WEATHER CLIMATE WATER

World Meteorological Organization

WORLD METEOROLOGICAL CONGRESS

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Submitted by:
President

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APPROVED

AGENDA ITEM 3: **WMO SUPPORT TO GLOBAL WATER AGENDA**

AGENDA ITEM 3.1: **Hydrology in the twenty-first century - WMO strategy and plan of action**

WMO VISION AND STRATEGY FOR HYDROLOGY AND ITS ASSOCIATED PLAN OF ACTION

DRAFT RESOLUTION

Draft Resolution 3.1/1 (Cg-Ext(2021))

WMO Vision and Strategy for Hydrology and its associated Plan of Action

THE WORLD METEOROLOGICAL CONGRESS,

Recalling:

(1) Resolution 24 (Cg-18) - Vision, strategy and organizational arrangements for hydrology and water resources in WMO, which requested the Executive Council to develop, with the support of the Hydrological Coordination Panel (HCP), a Plan of Action for hydrology that will support Member states' efforts to fulfil the eight WMO long-term ambitions, for consideration of an extraordinary session of Congress in 2021 (Cg-Ext(2021));

(2) Resolution 5 (EC-71) - Hydrological Coordination Panel, which in the Terms of Reference of HCP requested to develop the Vision and Strategy for Hydrology and its associated Plan of Action, to be reviewed by EC-72 in 2020 and submitted for consideration to the extraordinary session of Congress in 2021,

Having examined Recommendation 2 (EC-73) - WMO Vision and Strategy for hydrology and its associated Plan of Action,

Having also examined the recommendations by the Hydrological Assembly, contained in Cg-Ext(2021)/INF. 3.1(2)*],*

Decides to adopt the WMO Vision and Strategy for Hydrology and its associated Action Plan included in the annex to this resolution;

Takes note that several elements of the Action Plan are already in an advanced state of implementation, as detailed in Resolution 3.1(2) (Cg-Ext(2021));

Invites Members to become acquainted with the content of the Action Plan to determine how they can benefit from and contribute to its implementation;

Requests presidents of technical commissions and the Chair of the Research Board to review the proposed activities for alignment of the Plan of Action with the work plans of the technical commissions and the Research Board;

Requests president of INFCOM to prepare a concept note in consultation with HCP allowing the incorporation of hydrological and cryosphere data into GBON. Such a concept note could include considerations around data prioritization and potential funding considerations and should be presented to EC-75 in 2022;

Requests the regional associations to promote hydrological activities contributing to the Action Plan and to develop, with the assistance of HCP, regional action plans for hydrology as part of their regional operating plans to contribute to fulfilling the eight WMO long-term ambitions;

Requests the Secretary-General to widely disseminate the WMO Vision and Strategy for Hydrology and its associated Action Plan to all Members, international partner organizations, and other relevant public, private and academic sector organizations;

Requests also that the presidents of the Services and Infrastructure Commissions, the Chair of the Research Board, the presidents of Regional Associations, the Chair of the Hydrological Coordination Panel, based on the advice of the Regional Hydrological Advisers and with the support of the Secretariat, ensure that the outputs of the quarterly regional fora of Hydrological Advisers of relevance to their programmes, activities and initiatives, are appropriately integrated into the workplans and priorities of the bodies they lead, as well as in the extra-budgetary projects supported by WMO;

Invites the United Nations, the United Nation System organizations, other partner international organizations and relevant public, private and academic institutions, to consolidate their actions in support to the implementation of the WMO Vision and Strategy for Hydrology and its associated Action Plan, recognizing it as a fundamental and necessary building block in fulfilling the objectives of the Sustainable Development Agenda.

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Annex: 1

Annex to draft Resolution 3.1/1 (Cg-Ext(2021))

VISION AND STRATEGY FOR HYDROLOGY AND ASSOCIATED PLAN OF ACTION

About this document

The Eighteenth World Meteorological Congress (Cg-18) approved eight long-term ambitions to address the global water challenge and decided to develop a Vision and Strategy on Hydrology and Associated Plan of Action (Resolution 24 (Cg-18) - Vision, Strategy and Organizational Arrangements for Hydrology and Water Resources in WMO) to fulfil those ambitions. EC-71 requested the Hydrological Coordination Panel (HCP) to develop such a Strategy and Action Plan which Cg-18 called on Cg-Ext(2021) to approve.

