizations and the general public.

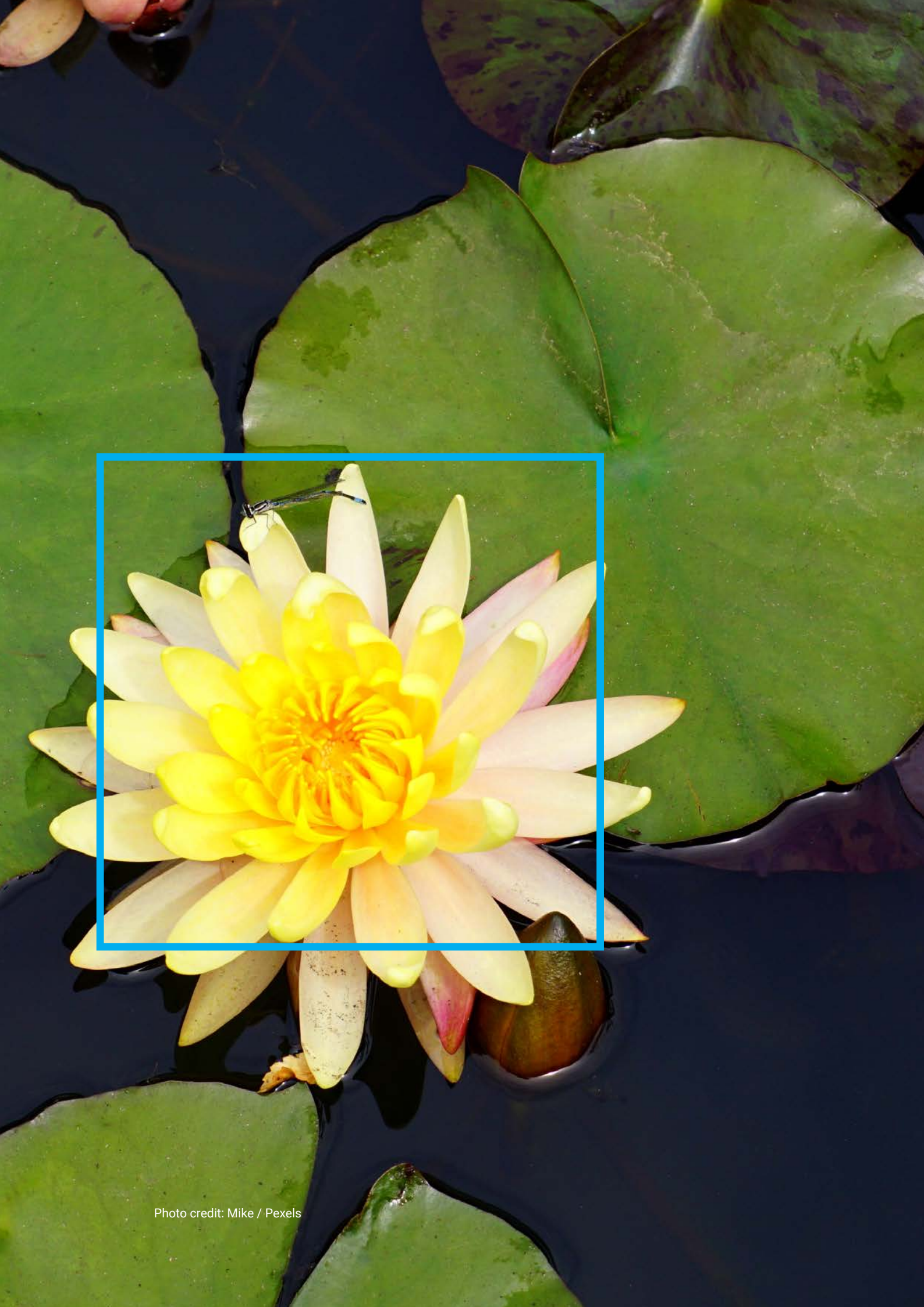
Volume 2 describes aspects of the Framework in more technical detail: classification systems for freshwater ecosystem types, setting targets for ecological status, and monitoring progress against these targets. It is primarily aimed at government agency staff responsible for the sustainable management of freshwater ecosystems. These aspects have been selected for elaboration as they are likely to be the most useful for the largest number of countries in relation to Aichi Biodiversity Targets and the SDGs. Additional technical guides that expand on other parts of the Framework, such as the design and implementation of remediation actions, may be developed depending on demand from countries.

Volume 3 provides examples from around the world, illustrating different aspects of the Framework.

Volume 4 underpins the series and includes a review of water quality guidelines for ecosystems from around the world.



Athabasca Falls, Canada
Photo credit: Ian Keefe / Unsplash



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1 Introduction and Objectives

The Challenge

Freshwater ecosystems such as wetlands, rivers, aquifers and lakes are indispensable for life on our planet; they provide a range of benefits and services fundamental to the environment, society and the economy. These include provisioning services such as water for food and beverages, energy production and manufacturing; regulating services such as water purification, and climate and natural hazard regulation; habitat services, including for migratory species and maintaining the diversity of gene-pools; and cultural services such as recreation, tourism and spiritual experiences. As such, freshwater ecosystems are essential for sustainable development, peace and security, and human well-being. These concepts form the crux of Sustainable Development Goal (SDG) target 6.6, 'to protect and restore water-related ecosystems', which, in turn, supports SDG 6: 'ensure availability and sustainable management of water and sanitation for all'.

Unfortunately, freshwater ecosystems are facing serious accumulative pressures, affecting their ability to provide these services. These pressures include pollution and overextraction as a result of socioeconomic development and are compounded by the impacts of climate change.

The diversity and complexity of freshwater ecosystems make it difficult for countries to know how to manage them. The challenges largely revolve around finding the balance between the need for short-term socioeconomic development, which often puts extra pressures on ecosystems, and the need to protect and restore ecosystems to support more long-term, sustainable development. Finding the balance partly depends on agreeing acceptable (or 'target') levels of ecological status, and indicators and threshold values to monitor these. This target setting requires a mix of scientific, social, economic and political inputs.

The Development of the Framework in the Context of the SDGs

Increasing awareness of the value of freshwater ecosystems for sustainable development, concern about their decline,[1] and the lack of globally-relevant guidelines, prompted a request from the United Nations Environment Assembly in 2013 for the development of international water quality guidelines for ecosystems.[2] Protecting and restoring freshwater ecosystems in

1 Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Synthesis (Washington, DC., Island Press, 2005). Available from: http://www.millenniumassessment.org/documents/document.356.aspx.pdf

2 At the time, the UN Environment Assembly was known as the UN Environment Programme Governing Council (GC). Decision 27/3, February 2013, requested the development of international water quality guidelines for ecosystems.

order to sustain their ecosystem services has long formed a core part of UN Environment's mandate and is at the centre of its Freshwater Strategy 2017-2021.[3]

This has led to the development of the UN Environment Framework for Freshwater Ecosystem Management series (see Preface for an overview).[4] The aim of the series is to support countries to achieve national and international goals related to ecosystems, including the majority of Aichi Biodiversity Targets;[5] healthy freshwater ecosystems also directly or indirectly support a number of SDGs targets (Table 1).

Table 1 The Framework for Freshwater Ecosystem Management supports healthy ecosystems, which either support or are supported by many SDGs and their targets.*

Direct synergy between implementing the Framework and SDG targets:	
6.3	Improve ambient water quality, reduce pollution
6.6	Protect and restore water-related ecosystems
15.1	Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services
15.5	Reduce the degradation of natural habitats, halt the loss of biodiversity, and protect and prevent the extinction of threatened species
Implementing the Framework and these SDG targets are mutually supporting:	
1.4	Ensure men and women have control over natural resources
1.5	Build resilience of those in vulnerable situations
2.4	Support sustainable food production that helps maintain ecosystems
2.5	Maintain genetic diversity
3.9	Reduce illness from water pollution
4.7	Ensure all learners have knowledge and skills to promote sustainable development
6.1	Ensure access to drinking water
6.2	Ensure access to sanitation
6.4	Increase water use efficiency, reduce water stress
6.5	Implement integrated water resources management
8.4	Decouple economic growth from environmental degradation
8.9	Support sustainable tourism
11.4	Strengthen efforts to protect the world's cultural and natural heritage
11.5	Reduce impacts of disasters, including water-related disasters
11.6	Reduce environmental impact of cities
11.7	Ensure access to public green spaces
12.2	Support sustainable management and use of natural resources
12.4	Implement environmentally sound management of chemicals, reduce their release into air, water and soil
13.1	Build resilience to climate-related hazards
14.1	Reduce marine pollution, in particular from land-based activities, including nutrient pollution
14.2	Sustainably manage and protect coastal ecosystems

3 http://www.unep.org/ecosystems/freshwater/resources/publications/un-environments-freshwater-strategy-2017-2021
4 See Annex 1 for an overview of the development of this series, and Annex 2 for a full list of contributors.
5 https://www.cbd.int/sp/targets/

14.5	Conserve at least 10 percent of coastal areas
15.3	Sestore degraded land and soil
15.4	Conserve mountain ecosystems
15.7	End poaching and trafficking of protected species of flora and fauna
15.8	Prevent the introduction and reduce the impact of invasive alien species in land and water ecosystems
15.9	Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts
Implementing the Framework indirectly supports these targets:	
1.1	Eradicate extreme poverty
1.2	Reduce poverty
2.1	End hunger
2.2	End malnutrition
8.1	Sustain economic growth
10.1	Achieve income growth for the poorest
15.6	Share benefits from genetic resources

* The SDG targets are presented in abbreviated forms for ease of presentation, as well as to highlight aspects that are most relevant for freshwater ecosystems. For the full wording of Goals and Targets, see https://sustainabledevelopment.un.org/sdgs.