HCP-1 prepared a draft Vision and Strategy and an annotated table of contents of the Plan of Action and submitted it for adoption to EC-72 in September 2020.

In September and October 2020, an open online consultation was held to identify Members' needs and gaps as inputs to the identification of activities needed to achieve the eight long-term ambitions for operational hydrology (Resolution 24 Cg-18).

HCP-2, held in November 2020, established drafting groups on identified action areas to propose detailed lists of activities to be included in the Plan of Action. In February 2021, HCP met virtually to review outputs from drafting groups. Based on additional comments from HCP members and invited experts, a first draft for consultations on priorities and risks was compiled.

The second online open consultation was held from 19 April to 31 May 2021 and comments received were incorporated to the text and tables of action.

The resulting final draft document is structured in two major parts, three annexes and an appendix.

Part I includes the definition of Vision and Strategy, which was based on the Preliminary Vision and Strategy for Hydrology developed by the High-level Task Force on Water in February 2019. It had been presented to EC-72 in September 2020. All comments received prior and during EC-72 were considered. Those that proposed changes in the parts already approved in other documents by Cg-18 and CHy-Ext. 2019 were rejected, all others were incorporated to the extent possible to the current version of the document (Part I).

Part II presents the Plan of Action as developed by drafting groups, reviewed by the HCP in February 2021 and including the comments received via the second online open consultation.

Annex I contains the detailed tables of activities contributing to the achievement of each ambition. A logical framework methodology was used to design a holistically consistent structure of goals, outcomes that lead to achievement of these goals, outputs that together will materialize into desirable outcomes, and finally activities through which outputs will be delivered.

Annex II contains a mapping of the Vision and Strategy on to the WMO Strategic Plan and of the Plan of Action on to the WMO Operating Plan.

Annex II includes background material intended to make this a self-contained document.

The appendix contains a list of acronyms used in the document and their meaning.

TABLE OF CONTENTS

PART I: VISION AND STRATEGY

1. VISION STATEMENT

By 2030 a cooperative global community is successfully addressing the growing challenges related to hydrological extremes, water availability and quality, and food security, by advancing operational hydrology through enhanced science, infrastructure, capacity-building and related services, in the context of sustainable development and enhanced resilience.

2. CONTEXT, CHALLENGES AND DRIVERS OF CHANGE (FACTORS)

2.1 Water is essential for life, environmental protection, sustainable development, and international peace and security. Stakeholders, policy and decision-makers at all levels of government and society require enhanced and actionable water information across all space and timescales (transboundary to national to local and minutes to years) to inform efforts to save lives and protect livelihoods, to enhance global economic prosperity and societal well-being. Specific high-level requirements include:

- Policy and decision-making that contribute to the achievement of the Sustainable Development Goals related to water;
- Real time management of flood and drought events and integrated flood and drought management in support to Multi-Hazard Early Warning Systems (MHEWS);
- Integrated water resources management in national and transboundary catchments;
- As regards civil engineering, for design and management of infrastructure;
- As regards agriculture, for decisions on agrotechnical practices, drainage and irrigation schemes and management;
- Ecosystem management;
- Academic support for climate and hydrological regime studies, trend analysis, decision support systems.

2.2 Stakeholders also require an efficient and sustainable coordination of the value chain[1] for the provision of operational hydrology, both across hydrological science, climatology, meteorology and related domains, but also across governments, other United Nations (UN) Organizations and other international bodies, as well as the private sector and the many non-governmental Organizations (NGOs) that work to implement water risk management and to link sustainable development with water management.

2.3 Perception of water-related risks due to their far-reaching impacts have evolved to include political, economic, social demographic, and technological, as well as environmental risks and drivers in their full complexity. Activities of WMO in operational hydrology will be

[1] A value chain is a business model that describes the full range of activities needed to create a product or service. For hydrological services, a value chain comprises the steps that involve network design and maintenance, in-situ observation of hydrological parameters, data transmission, quality control, sharing and archiving, design, testing and delivery of products and services for the users in the field of water management, disaster risk management, navigation, health, agriculture and others. The purpose of a value-chain analysis and coordination is to increase efficiency so that a hydrological service can deliver maximum value.

focused on the development of new capabilities to deliver actionable information which informs and mitigates these water-related challenges.