While freshwater ecosystems provide a vast array of services to support sustainable development objectives and directly or indirectly support a large number of SDGs and their targets, the processes outlined in this Framework are most closely linked with monitoring and reporting for the following SDG targets and indicators:

- Target 6.6: By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
  - Indicator 6.6.1: Change in the extent[6] of water-related ecosystems over time.
- Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
  - Indicator 6.3.1: Proportion of wastewater safely treated.
  - Indicator 6.3.2: Proportion of bodies of water with good ambient water quality.

This Framework can be used in conjunction with the more detailed SDG indicator methodologies.[7] It supports the more specific SDG indicator methodologies by providing the context in which they can be developed. Furthermore, it provides information on the links between relevant SDG indicators, particularly SDG 6.6.1 and 6.3.2, thus supporting harmonization and streamlining of efforts to report on those indicators.

While this Framework is intended to support countries to report on indicators and work towards SDG targets, the implementation and revision of the Framework is expected to continue beyond 2030.

A note on text boxes throughout this document: Green boxes provide references to SDGs and other international political commitments. They generally refer to the SDG 6 step-by-step indicator methodologies, available at http://www.sdg6monitoring.org. Purple boxes provide country examples. Further details on these country examples can be found in Volume 3 in this series.

6 Includes spatial extent, water quantity, water quality and overall ecological health.
7 Further information on the SDG targets, indicators and methodologies are available at http://www.sdg6monitoring.org (or http://unstats.un.org/sdgs/metadata/, or via http://www.unwater.org)

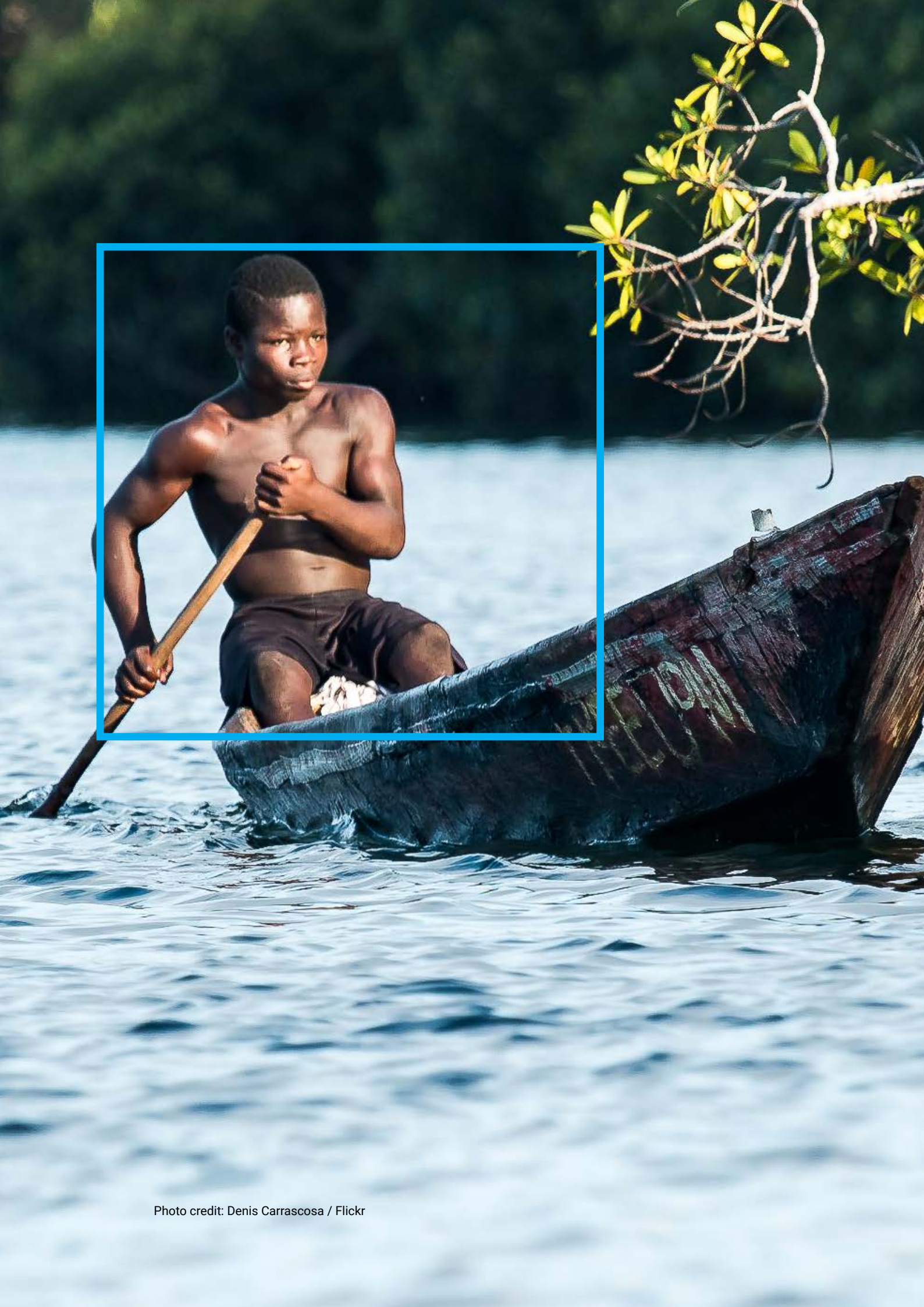


Photo credit: Denis Carrascosa / Flickr

2 Summary of the Framework for Freshwater Ecosystem Management

The Framework for Freshwater Ecosystem Management (hereafter referred to as the 'Framework') identifies the main activities for countries to sustainably manage freshwater ecosystems. It is laid out in four phases with underlying steps. An overview of the Framework is provided in Figure 1, with more detail in Section 3.

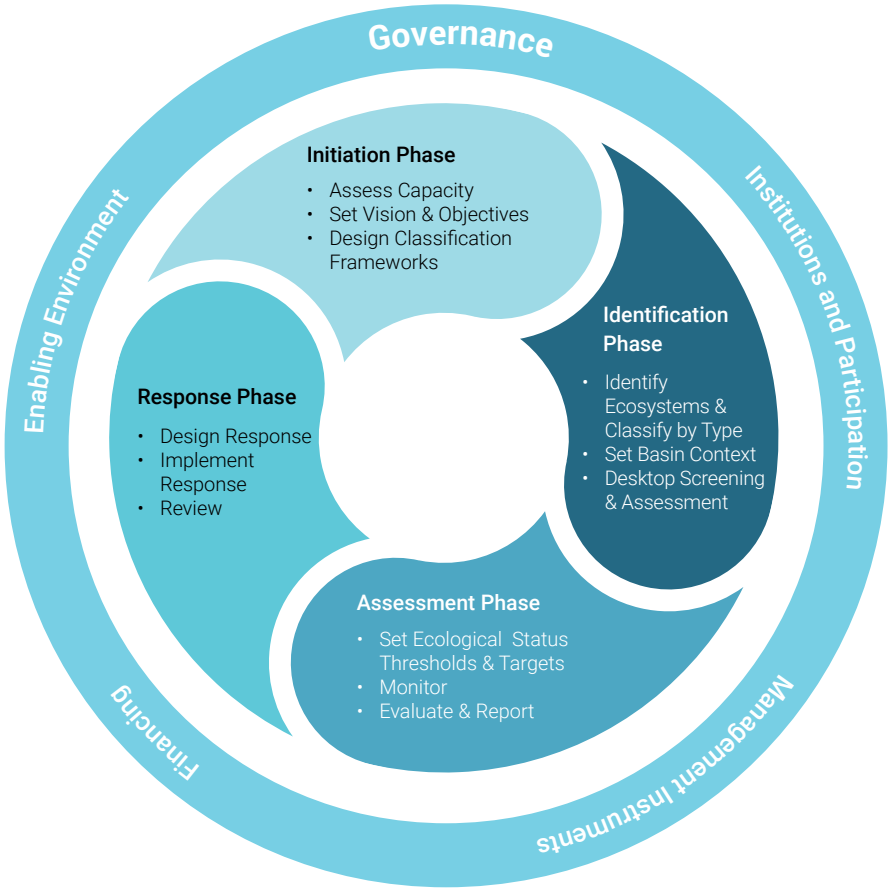
Each country has unique political, economic, environmental, social and cultural conditions, which mean that there is no single blueprint for protecting and restoring freshwater ecosystems. With this in mind, the Framework presented in this series is intended as a 'guide' (rather than a 'manual') to ensure that key issues are considered. The main aim of the Framework is to facilitate the development and refinement of context-specific, national processes to sustainably manage freshwater ecosystems. The Framework is applicable to a wide range of countries with different starting points, ambitions and capacities. Being able to identify national processes within a common global Framework facilitates cross-country collaboration and learning, not least between countries that share freshwater ecosystems. As well as being applicable at national and subnational levels, the Framework can also be used for transboundary freshwater ecosystems shared by two or more countries.

While the steps follow a logical progression for protecting and restoring freshwater ecosystems, most countries will already have embarked on some, if not all, of these steps. Therefore, work may be undertaken on different steps concurrently; in other words, each step does not have to be completed before work on the next step begins. Similarly, while the Framework follows a circular progression, the steps do not necessarily have to be completed in sequential order, and many of the steps can be revisited and revised at any time. An adaptive management approach is strongly recommended, whereby steps are periodically reviewed and revised as required.[8]

For countries in the early stages of this journey, the Framework may be a useful starting point. It can also be used as a long-term planning tool to ensure a holistic approach to understanding the value of ecosystems and protecting and restoring them. For others, it may offer some inspiration for improving current processes. The four phases and underlying steps are summarized below.

8 See Sections 2.9 and 4.8.1 of UN Environment 2017, A Framework for Freshwater Ecosystem Management. Volume 4: Scientific background for regional consultations on developing water quality guidelines for ecosystems.

Figure 1 – The Framework for Freshwater Ecosystem Management, underpinned by good governance



Good governance is essential for the sustainable management of freshwater ecosystems. Good governance is participatory, accountable, transparent, responsive, consensus oriented, effective and efficient, equitable and inclusive, and follows rules of law. Governance underpins and effects all aspects of the four phases of the national framework. Governance of freshwater ecosystems can be broken down into the following four components: (1) Enabling Environment; (2) Institutions and Participation; (3) Management Instruments; and (4) Financing (see Section 4).

Overview of the Framework Phases

INITIATION PHASE

Assess Capacity: Assess national capacities to sustainably manage freshwater ecosystems, including all aspects of governance (e.g. policies, plans, laws, institutions, monitoring programmes and financing).

Set Vision and Objectives: Agree on a broad national vision and objectives for freshwater ecosystems. Involve relevant stakeholders.

Design Classification Frameworks: Design classification system for ecosystem types (e.g. rivers, lakes, wetlands), define the potential ecosystem services for each ecosystem type, and identify potential indicators that could be used as proxies for the provision of ecosystem services.

IDENTIFICATION PHASE

This Phase draws on existing data and information to identify, categorize and undertake a preliminary assessment of freshwater ecosystems.

Identify Ecosystems and Classify by Type: Using the classification frameworks designed in the Initiation Phase, identify and categorize freshwater ecosystems, their services, and any key variables that are likely to influence the provision of ecosystem services.

Set Basin Context: Defining the hydrological drainage basin for each ecosystem facilitates an assessment of the main pressures on them, as well as the main recipients of the ecosystem services they provide.

Desktop Screening and Assessment: Involves gathering existing information at the basin level, identifying key pressures on each ecosystem, and making an initial assessment of the ecological status of each ecosystem. This step should involve relevant stakeholders and experts to get the most accurate picture of the basin, without the need for undertaking additional monitoring.

ASSESSMENT PHASE

Set Ecological Status Thresholds and Targets: Involves the definition of ecological status classes (e.g. good to bad), the design of indicators and threshold values for each indicator – to classify ecosystems into status classes. Finally, targets can be set (with the involvement of stakeholders) for an acceptable ecological status for each ecosystem.

Monitor: Involves the design of the monitoring programme, the collection of data, quality assurance and data management.

Evaluate and Report: Involves analysing the monitored data, comparing them against the defined indicator thresholds, and assigning each ecosystem to an ecological status class.

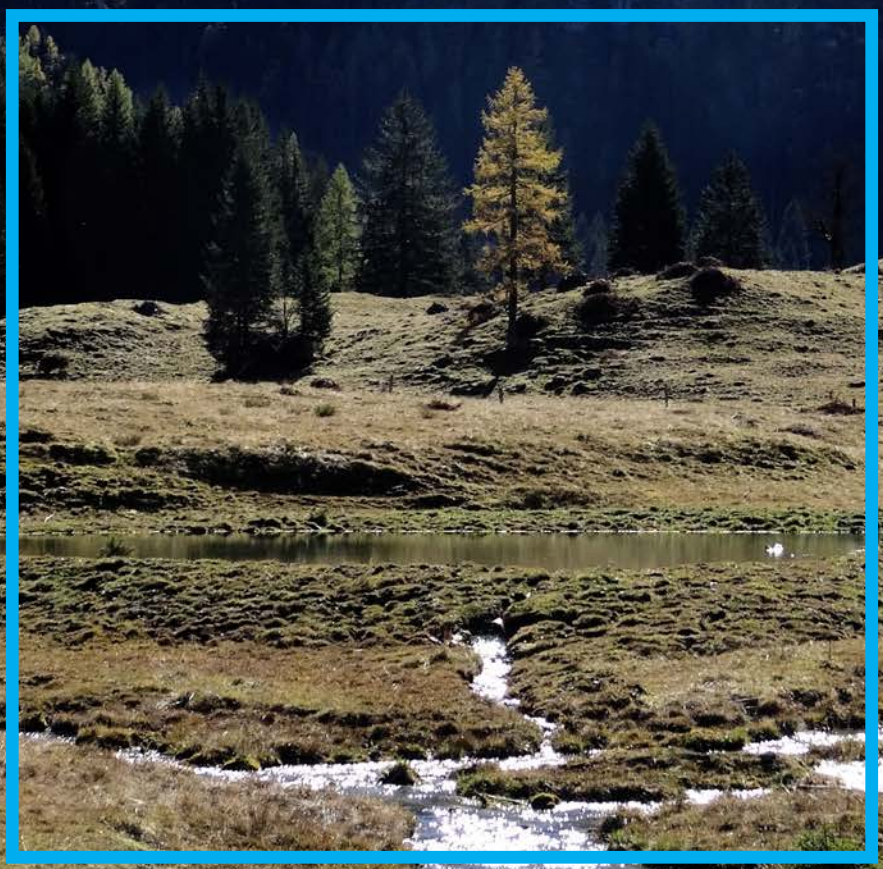
RESPONSE PHASE

This Phase concerns the managment actions for sustainable freshwater ecosystems.

Design Response: Based on the assessment results in the previous Phase, refine the objectives for each ecosystem, identify and prioritize management actions, and undertake detailed design of the selected management options. The aim is to attain the target status class.

Implement Response: Implement the management actions designed in the previous step.

Review: review the effectiveness of the management actions, as well as the entire Framework, and identify steps that require revision.



Untertauern, Austria
Photo credit: Georg Nietsch / Unsplash

3 Phases and Steps in the Framework for Freshwater Ecosystems Management

This section outlines the phases, steps and substeps in the country-level framework for the sustainable management of freshwater ecosystems (see Box 1). More detail is provided on many of the steps in Volume 2.[9]

For the purposes of this series, 'freshwater ecosystems' refers to all inland waterbodies. They include vegetated wetlands, rivers, streams, canals, lakes and reservoirs. They also include brackish water, such as estuaries, mangroves and lagoons. This is because the quantity and quality of freshwater inflows are often a critical factor in maintaining ecosystem functions in these water bodies. This is in line with the 'drainage basin' and 'source to sea' approaches to natural resources management. Finally, groundwater is also included because groundwater–surface water interactions are often a critical element in surface water ecosystem function; groundwater bodies also provide direct ecosystem services.

For the sake of brevity, 'freshwater ecosystems' are sometimes referred to in this volume simply as 'ecosystems'.

Box 1 - Freshwater Ecosystem Types

3.1 Initiation Phase

Initiation Phase
- Assess Capacity
- Set Vision & Objectives
- Design Classification Frameworks

The objectives of this Phase are to:
- assess the capacity (in-country) to sustainably manage ecosystems
- bring stakeholders together to develop a common understanding of the value of ecosystems and their relationship with socioeconomic development
- design classification systems for ecosystems and their services

9 UN Environment 2017, A Framework for Freshwater Ecosystem Management. Volume 2: A technical guide for regional consultations on classification and target setting.