Political and Institutional

(a) Considerable fragmentation exists among many water sector players. This is true for institutions concerned with water governance, science, research, as well as operational service provision at the national level. This fragmentation is mirrored in a multifaceted community of regional and international entities including NGOs, research associations/programmes and UN Organizations, where the UN-Water coordination mechanism has been implemented to ensure coordination in response to water-related challenges;

(b) Recent criticism of some aspects of multilateralism show the need for increased alignment and support among Member States, international development banks, donor agencies. New specific initiatives are needed, requiring a clear business case analysis to quantify the value proposition of enhanced hydrologic services worldwide;

(c) A variety of international agendas addressing disaster risk reduction (DRR); development, climate change adaptation and regional cooperation and peace, such as the Sendai Framework for DRR, the Sustainable Development Goals, the United Nations Framework Convention on Climate Change (UNFCCC) process, and others depend, in various aspects, on hydrology, and require adequate support from the operational hydrology community, which needs to be also adequately recognized and supported;

(d) The availability of an increasingly diverse spectrum of 'non-authoritative' sources of information will create competition in the attention of economy for public agency data and has the capacity to undermine public trust and create confusion, preventing appropriate actions;

(e) The WMO reform, while engendering some risks associated with organizational change, affords the opportunity for increased participation and influence of hydrologists within and across the WMO structure, programmes and activities;

(f) Hydrology is transboundary and regional in nature. While NHSs need to build their own competency/capacity in the field of operational hydrology, Members are encouraged to share data and forecast capabilities across jurisdictional boundaries in partnership with River Basin Commissions and other organizations as appropriate.

Economic

(a) There are increasing and competing demands for limited water resources to support a spectrum of industrial, environmental, navigational, recreational, agricultural, and municipal uses. Population growth and economic development, particularly in flood and drought prone regions, are stressing water supplies and increasing vulnerability;

(b) The economic and societal impacts of flood and drought are increasing, as demonstrated by annual upward trends in flood and drought loss data, highlighting the need for increased investment in development and sustainability of early warning systems (including monitoring networks), disaster preparedness and integrated management for extreme water events, as well as other hydrologic services;

(c) Slowing economic growth and limited budgetary resources accentuate the need for innovation and creativity;

(d) A deteriorating global water infrastructure is forcing critical, expensive decisions;

(e) Slow-onset disasters provide a specific set of challenges, creating economic conditions that widen inequality and severely affecting the most vulnerable populations. At the same time, such disasters also create opportunities for early interventions and mitigation before the most serious impacts are realized;

(f) Technological development, globalization, and continuing implementation of an open data policy is opening the hydrometeorological services market to new players, increasing competition and menacing the single voice principle[2] on one hand, but enhancing the potential for public-private partnership on the other;

(g) There is an increased need for the quantification, understanding, and communication of uncertainty and risk on all timescales, to better support investments in community resiliency, mitigation, response and recovery.

Socio-cultural, demographic

(a) The gender imbalance in hydrology must be addressed from the perspectives of equality and poverty alleviation;

(b) An ageing workforce gives rise to the potential loss of experience and expertise, requiring an increased emphasis on engaging, recruiting and developing the next generation of hydrologists. As the new generation enters the discipline, opportunities to exploit new ideas and fresh approaches can be realized, particularly regarding the use of emerging technologies, including citizen science via social or other media;

(c) Demographic development, such as population growth, ageing of population, or urbanization in different parts of the world changes the potential impacts of hydrological hazards through increased exposure and changed vulnerabilities of society;

(d) There are likely to be changes in peoples' perception of information and modes of communication leading to new ways of providing actionable warnings and information to the general public;

(e) Hydrological services are particularly vulnerable to emergency situations affecting society, as the COVID-19 pandemic demonstrated.

Technological

(a) The emerging convergence of disciplines around the Earth system prediction will offer new frameworks and opportunities for the meteorological, hydrological/terrestrial, ocean, and cryospheric communities to strengthen their cooperation to deliver information, products and services responding to the need of a vast array of stakeholders. The development of a seamless Earth system modelling capability should enable a quantum leap forward in operational hydrological prediction;

(b) Satellite and ground-based remote sensing is becoming an operational tool for hydrology and water resources providing a variety of new products with increasing accuracy, resolution and coverage. NHSs will need increased access to and competency in the use of remote sensing as a part of the observation system of the future;

[2] It is noted that some private sector involvement may carry risks of multiple voices and messages, some of which may include different motivations. NHSs may need support in formulating policies to deal with such issues.