3.1.1 Assessing Capacity[10]

In order to design or refine activities to monitor, protect and restore freshwater ecosystems, it is important to understand the current capacity of countries to do so. A capacity assessment may be structured around the four components of governance (see Section 4):

1. Enabling Environment: The existence of provisions in government plans, policies and law related to the protection and sustainable use of freshwater ecosystems.
2. Institutions and Participation: The institutional and human capacity, from the national level through subnational and basin levels to the local level, to manage and protect freshwater ecosystems. The capacity to effectively engage with the private sector and other stakeholder groups should also be assessed.
3. Management Instruments: such as monitoring programmes, and financial incentives and measures to protect and restore ecosystems.
4. Financing: Financial resources available, including grants and more sustainable revenue streams.

In addition to assessing these four components, the capacity assessment should identify any particular capacity gaps that may need addressing to achieve the vision and objectives. The level of detail in the capacity assessment, and in particular the identification of capacity gaps, depends on the degree of implementation of other steps in the management framework, such as the monitoring and reporting systems. At the most basic level, this would involve gathering information on existing provisions and instruments related to the sustainable management of freshwater ecosystems.

More detailed capacity assessments can also be undertaken as part of a review (in the Response Phase), through the implementation of monitoring and reporting systems.
This step is also linked to 'desktop screening' in the Identification Phase, which involves a more detailed assessment of data availability at the basin level.

Compiling available data and assessing water quality monitoring capacity is a key early step in assessing SDG 6.3.1 and 6.3.2. Even if not specified in SDG 6 step-by-step indicator guides, assessing relevant capacity is also likely to be a critical step in monitoring other SDG indicators.

Box 2 Capacity Assessment for SDG indicators

3.1.2 Agreeing on a Vision and Set Objectives

Setting a national vision for the sustainable management of freshwater ecosystems needs to balance social, economic and environmental concerns. It is essentially a sociopolitical process that needs to be informed by scientific evidence. Therefore, it is imperative that key stakeholders are included in the development of the vision and associated objectives. It is also an opportunity to raise awareness of the importance of ecosystems, their role in sustainable development, and the benefits of protecting and restoring them.

A national vision may include elements such as:

- Preventing further deterioration of ecosystems (see Box 3)

10 Addressed in more detail in Volume 2.

- Promoting sustainable management and use of ecosystems
- Recognizing the valuable contribution of ecosystems and their services to sustainable development, as well as in meeting various national, regional and global targets
- An acknowledgement that the state of ecosystems is influenced by aggregate impacts from a variety of pressures

The vision may also include specific goals and targets, with associated timelines.

Some countries, such as the USA, Canada and South Africa, have set a 'no net loss' policy for the spatial extent of wetlands, requiring that any loss of wetland resources needs to be offset by rehabilitation of a greater number of resources. Similarly, the Ramsar Convention on Wetlands refers in its COP11 (Doc 24) to 'Limits of Acceptable Change'.

Box 3 'No net loss' policies for wetland extent.

Objectives may include elements such as:

- The need for quantitative information about the pressures on ecosystems and the state they are in
- The need for the protection of high-value ecosystems and enforcement of standards
- An intention to develop programmes for the sustainable management and use of ecosystems

At the national level, the vision and objectives should be broad enough to cover the whole country, but should guide more explicit objectives at the ecosystem level, set within the context of each basin. The vision should also consider international commitments and targets, and the extent to which they should be followed or adapted to suit national circumstances (see Box 4).

Aichi Targets 5, 14, 15.
SDG Targets 6.3, 6.4, 6.5, 6.6, 15.1, 15.5.

Box 4 International targets and commitments that should be considered when setting a vision and objectives.

The vision and objectives should be documented in an official government report, and ideally reflected in national policy and legal frameworks. Incorporation into policy and law can take some time and may depend on gathering more scientific evidence – as described in subsequent steps in this Framework. Thus, the vision and objectives may initially be produced in draft form, to be refined at a later stage (for example, in the 'design response' step in the Response Phase).

3.1.3 Designing Classification Frameworks[11]

This step involves designing classification frameworks for ecosystem types, identifying potential ecosystem services provided, and identifying some of the potential indicators that could be considered (as proxies) for measuring ecosystem health, and thereby the provision of ecosystem services. This step does not require a lot of data and does not have to be a detailed assessment. The main intention is to design the classification frameworks, which will then be filled out in the 'identify ecosystems and classify by type' step in the Identification Phase. These two steps are closely linked and likely to be undertaken concurrently.

Classify Ecosystem Types[12]

A classification framework for ecosystem types is useful for designing monitoring systems and setting targets. In the context of this Framework, freshwater ecosystems may also be referred to as waterbodies (see Box 1).

A hierarchical, or nested, classification framework is recommended, whereby basic categories are defined at the upper level, and these can be divided into more detailed categories based on the amount of data available and level of ambition. At the most basic level, four broad categories can be defined:

1. Running waters: rivers and streams (including estuaries)
2. Standing waters: lakes and reservoirs
3. Vegetated wetlands: vegetation and water dominated ecosystems such as swamps, swamp forests, marshes, peatlands, paddies and mangroves
4. Groundwater bodies: including aquifers

These categories can be progressively refined to define other similar types of ecosystems, depending on available data and capacity. Moving to a finer scale of classification allows for more relevant indicators to be identified for the ecosystem subtypes and more specific thresholds to assess ecosystem condition and initiate management responses. A common approach to subclassification of ecosystem types is to use an 'ecoregion' approach. Ecoregions are areas where the ecosystems have similar characteristics and are generally subdivisions of hydrological drainage basins.

Defining Potential Ecosystem Services for Ecosystem Types

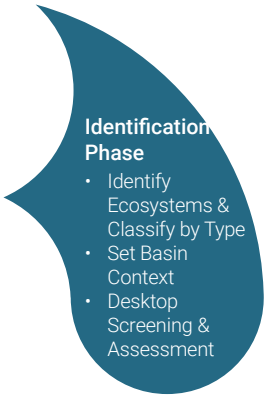
Defining and understanding the different types of ecosystem services provided by each ecosystem type helps develop an appreciation of the role of ecosystem services in sustainable development. It also helps with designing the monitoring framework, used to help track the capacity of the ecosystems to continue providing these important services.[13]

Identifying Potential Indicators Important for the Provision of Ecosystem Services

To help with designing the monitoring system, as well as communication with stakeholders, it would be useful to identify potential types of indicators (such as 'minimum flows' or 'total nitrogen') that could be used as a proxy for the provision of ecosystem services. These would be broad indicator types, or draft indicators, which could be refined in the first step of the Assessment Phase: 'set ecological status thresholds and targets'. The 'desktop screening' step (in the Identifaction Phase) also contributes to the selection of indicators for a more detailed assessment.

11 This step is covered in much more detail in section 4 of Volume 2.
12 More information provided in section 4.1 of Volume 2 and in sections 2.2 and 4.2 of Volume 4.
13 See Section 2.3 of Volume 4; other examples can be found in The Economics of Ecosystems and Biodiversity (TEEB - http://www.teebweb.org), the Common International Classification of Ecosystem Services (https://cices.eu), and the Millennium Ecosystem Assessment (http://www.millenniumassessment.org/en/index.html).

3.2 Identification Phase



The Identification Phase builds on the Initiation Phase, particularly the classification frameworks. The objectives of this Phase are to:

- identify the ecosystems and classify them by type
- determine the hydrological basin boundaries for each ecosystem
- undertake a desktop screening to identify the main pressures, and high-value or at-risk ecosystems (through an initial estimate of ecological status)

These steps are all closely linked and likely to overlap.

3.2.1 Identifying Ecosystems and Classify by Type

Following the framework established in the previous step, freshwater ecosystems should be identified and categorized by type. For each identified ecosystem, an attempt should be made to identify the main ecosystem services associated with it, as well as potential indicators that could be used for monitoring. Indicators may be developed further in the Assessment Phase.

3.2.2 Setting Basin Context

Each ecosystem is located within a hydrological drainage basin. Activities within the basin can impact on the ecosystems. Therefore, delineating the hydrological boundaries for each ecosystem (or waterbody) allows us to identify the pressures on the ecosystems, and design and implement management plans at the basin level. The delineation of sub-basins may be appropriate: the level of detail required is linked to the level of classification defined in the Initiation Phase. Many countries may have already delineated most basins. Where national data gaps exist, global data sets are readily available.[14]

3.2.3 Desktop Screening and Assessment

The aim of this step is to analyse available data and information, and on this basis, compile the first assessment of the status of freshwater ecosystems. It may not be limited to a desktop study; it could also involve inputs from experts and stakeholders, where feasible.

The delineation of waterbodies is described in detail in the methodology for SDG indicator 6.3.2.

Box 5 Delineation of waterbodies in SDGs

Assessing Data Availability by Basin

Building on the broader capacity assessment in the Initiation Phase, this is a more detailed analysis of the availability and quality of data at the basin level. This information can be used in designing or refining the monitoring system for each basin.

Identifying Key Pressures

Pressures that impact on ecosystem condition can include: water infrastructure (e.g. dams and levees), flow alteration (e.g. water withdrawals and diversions, reservoir operation); modification of aquatic habitat; overexploitation (e.g. overfishing or hunting, excessive water withdrawal or sand mining); biological water pollution (e.g. invasive species); chemical water pollution (e.g. agricultural or urban run-off or untreated wastewater); and thermal water pollution.

14 Such as HydroBASINS (http://www.hydrosheds.org/page/hydrobasins) and the Global Lakes and Wetlands Database (http://www.worldwildlife.org/pages/global-lakes-and-wetlands-database)

If possible, attention should be given to the development of pressures in the future, including an analysis of the likelihood of specific changes. Socioeconomic developments such as expected increases in population, economic growth and changes in land and water use should be considered. Negative impacts on ecosystems might be expected from increases in population, growth of economic activities such as industrialization, fisheries, recreation or large-scale infrastructure (e.g. land reclamation or hydropower developments).

Estimating Ecological Status of Each Ecosystem

This is the first attempt to classify the ecological status of the ecosystems, based on available information. The main objective is to identify those basins and ecosystems that are likely to be most at risk, as well as those that are 'near natural' ecosystems. Identifying ecosystems at both ends of the spectrum helps to prioritize those areas that may need more urgent monitoring and work to mitigate the risk, as well as helping to set thresholds for various classes of ecosystem status (as discussed in the next step – see section 3.3.1).

Ecosystems that may have particularly high value (in either the national or international context) can also be identified in this step. The value can be, for example, in terms of ecosystem services provided, the level of biodiversity or the presence of threatened species.

3.3 Assessment Phase

The aim of this Phase is to conduct a scientifically based and quantitative assessment of the state of freshwater ecosystems. This assessment includes:

- designing indicators, setting threshold values (for each ecological status class) for each indicator, and agreeing on target status classes
- designing and implementing a monitoring programme to gather data on the indicators
- evaluating the data and reporting on freshwater ecosystem status, in accordance with agreed management targets

3.3.1 Setting Ecological Status Thresholds and Targets[15]

This step involves defining ecological status classes, selecting indicators to monitor ecological status, defining the thresholds values between each status class for each indicator, and setting management targets for each ecosystem.

Defining Ecological Status Classes

It is important to define classes of ecological status that can be used to set management targets as well as assess and communicate changes over time. Many classification systems exist for ecological health, usually ranging from 'good' to 'poor'. An example of a classification system is provided below[16] (see section 3.3.1).

15 This step is covered in much more detail in Volume 2 and in sections 2.7 and 4.5 of Volume 4.
16 Based on classes from SDG 6.6.1 and modified from Kleynhans C.J. and Louw M.D. (2008), River EcoClasssification: Manual for EcoStatus determination. Report No. TT 329/08. Water Research Commission, South Africa.

Table 2 - Example of Ecological Status Classes

A. Natural	B. Largely Natural	C. Moderately Disturbed	D. Largely Disturbed	E. Seriously Disturbed
Changes To Ecosystem, Ecosystem Function And Services				
Insignificant changes from natural	Minor changes to ecosystem but no significant loss of ecosystem function/ services	Some loss/change of habitat & biota but basic ecosystem function/services remain	Large loss/change of habitat & biota. Ecosystem function/ services reduced	Extensive loss/ change of habitat & biota. Ecosystem function/services mostly lost
Sustainability				
Highly sustainable	Highly sustainable	Generally sustainable but requires management	Generally unsustainable. Corrective actions strongly recommended	Unsustainable. Urgent renewal required

Selecting Indicators

There are many indicators that could be used to assess the ecological status of freshwater ecosystems. The main challenge lies in selecting the most appropriate set of indicators; this depends on the basin context, the monitoring objectives, ecosystem types and available resources. This step builds on information gathered during the Identification Phase. Indicators for freshwater ecosystems can generally be categorized into: quantity (e.g. flow volumes, depth, timing); quality (e.g. dissolved oxygen, nutrients, toxicants); habitat (e.g. substrates, bank stability and riparian vegetation); and biological (e.g. fish, inverterbrates, algae).

Generally, it is better to select a few indicators that are meaningful rather than to try to measure everything – in other words, to have the least number of indicators that will purposively reflect the ecological status of the ecosystem. It is also important to select indicators that can help diagnose the likely cause of observed degradation and guide management actions.[17,18,19]

SDG indicators, as well as underlying sub-indicators or parameters, are well-specified within the SDG indicator methodologies. These indicators and their respective parts should serve as a minimum set of indicators to be considered at the national level. However, as the SDG indicators are designed to be globally applicable, it is likely that additional indicators and sub-indicators would be needed for national level ecosystem management.

Box 6 SDG indicators

17 Jørgensen, SE, Fu-Liu Xu, Marques, JC & Salas, F. 2010. Application of Indicators for the Assessment of Ecosystem Health. In: Handbook of Ecological Indicators for Assessment of Ecosystem Health. Second Edition. Ed. Sven E. Jørgensen Fu-Liu Xu Robert Costanza. CRC Press.
18 Jackson, L. E., Kurtz, J. C. and Fisher, W.S., Eds, Evaluation Guidelines for Ecological Indicators, EPA/620/R-99/005. (North Carolina, US Environmental Protection Agency, Office of Research and Development, 2000).
19 Bertule, M., Bjørnsen, P.K., Costanzo, S.D., Escurra, J., Freeman, S., Gallagher, L., Kelsey, R.H. and Vollmer, D. (2017). Using indicators for improved water resources management - guide for basin managers and practitioners. 82 pp. ISBN 978-87-90634-05-6.

Setting Threshold Values

To assign ecosystems to an ecological status class, it is necessary to define threshold values for each class for each of the selected indicators. Ideally, the threshold values for the natural or near natural classes should be set from data collected in those ecosystems, or similar ecosystems (see Box 7).

The methodology for SDG 6.3.2 describes approaches for establishing target values for various parameters for 'good' water quality, based on monitored data. SDG 6.6.1 defines threshold values as percentage change from reference conditions.

Box 7 Setting water quality target values

In the absence of appropriate data for setting threshold values, guideline values from other jurisdictions may be referred to. A significant number of national and international standards have been developed for many physical and chemical indicators (see Section 4.3 not 4.2).

Setting Targets for Ecosystem Status

Using the status classes designed above, and building on the 'desktop screening' undertaken in the Identification Phase, it is possible to set status targets for each ecosystem, within the context of national (and international) sustainable development objectives. While the target for some ecosystems may be to preserve, or return them to their natural or near natural condition (e.g. ecological status classes A and B in the example above – Figure 2), for others a balance may need to be found between ecosystem protection and other socioeconomic development objectives (in this case, D may be deemed acceptable). Ecological class E is unsustainable and should therefore never be used as a target for management. This is a sociopolitical process, closely linked to the vision and objectives discussed in the Initiation Phase. As such, adequate involvement of stakeholders is a critical consideration.

3.3.2 Monitoring[20]

Designing a Monitoring Programme

The monitoring programme should be able to provide sufficient data to track the change over time of the key indicators against the threshold values established in the previous step. It is important to consider existing monitoring capacity (see also 'asess capacity' and 'desktop screening' steps) in the design or refinement of the monitoring programme in order to make best use of resources and expertise.

Design of the monitoring programme should consider, for each of the required indicators:

- the ability to establish trends over time
- the costs to establish and maintain the system, and sources of financing
- anaylitical capacity
- quality assurance procedures and their cost implications

20 This step is covered in much more detail in Volume 2 and in sections 2.6 and 4.6 of Volume 4.

The methodologies for SDG indicators, such as 6.3.1, 6.3.2, 6.4.1, 6.4.2 and 6.6.1, describe in more detail specific aspects of the design and implementation of monitoring systems for those indicators. 6.6.1 in particular, provides plenty of information on potential data sources and data harvesting techniques from global (such as Earth Observations) through to local sources.

Box 8 Monitoring for SDG indicators

Collecting Data

Quality assurance and effective quality control procedures during sampling, analyses and data handling are essential for producing reliable monitoring data. Where possible, monitoring methods should be widely accepted – for example, be accredited according to ISO guidelines,[21] or be the subject of national or international testing schemes. These methods should also have been subject to peer review through scientific publication or have been published in reputable sources such as Standard Methods for the Examination of Water and Wastewater.[22]

Data Management

The main objective is to develop simple-to-use data storage and retrieval systems in order to compare monitoring results and access associated reports and background information. Ideally, the data should be organized in a way that makes it possible to share between organizations and agencies within the country. In many cases, data for different parameters may be collected by different agencies, as well as at different levels of governance. Therefore, the balance between centralized and distributed data management systems, and how data is transferred between them, requires careful consideration.