(c) There is a need for increased development and utilization of more physically based modelling approaches to address non-stationarity of the climate system and land-use changes;

(d) Enhancements of artificial intelligence might open doors for wider use of machine-learning approaches in modelling and forecasting;

(e) Advances in observations and modelling and the rapid expansion of data and information, also through crowd sourcing and citizen science initiatives, present both opportunities and challenges to leverage new data assimilation techniques, big data analytics, and advanced dissemination and communication capabilities;

(f) The deployment of new technologies creates opportunities for increased knowledge and understanding and the development of authentically new hydrologic services but presents immediate challenges with regard to long-term operation and maintenance.

Environmental

(a) The Intergovernmental Panel on Climate Change (IPCC) in its fifth Assessment Report states that in many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality (medium confidence);

(b) While there is low confidence that anthropogenic climate change has affected the frequency and magnitude of fluvial floods and droughts on a global scale, this is due to the current lack of observation and trend analysis possibilities of extreme events (IPCC, AR5);

(c) Changes in precipitation in a warming world will not be uniform. In many mid-latitude and subtropical dry regions, mean precipitation will likely decrease, while in many mid-latitude wet regions, mean precipitation will likely increase under the RCP8.5 scenario. Globally, it is likely that the area encompassed by monsoon systems will increase, monsoon precipitation is likely to intensify and El Niño-Southern Oscillation (ENSO)-related precipitation variability on regional scales will likely intensify (IPCC, AR5);

(d) Sea-level rise has resulted in an increase in coastal inundation events, especially exacerbated during high tides, and coastal systems and low-lying areas will increasingly experience submergence, flooding and erosion throughout the twenty-first century and beyond, due to sea level rise (IPCC, AR5). Coastal communities are exposed to multiple climate-related hazards, including tropical cyclones, extreme sea levels and flooding, marine heatwaves, sea ice loss, and permafrost thaw. Extreme sea levels and coastal hazards will be exacerbated by projected increases in tropical cyclone intensity and precipitation (IPCC, SROCC).

2.4 The World Economic Forum has consistently highlighted the high impact and likelihood of weather and water-related events; water is increasingly being identified as one of the highest global risks in terms of impact. Addressing water issues involves consideration of both risks and opportunities: WMO is committed to taking a programmatic approach that will focus on advancing the end-to-end processes for operational hydrology, thus maximizing benefits to Members while minimizing risks.

3. LONG-TERM AMBITIONS

In response to these challenges and drivers of change, the WMO has identified the following eight long-term ambitions designed to yield societal benefits:

- No one is surprised by a flood
- Everyone is prepared for drought
- Hydro-climate and meteorological data support the food security agenda
- High-quality data supports science
- Science provides a sound basis for operational hydrology
- We have a thorough knowledge of the water resources of our world
- Sustainable development is supported by hydrological information
- Water quality is known.

4. GUIDING PRINCIPLES

- Hydrological data and products are a global public good: free and unrestricted access to public and private high-quality hydrological data and products for all.
- Interoperability is key to improved services: related disciplines, data, models, and risk management systems across all scales need to be interoperable and connected wherever it improves our analysis and optimization capabilities.
- Innovation and technology bring opportunities for operational hydrology: established systems which will benefit from new sources of information and new methods of data processing; using the full potential of the digital revolution will improve science and operations in hydrology.
- Hydrological Services provide public benefits: Hydrological Services are recognized as being of high priority and of public interest having clearly defined roles and responsibilities and sustainable financing.
- Partnerships help to enhance delivery: new actors and partners are incorporated along the hydrological value chain from data to product/service.
- All aspects of the water cycle are interconnected: water quality and quantity issues must be addressed in an integrated, holistic way, following the principles of Integrated Water Resources Management (IWRM).
- The weather-water-climate system requires an integrated Earth system approach across multiple temporal and spatial scales: the progress of terrestrial hydrological science and prediction is enhanced significantly through integration with atmosphere, cryosphere, and ocean and coastal processes, recognizing the water cycle itself is the natural connection point for the integration of these basic sciences.