3.3.3 Evaluating and Reporting

The main objective of this step is to develop useful information for decision-making. Developing effective communication material to engage with all relevant stakeholders is an important aspect (see Box 9).

This step analyses the data collected during monitoring and compares it against the threshold values for each indicator, to assign each ecosystem to an ecological status class.
The evaluation and reporting should include an assessment of the degree to which relevant national and international targets (such as the SDGs) are being met, and whether or not they are on track to be met within the specified time frames.

The reporting may include the identification of priority ecosystems that need urgent attention, as well as examples of success stories that may provide inspiration to others. In response to the reported findings, potential management actions can be identified; these could be either more general actions or more specific options, depending on the level of detail required.

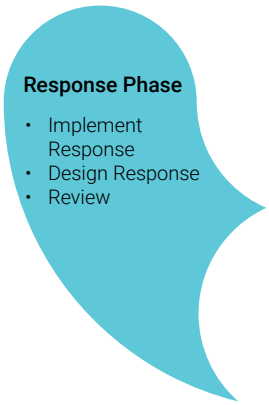
For example, if the problem is excessive nutrient loads to an ecosystem, then management actions could include various ways of reducing nutrient loads from agricultural run-off. These potential management actions can be explored in more detail in the Response Phase.

21 International Organization for Standardization (ISO).
22 https://www.standardmethods.org/Links.cfm

In a mining impact study on the Strickland River (Papua New Guinea), report cards provide a visual summary of relevant data and information in a format that is relatively easy to understand and can be used to communicate ecosystem status to a range of stakeholder groups. Various indices within each indicator group were combined into a single score, with data for the five indicator groups presented separately. The report card was widely publicized and made available on the mining company website. While this type of highly condensed reporting is useful for communication purposes, it should not replace technical reports that guide the design and implementation of management actions.
Reference: Case Studies volume.

Box 9 Example use of an ecosystem health report card to condense data and information.

3.4 Response Phase



The term 'response' primarily refers to actions taken to protect, restore and sustainably manage freshwater ecosystems. These may range from broad actions such as changes to governance (e.g. policy, legislation, plans, institutions, capacity or financing – see section 4), to more targeted management and remediation projects, or programmes covering particular areas or issues.[23] One of the aims of this Phase is to respond to the findings and recommendations developed in the 'evaluate and report' step.

This Phase includes:
- the design of response options
- their implementation
- a review

3.4.1 Designing Response

To design effective response options, it is imperative that decision makers and other stakeholders have access to reliable information (as developed in previous steps). Tools such as Decision Support Systems or Decision Support Frameworks can help in the design of response options. These resource management tools can facilitate decisions on how and where to focus (future) interventions and allocation of resources (as part of an adaptive resource monitoring programme). The design of response options may involve the following:

Refining Objectives

Building on the vision and objectives set in the Initiation Phase, and using the information provided through the 'desktop screening' in the Identification Phase and/or the more detailed evaluation in the Assessment Phase, management goals and objectives can be refined with inputs from stakeholders. This provides the context for the identification and prioritization of response options.

Priotizing Options

This step involves the assessment and prioritization of various response options, to address the findings from the Assessment Phase and the refined objectives described above. It may involve outlining various response options (with cost estimates) for protecting and restoring freshwater ecosystems. Response options can cover different timescales (short to long term) and geographical scales (local to national).

23 For more information, see for example: https://www.iucn.org/theme/ecosystem-management; http://www.ramsar.org/resources/ramsar-handbooks; www.unenvironment.org/water

There should then be a process to prioritize and select the most effective and viable options. This may involve cost-benefit analyses. Relatively simple or more complex modelling can be undertaken to test various management options – for example, a risk assessment could be carried out to estimate the risks of failure of different ecosystems and/or the planned interventions.

During the assessment and prioritization of response options, consideration should be given to the level of stakeholder engagement throughout the process.

Detailed Design

Once the options have been prioritized and selected, they can be designed in more detail, including implementation plans, costings and identification of funding sources.

3.4.2 Implementing Response

This step involves the implementation of management interventions, projects and programmes designed in the previous step. Usually, greater levels of stakeholder engagement and buy-in will lead to more sustainable and positive outcomes for both society and ecosystems (Box 10). The award of projects and allocation and management of resources should be transparent, and organizations and companies implementing projects should be accountable for project outcomes.

The programme was initiated by a petition to clean up the river, signed by 1.2 million people. Civil society, NGOs and the media have all played an important role in formulating and implementing the programme, which focusses on increasing sewage collection and treatment. While there has been a significant reduction in pollutants and a corresponding increase in some fish species, by the end of 2015 the water quality still did not comply with guidelines for some uses. Experience has shown that, even with political dedication, good governance, public involvement, sufficient funding and technical capacity, the rehabilitation of deteriorated freshwater ecosystems can take decades to achieve. Reference: Case Studies volume.

Box 10 Upper Tietê River Basin Cleanup Programme (1992-2025), Brazil.

3.4.3 Review

There are two main parts to this step:

- a review of the management interventions (implemented in the previous step)
- a review of the entire framework, including identifying lessons learned and opportunities for improvement

Periodic review of management interventions is an important aspect of any adaptive management cycle. The extent and frequency of review will depend on the type of intervention. For ongoing programmes, there may be periodic review – for example, every one or two years. For one-off projects, there should be (at the very minimum) a review upon completion of the project, and for longer projects (e.g. longer than one year), intermediate reviews should be considered. Reviews may include, among other things:

- effectiveness and sustainability of project/programme outcomes
- effective and transparent use of funds
- the extent to which outcomes support progress towards relevant targets and objectives

The review of the entire Framework links back to the 'assess capacity' step in the Initiation Phase: a revised capacity assessment could form part of the review. It should be stressed that the review does not necessarily have to follow the completion of all previous steps. Indeed, a review can be undertaken at any stage of the Framework (e.g. as part of the monitoring programme).

Huascarán National Park, Peru
Photo credit: Orlando Leon / Unsplash

4 Governance

Governance underpins all aspects of the four Phases of the Framework.[24] There are many frameworks for ecosystem and water governance.[25] One of the most established is the Integrated Water Resources Management (IWRM) approach, which is also monitored through SDG indicator 6.5.1. The IWRM approach is suitable for freshwater ecosystem governance. Governance may be broken down into the following four components[26]:

1. Enabling Environment
2. Institutions and Participation
3. Management Instruments
4. Financing

The 'assess capacity' step in the Initiation Phase provides an opportunity to gain an understanding of the current status of each of these four components, and identify any gaps that may need addressing.[27]

1. **Enabling Environment:** this includes the policies, plans and legal frameworks that contain provisions related to the sustainable management of freshwater ecosystems. This need not be limited to the ministry with primary responsibility for the environment, but may also include other sectors and ministries which depend on, or impact on, ecosystems. The significance of freshwater ecosystems for sustainable development at local, national and even international levels should be recognized. Policies give institutions the mandate to act; plans or programmes lay out the path for achieving sustainable management; and the legal framework ensures that individuals, organizations and companies are held to account and act to support the overall goals and objectives of policies.

   Developing policies and plans are closely linked to the 'set vision and objectives' step in the Initation Phase; relevant stakeholder groups should ideally be given the opportunity to participate in this process. Gathering more information (e.g. from the 'desktop screening' or 'evaluate and report' steps), allows the design of more specific objectives

24 For more information on adaptive management, governance and legal issues, see sections 2.9 and 4.8 of Volume 4.
25 Eeva Primmer, Pekka Jokinen, Malgorzata Blicharska, David N. Barton, Rob Bugter, Marion Potschin, Governance of Ecosystem Services: A framework for empirical analysis, Ecosystem Services, Volume 16, 2015, Pages 158-166, ISSN 2212-0416, http://dx.doi.org/10.1016/j.ecoser.2015.05.002.
26 These components are founded on the main principles of Integrated Water Resources Management (IWRM), and are also reflected in SDG indicator 6.5.1 on IWRM at all levels.
27 For more information on capacity assessment, see Volume 2.

and ecosystem management goals and, in turn, the development of policies and plans to achieve them.

Incorporating aspects of the four-phase Framework into the legal framework can help to ensure that, for example, pressures are reduced, areas of high sensitivity or importance are protected, and that monitoring requirements are fulfilled.