5. CONDITIONS FOR SUCCESS

5.1 The conditions needed for successful achievement of the long-term ambitions include the following:

- The capabilities of national and regional hydrological entities need to be known;
- A comprehensive monitoring of capabilities needs to be agreed and put into routine operation;
- The value chains from hydrological data to products/services must be clear;
- The products and services needed must be defined at local, national and regional level and examples championed by WMO can serve as starting points to design the necessary links in the value chains;
- Capacity issues must be expressed and addressed;
- Capacity gaps with regard to data and products should be analysed and activities linked to developing the necessary value chains harmonized with those linked to capacity-building;
- Cooperation should be wanted and supported;
- Cooperation must be focused and based on a common understanding so that the entire system benefits equally;
- Policies should reflect the fact that economic development is predicated on adequate hydrological infrastructure. The actions of national policymakers should demonstrate that hydrological data and products are essential to economic prosperity and societal well-being.

5.2 Free and unrestricted data policy shall be promoted among Members, including consistent methods for measuring and reporting water use.

PART II: ACTION PLAN

1. PURPOSE

WMO Members/NHMS/UN organizations responsible for other water programmes will collaborate under this Action Plan to implement a strategic suite of enhanced services for operational hydrology to be supported by WMO in the period 2022–2030, to achieve the Long-Term Ambitions (LTA) (see Part I – Section 3), thus significantly improving the capacity of National Hydrologic Services to deliver enhanced products and services based on cutting edge science and technology.

2. OUTPUTS AND ACTIVITIES BY AMBITION

The Eighteenth World Meteorological Congress (Cg-18) in 2019 approved eight LTA that should guide the development of WMO activities relevant to water. Each ambition represents a goal that society aims to achieve in the frameworks of sustainable development and disaster risk management. The following section presents major outcomes necessary to reach each of the ambitions and lists all identified contributing outputs.

2.1 Cross-cutting issues

"Little will be done, if the National Hydrological Service is not fully responding to its goals and objectives due to lack of finance, lack of professional staff, insufficient equipment, and more". Michael Maehaka, consultation on needs and gaps.

2.1.1 Gaps identification and consultations made during the preparation of this Action Plan revealed that some issues are of a clearly cross-cutting nature and are prerequisites to achieve any of the eight long/term ambitions. These issues are related mainly to the functioning of National Hydrological Services, including their visibility, financing, sustainability, governance and management. Unfortunately, in some parts of the world, the responsible agencies struggle to maintain long-term monitoring due to limited financial resources leading to patchy (or no) data. But it is essential to understand the water cycle globally, regionally and locally, which requires permanent operational observations of various hydrological variables within a holistic understanding of the Earth system. The gaps related to targeted research needs to improve operational hydrology are addressed in the Hydrological Research Strategy developed by the Research Board, which underpins this whole Action Plan and will be implemented in conjunction with it.

2.1.2 There is a need to extend the outputs and activities to enhance the visibility of NHSs with their respective governments to ensure recognition and sustainability (adequacy) of budget allocations for hydrological services. At the same time, sustainability of operations (including monitoring networks, capacity-building, personnel stability and training) was identified as a clear prerequisite for any operation and service delivery.

2.1.3 Hand in hand with political recognition comes also the data policy set up. Monitoring, observation and data sharing has been identified as a critical component of National Meteorological and Hydrological Services (NMHSs) operations that needs to be enhanced to deliver the majority of outcomes identified bellow. Downstream and upstream countries in a transboundary basin are in an asymmetric position with respect to data exchange, with downstream countries requiring hydrological data as well as forecasting products from the upstream countries. On top of that, hydrological/water resources data are sometimes considered to be strategic information and possible subject of international disputes over water impacts. In such a case, the decision on data policy is not at the level of Line Agencies such as National Hydrological Service, but at a higher governmental level.

2.1.4 Besides policy issues, technical (easy to use and maintain) capability to effectively exchange data might be a limiting factor in international data sharing (communication links, servers, protocols implemented).

2.1.5 At the same time, involvement of the hydrological community remains limited in particular as regards integrated programmes and activities of WMO like the WMO Information System (WIS)/ the WMO Integrated Global Observing System (WIGOS), Global Data-processing and Forecasting System (GDPFS), Global Climate Observing System (GCOS), etc.

2.1.6 On the other hand, the cooperation of WMO and its programmes with the International Network of Basin Organizations and individual River Basin Organizations remains underexploited.

2.1.7 Therefore, the following outcomes are proposed to support all eight LTA.

Outcomes:

(1) National Hydrological Services operations are sustainable and visible for societies and governments, and the benefits provided are recognized and valued;
(2) The financing schemes of hydrological services are improved to ensure operational sustainability and attractiveness for professional staff;
(3) There is increased sharing of hydrometeorological data for operational hydrology on a free and unrestricted basis across political borders;
(4) There is increased involvement of hydrological communities of Members in the global activities of WMO and greater consequential benefits to national scale services;
(5) There is increased involvement by and cooperation with private sector entities which are responsible for the hydrological operations of their own facilities and do not always share their data (e.g. hydropower).

Metrics: Success in this outcome will be measured by:

(1) Number of Members reporting through the Country Profile Database a sustainable financial (budgeting) situation for their core operations;
(2) Number of stations registered by Members in the reference hydrological network and sharing data;
(3) Number of Members providing operational and historical data and products to the WMO Hydrological Observing System (WHOS) (phase II);
(4) Number of experts registered in the WMO Expert Network with hydrological skills;
(5) Number of experts with hydrology expertise involved in the working structures of technical commissions and regional associations.

Outputs:

A.1 Increased presentation/communication and understanding of value proposition, benefits and risk analysis, and value of hydrological services to foster understanding by ministries and governments

2.1.8 The Hydrological Assembly presents an opportunity for representatives of the hydrological community to participate actively in the strategic work of the organization. NMHSs will be supported to engage with politicians and better describe the value of NMHSs by organizing Regional Associations High-Level Forums, leader's coalition and by provision of communication materials and toolkits.

A.2 Increased management skills of NHSs managers (including middle and lower management managers) supports the effectiveness and development of NHSs

2.1.9 Capacity-building activities for top and middle management of NMHSs will be prepared including guidelines development, training courses, targeted twinning projects and promotion activities.

A.3 Enhanced regional cooperation, planning and implementation of NMHS-led activities

2.1.10 Regional Associations hydrological activities (e.g. Hydrological Forums) and support to other technical symposia will be organized to coordinate on regional hydrological requirements.

A.4 Enhanced customer orientation and better marketing skills generates better services and products with higher added value

2.1.11 Targeting customer orientation skills of the NMHSs through training materials and case studies will help to establish better services, build tighter connections with and increase satisfaction of users of products and services.

A.5 The end-users of hydrological information/data have a clear understanding of what the data means and its relative (un)certainty

2.1.12 Developing of unified communication standards for hydrological information based on definition of guidelines and regulatory material to ensure that communication is based on uptake requirements defined by end-users. This will include the communication of uncertainty.

A.6 Institutional development plans and monitoring network development programmes are in place and implemented taking into account the catalogue of products and services

2.1.13 Planning of development and operation will help achieving sustainability of observations and services provided by the NMHSs. Hydrological services providers will have the tools to plan and build hydrological networks that can grow/adapt as needs and resources changes are indicated by targeted research. Guidelines on hydrological monitoring network design, implementation and maintenance will be available.

A.7 Enhanced resource mobilization (increased expertise, financial resources, establishment of partnerships) for capacity building, technical assistance, training of personnel and sustainability of End to End Multi-Hazard Early Warning Systems (E2E MHEWS), flood, drought and water resources management

2.1.14 Project proposals development will be supported by a framework mechanism to sponsor development initiatives through provision of Reimbursable Advisory Services via the WMO/Global Water Partnership (GWP) Associated Programme on Flood Management (APFM) and Integrated Drought Management Programme (IDMP) Helpdesks, Regional offices and in cooperation with other partners.

A.8 Sustainable projects helps build capacities of NHSs

2.1.15 Capacity development projects in monitoring and data assessment will be coordinated across UN bodies and build to support achievement of the eight LTA. Sustainability of projects will be supported by the Systematic Observations Financing Facility (SOFF), use of local resources to maintain equipment, standardization and use of open platforms, and interoperability of equipment.