2. **Institutions and Participation:** institutions need to have the mandate and resources to design and implement all aspects of the four-phase Framework. Given the wide variety of sectors that rely on, or may impact on, freshwater ecosystems and the services they provide, cross-sectoral collaboration and integration is a vital element of effective institutional function. As well as ministries with primary responsibility for water and the environment, other sectors that should be involved include those with responsibility for agriculture, energy, land-use management and planning, urban development, socioeconomic development, transport and health. Within the 'water sector', the management of surface water and groundwater is often split between different institutions; it is critical they are coordinated.

   In addition to cross-sectoral (or horizontal) integration, it is important to have institutional capacity at different levels, ranging from the national to subnational levels (such as state or district level), down to the local level, within both government and non-governmental bodies. This is also known as 'vertical integration'. Of particular importance for freshwater ecosystem management is the existence of institutions at the basin level, ensuring that all demands and pressures on particular ecosystems – that may span multiple jurisdictions – are managed holistically. Where basins span national borders, transboundary institutions, or at least mechanisms for transboundary collaboration, should be established.

   Another aspect of horizontal and vertical integration is the effective involvement of relevant stakeholders. This can range from sharing information and inviting inputs from the general public, to working with umbrella organizations representing various interest groups.

   Institutional capacity extends beyond government institutions and includes the education and research sector, and non-governmental and community-based organizations with an interest in freshwater ecosystems. Institutional capacity needs to be underpinned by individual expertise, developed through education, training and experience.[28]

3. **Management Instruments:** These include the tools and activities that enable decision makers and stakeholders to make rational and informed choices between alternative actions, and implement these decisions. They include monitoring programmes to understand the state of freshwater ecosystems and the pressures on them, and plans and programmes to reduce pressures and improve or maintain the target ecological status. These may include educational campaigns, regulations and financial incentives.

   The monitoring programme designed and implemented in the Assessment Phase needs to be backed by institutional and individual capacity, technical resources and infrastructure, and adequate financing.

28 For more information on capacity issues, and professional and institutional competence, see Section 4.8.2 of Volume 4.

4. **Financing:** refers to the financial resources available, including central government budget allocations, fees and tariffs levied on water users, and polluter fees. In addition to these ongoing revenue streams, grants may be available – for example, through donor funding, international organizations, charities or philanthropic funds.

   Budgeting needs to consider the initial set-up costs and the ongoing costs of monitoring and reporting, as well as funding for management responses (Response Phase) such as remediation projects and programmes.

   Monitoring is a recurring expenditure, irrespective of the ecological status of the ecosystems being observed. During the restoration of impaired freshwater ecosystems, monitoring is vital for guiding restoration measures and documenting achievements. Once a freshwater ecosystem is restored, ongoing monitoring is needed to ensure that the ecological status is maintained.

   While the total budget needed for freshwater ecosystem restoration is very difficult to estimate – the costs and schedule for improvement efforts depend on a range of factors including the location, size, severity and duration of deterioration, and the desired target level of ecological status – it is possible to determine reasonable estimates for monitoring expenses.[29]

   Involving 'citizen science' and school classes in monitoring programmes can extend the scope of monitoring and potentially contribute to reducing the costs of individual observations, but cannot replace professional services. For voluntary efforts to be effective, they require expert guidance and support, as well as professional data evaluation, laboratory capacity, archiving and reporting.

29 See section 4.9 of Volume 4.

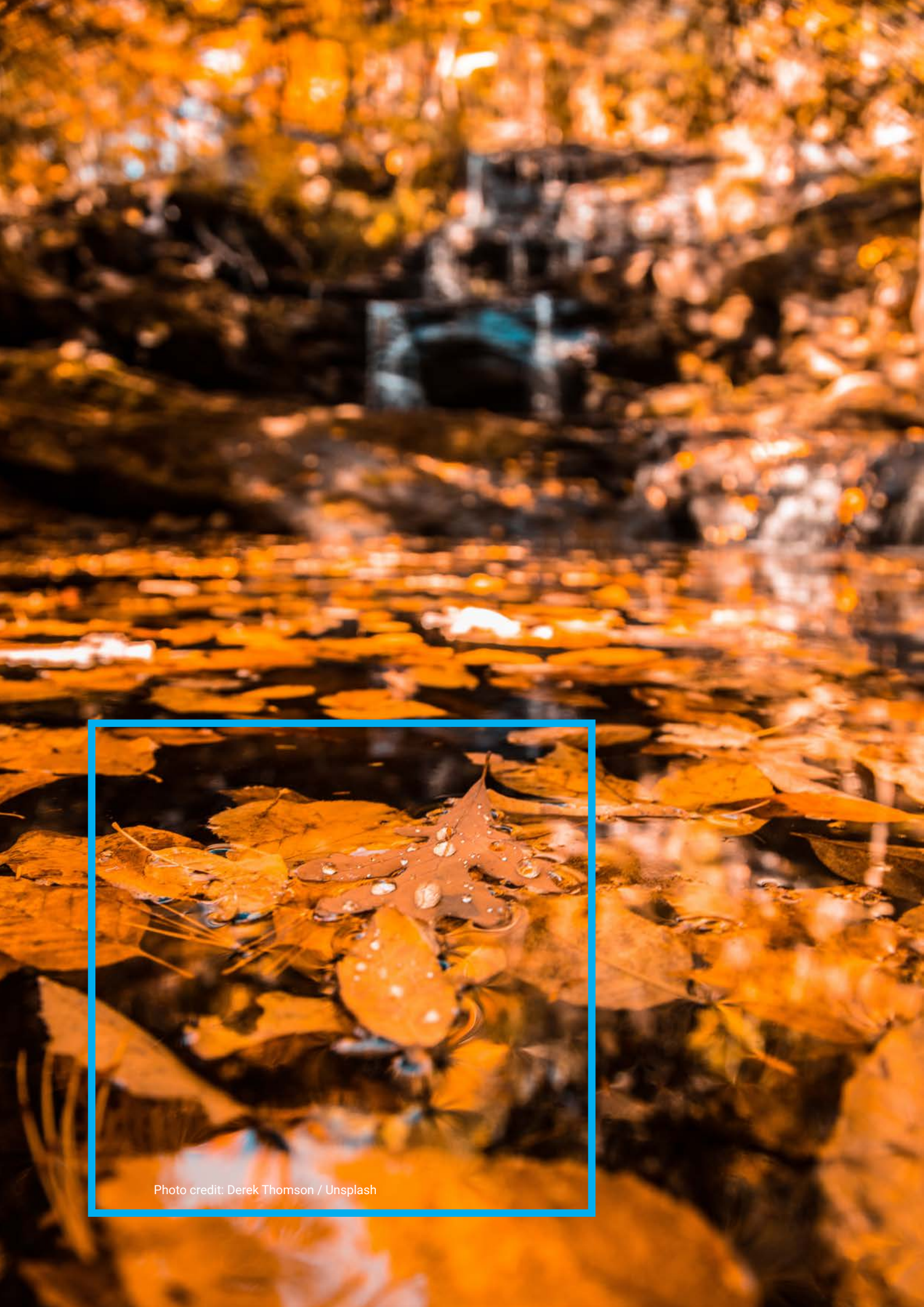


Photo credit: Derek Thomson / Unsplash

5 Summary

Implementing the Framework

This volume presents an overview of a framework (for individual countries) to guide action to sustainably manage freshwater ecosystems. Each country is home to unique ecosystems and places different values on the services they provide depending on their needs and stage of development. Each country also has a unique national system in place for protecting and restoring those ecosystems. Different countries will be at varying stages of implementing their national management plans and will be constrained by their capacity to design and implement them. Recognizing this, this Framework does not prescribe a detailed step-by-step blueprint for all countries to follow. Rather, it provides a holistic, cyclical framework that most countries should be able to relate to. It is hoped that this will inspire action at the country level to design or refine aspects of the Framework that may need improvement. Providing a common, overarching framework that all countries can relate to also helps to facilitate cross-country learning and capacity development.

Using the Publication Series

This document is Volume 1 of UN Environment's Framework for Freshwater Ecosystem Management series. Volume 2, 'A Technical guide for classification and target-setting',[30] expands on some of the steps in the Framework: primarily, designing classification systems in the Initiation Phase and defining ecological status categories, indicator threshold values and management targets in the Assessment Phase. Volumes 1 and 2 are supported by Volume 3, 'Case studies',[31] and underpinned by Voume 4, 'Scientific background for regional consultations on developing water quality guidelines for ecosystems', [32] produced in 2016 uring the early phases of this work.

This series has been developed in response to a request from the UN Environment Governing Council in 2013 to develop voluntary guidelines for ecosystems that could support the development of national standards, policies and frameworks.[33] This has subsequently been expanded to take into account the targets in the 2030 Agenda for Sustainable Development and feedback from countries (which suggested a framework rather than a set of water quality guidelines). There is opportunity to develop additional volumes to expand on various parts of the Framework in the future. The focus of these should address demand from countries and regional counterparts for further information.