A.9 Effective and efficient, low-cost methods for hydrological observations are broadly available

2.1.16 Guidance will be developed on how to amplify the information through citizen science, proxy data, and innovation. HydroHub Innovation hub will stimulate development and deployment of low-cost technologies for hydrometric monitoring.

A.10 Increased involvement and enhanced cooperation with the private sector supports Members' flood, drought and water resources management

2.1.17 Examples of success stories will be compiled to demonstrate possibilities and models of mutually beneficial cooperation between public and private partners in the field of hydrological data monitoring and sharing and products and services co-production in support of flood, drought and water resources management.

A.11 Increased availability and national and international exchange and use of hydrometeorological data for operational flood forecasting and early warning purposes and enhanced international cooperation in flood and water resources management, especially for transboundary basins

2.1.18 To support the implementation of the WMO Unified Policy for the International Exchange of Earth System Data, a network of reference observation stations will be established from which Members commit themselves to mandatorily share the data leading to the future inclusion of hydrology and cryosphere data in the Global Basic Observing Network (GBON). WHOS will be further implemented for sharing of operational and historical data among Members including demonstration projects on additional types of data (e.g. forecast products from various producers).

A.12 The operational hydrology community at the national scale knows how to access global and regional products, services and tools and actively participates in the activities of the WMO community.

2.1.19 Overcoming the input obstacles for hydrologists to WMO activities will be done by developing a "Welcome portal" including explanation of the benefits for NHSs to become an active part of the WMO family.

Ongoing activities

2.1.20 Given the cross-cutting nature of the above-listed outputs for enhancement of sustainability of NHSs and increased data sharing, many of the ongoing hydrological activities need to be continued and intensified to achieve the long-term ambitions. **Capacity-building in hydrology and water management** and capacity development through projects supported by **the Associated Programme on Flood Management (APFM)** and **IDMP** programmes will be critical to succeed. Governance of NHSs and their effective operation to deliver high value users-oriented products and services needs to be framed by the principles of the **Quality Management Framework – Hydrology**. At the same time, the development of observation networks and data sharing demands the continuing advancement of **Hydrological data operations and management** through implementation of **WHOS** and intensified use of **The Global Hydrometry Support Facility (HydroHub)** to stimulate development of technology and methods of observation and data processing.

Assumptions and risks

2.1.21 We assume that preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies, and that emphasis will be put on the management of hydrological services and on providing high-quality data, products and services in the field of operational hydrology.

We further assume that the WMO reform will create a reliable and viable platform for hydrologists to meet and cooperate on operational hydrology issues and affect the strategic and operational activities of the Organization.

Additionally, the activities proposed assume the implementation of the new unified data policy of WMO, including the involvement of private sector.

Possible risks are:

- Change in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda;
- Lack of alignment with other activities in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, UNECE-Water Convention) leads to competition for the attention of governments and hydrological experts;
- Technological innovations might change ways of delivering products and services currently provided by national hydrological services and might change the market in the field of operational hydrology;
- NHSs do not recognize the increase of management skills to be an important factor in the operation and development of services (due to a preference for operational issues only, or internal, cultural conditions and other external conditions);
- Skills drain of NHSs to better (paid and supported) positions in private entities (e.g. water boards, water agencies, hydropower operators);
- Loss of income to NHSs due to open (no-cost) data sharing (seen as a threat to the funding sources of NHSs);
- Replacement of technology of long-term observing stations may cause inhomogeneity in time series;
- Perception of marginalization of hydrological issues in implementing the Earth system approach may arise if hydrological requirements are not considered adequately in the work of various WMO bodies;
- Differing interests of private and public partners causes asymmetry in cooperation.

2.2 Ambition/goal: No one is surprised by a flood

"Lack of trained people and good hydrological monitoring network is the biggest gap in the process of creating flood forecasting and warning service".
Vasko Stojov, consultation on needs and gaps.

2.2.1 Floods represent a major hydrometeorological hazard from the point of view of the number of affected people. While the total economic damage caused by floods has tended to increase, flood early warning systems have proved to be an effective tool to decrease the numbers of fatalities. Increased understanding of flood hazard and risk and its changes, flood forecasting and warning have enhanced the preparedness and response capacities of nations and communities. The modern concept of early warning system comprises components of risk knowledge, monitoring and warning, dissemination and response capability reaching beyond delivering warning information, to improve its effective use for action.