30 UN Environment 2017. A Framework for Freshwater Ecosystems Management. Volume 2: Technical guide for classification and target-setting.
31 Available online at: www.unenvironment.org/water
32 UN Environment 2017. A Framework for Freshwater Ecosystem: Volume 3 - Scientific background for regional consultations on developing water quality guidelines for ecosystems.
33 Decision 27/3, February 2013. The UN Environment Assembly was formerly the UNEP Governing Council.

This series supports countries to achieve relevant global political targets, including several Aichi Biodiversity Targets under the Convention on Biological Diversity, and the Sustainable Development Goals (SDGs). The most relevant SDG targets are 6.6 (protecting and restoring freshwater ecosystems) and 6.3 (reducing pollution and improving ambient water quality). It does not replace detailed guidance on reporting on the respective global indicators.

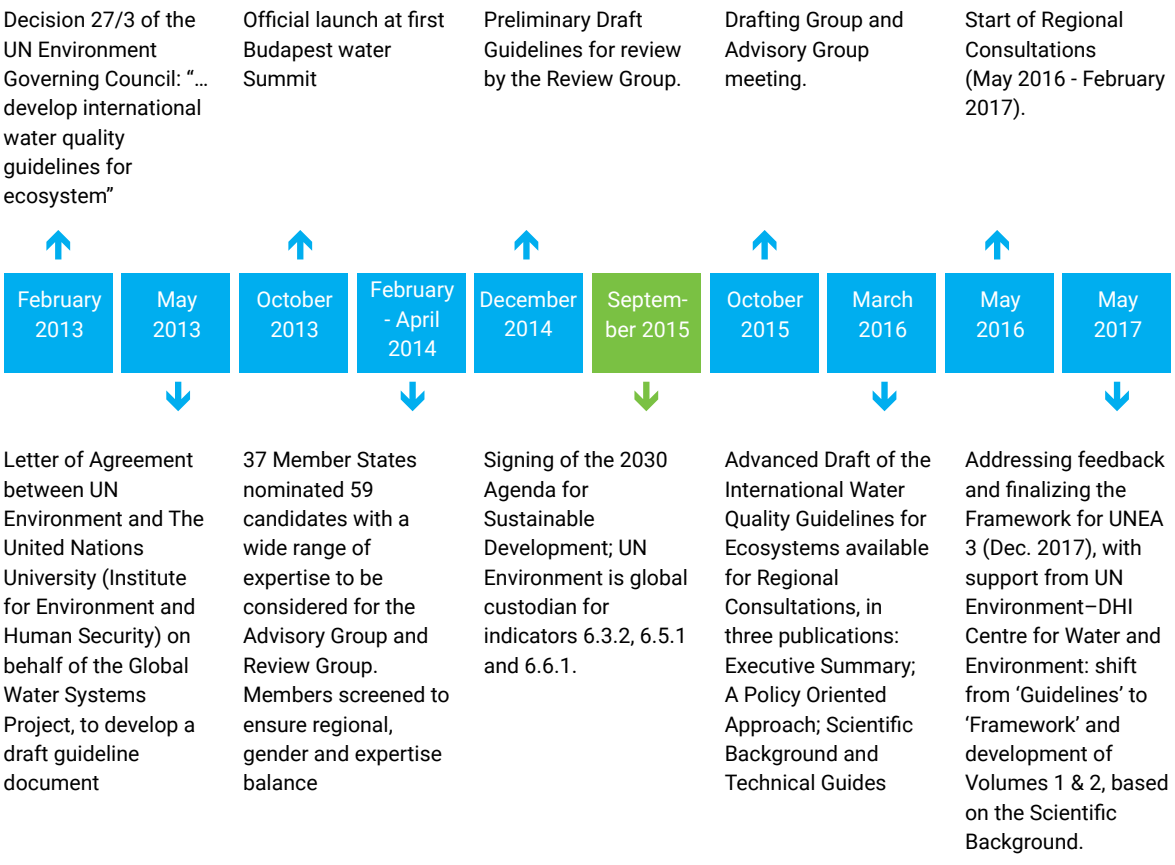
This series supports UN Environment's Freshwater Strategy for 2017-2021 and complements related initiatives such as the Sub-Global Assessment Network, which supports a common platform for ecosystem assessment practitioners at sub-global scales (regional, subregional, national, subnational) with the aim of building capacity.[34]

34 http://www.ecosystemassessments.net

Bi Peng Gou, China
Photo credit: Arnaud Jaegers / Unsplash

Annex 1

Process of Developing the Framework for Freshwater Ecosystem Management



Annex 2

Acknowledgements for Developing the 'Scientific background'

Volume 1 builds heavily on Volume 4, 'Scientific background for regional consultation for developing water quality guidelines for ecosystems'. As shown in Annex 1, Volume 4 was developed over several years and involved a number of institutions and individuals.

Developing the Scientific Background for Regional Consultation (2013 - March 2016)

Individuals involved are listed in alphabetical order below.

Editorial Team: United Nations University – Institute for Environment and Human Security (UNU-EHS): Mr Janos Bogardi, Mr Fabrice Renaud, Ms Zita Sebesvari, Ms Nike Sommerwerk, Ms Yvonne Walz; supported by Ms Aarti Basnyat, Ms Susanne Haas, Ms Janine Kandel, Ms Aileen Orate, Ms Mariko Shimazu and Ms Sijia Yi.

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Advisory Group (AG). The members of the AG were nominated by Member States of the United Nations Environmental Assembly and invited by UNEP to critically review, advise and contribute to the subsequent draft versions of the reports. Members, in alphabetical order of countries, were: Mr Mehmed Cero (Bosnia and Herzegovina), Ms Monica Porto (Brazil), Mr Chazhong Ge (China), Ms Nassere Kaba (Côte d'Ivoire), Mr Harry Liiv (Estonia), Ms Marta Moren Abat (European Commission), Mr Fritz Holzwarth (Germany), Mr Sabah Obaid Hamad Al-Shujairi (Iraq), Ms Deborah Chapman (Ireland), Ms In Ae Huh (Republic of Korea), Mr Mohamed Salem Hamouda (Libya), Mr Tahir Malik (Pakistan), Ms Elena Dumitru (Romania), Ms Jarmila Makovinská (Slovakia), Mr Yakup Karaaslan (Turkey), Mr Simon Etimu (Uganda), Ms Nadhifa Kemikimba (United Republic of Tanzania), Ms Sasha Koo-Oshima (United States of America), Ms Nyaradzayi Anna Mawango (Zimbabwe).

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Regional Consultation (May 2016 – February 2017)

During the regional consultation period (May 2016 to February 2017), side events were held at five global and regional conferences and meetings, with participants from over 20 countries. In addition, representatives from over 40 countries were invited to review either the main 'Scientific background', or the supporting documents (Executive Summary and 'A policy oriented approach'). Feedback was gratefully received from participants during the side events, and written submissions were received from the following individuals:
Damien Nindorera, Ministry of Water, Environment, Land and Urban Planning, Burundi; Mojtaba Ardestani, University of Tehran, Iran; Deborah Chapman (University of Cork, Ireland); Ronald Roopnarine, University of The West Indies, Trinidad and Tobago; Emília Mišíková Elexová and Jarmila Makovinská, Water Research Institute, Slovakia; Yakup Karaaslan, Ministry of Forestry and Water Affairs, Turkey; Sasha Koo-Oshima, US Environmental Protection Agency, United States of America; Nyaradzayi Anna Mawango, Advisory Council for Development of Guidelines, Zimbabwe.

Notes

Freshwater ecosystems such as wetlands, rivers, and lakes are indispensable for life on our planet and vital for directly ensuring a range of benefits and services fundamental to the environment, society and the economy.

However, they face serious pressures which affect their ability to provide those services, such as pollution, over-extraction and encroachment from urban and agricultural development.

One of the main challenges in managing freshwater ecosystems lies in finding the balance between short-term socioeconomic development objectives and the need to protect and restore freshwater ecosystems to support more sustainable, long-term socioeconomic wellbeing.

UN Environment has developed a publication series entitled 'A Framework for Freshwater Ecosystem Management'. The main aim of the series is to support countries to sustainably manage freshwater ecosystems. In doing so, it supports national and international goals related to freshwater ecosystems, such as certain Aichi Biodiversity Targets and Sustainable Development Goal (SDG) targets. The series currently consists of four volumes:

- Volume 1: Overview and guide for country implementation
- Volume 2: Technical guide for classification and target-setting
- Volume 3: Case studies
- Volume 4: Scientific background for regional consultations on developing water quality guidelines for ecosystems

This volume, 'Overview and guide for country implementation', provides an overview of the Framework, and places it in the context of supporting Agenda 2030. It is intended for a wide audience, including decision makers, practitioners, scientists, non-governmental organizations and the general public.

UN environment