2.2.2 Further strengthening of Members' early warning systems for floods and their adaptation to climate and societal drivers is necessary to be prepared for future floods and changes in flood hazard and flood risk.

Outcomes:

(a) Impact-based end-to-end Early Warning Systems (EWS) for flood forecasting in the context of a broader integrated flood management strategy implemented by Members;

(b) Public, communities and businesses have enhanced access to and better capacity to react to official national flood forecasts and warnings locally and globally.

Metrics: Success in this outcome will be measured by:

(a) Number of Members having the Multi-hazard Early Warning System set up for floods;

(b) Number of Members providing their flood warnings using the Common Alert Protocol (CAP) to be integrated into the Global Multi-hazard Alert System (GMAS) (at least 50% of Members doing so).

Needs and gaps

2.2.3 Floods are one of the most impactful natural disaster and are a result of a combination of various phenomena and processes. As a consequence, many WMO programmes and activities address different aspects of floods, which constitutes a challenge for effective coordination.

2.2.4 Gaps and needs of national flood forecasting and early warning system are not identified in a consistent and organized way. Additionally, there is a lack of expertise in design and development of a flood forecasting and warning system in some regions and the low standardization of data flows and methods of operation make it difficult to transfer solutions easily, without mentioning the additional challenge of language barriers.

The flood risk assessment process (and related tools) is not available or not fully understood by all Members. Hydrological data might not be sufficient to enable a proper flood regime (flood hazard) assessment, without mentioning the difficulties to estimate future probabilities of flood occurrence under the changing climate and catchment conditions. Estimation of impacts demands close cooperation with other institutions to access (if existing), understand and evaluate data about potential impacts of flood to determine flood risk.

2.2.5 In some countries, collaboration between NHSs, NMSs, and other authorities involved in flood forecasting (national Disaster Risk Reduction (DRR) authorities) towards the creation of Multi-Hazard Early Warning Systems (MHEWS) is not effective enough. Sometimes, processes in flood early warnings are understood as sequential steps where components of MHEWS (risk knowledge; monitoring and forecasting; dissemination; capacity to respond) are dealt as completely separate issues without considering the whole value chain. Such discrimination of actions might lead to ineffectiveness at the interfaces and lack of coordination. Special importance should be given to flash floods that demand for different approaches and tools to be used for efficient early warning. Sustainability of projects at national as well as regional and global level (e.g. Flash Flood Guidance System (FFGS)) must be ensured to support operation of National Hydrological Services and National Meteorological Services and their joint activities in provision of flash floods warnings.

2.2.6 Financial resources are limited, both at national and international level, to realize all necessary development projects around the world. Additionally, after the investment, lack of resources for operation and maintenance (sustainability) is often a reason for failure, degradation or suboptimal functioning of implemented systems.

2.2.7 Sharing of data in near-real time remains a challenge in some parts of the world. Use of global coverage products (satellite, Numerical Weather Prediction (NWP), hydro models), despite its huge progress over the last few decades, remains limited in operational hydrology (likely due to data policies, IT connections, lack of knowledge of where to search, etc.). When using global products, quantitative interpretation is often needed, but access to basic data (of hydrological meaning) at reasonable scales is rarely available. Experience also shows that a majority of Members have some gaps in conveying forecast and warning information to users, which results in a decrease of effectiveness of forecasts and warnings.

2.2.8 From a wider perspective, flood protection measures sometimes neglect integrated flood risk management principles. Considering development of an end-to-end early warning system without a context of other components of flood protection (land-use planning, reservoir operation, response planning etc.) leads to conflicts and inefficiency where a holistic approach is not applied.

2.2.9 Given the above-mentioned issues, targeted research is essential to improve forecasting methodologies, to better understand the societal response to forecasts, warnings, and flood risk management in a broader sense.

Outputs:

B.1 Enhanced coordination, effectiveness and governance of all WMO activities in supporting Members with respect to Flood Risk Assessment and Flood Forecasting and Warning

2.2.10 The Flood Forecasting Initiative will be reinforced as the coordination mechanisms of activities for flood risk assessment, forecasting and warning across WMO. Effective joint planning and implementation mechanisms must be initiated or strengthened with major partners and activities (e.g. the International Flood Initiative (IFI), the United Nations Office for Disaster Risk Reduction (UNDRR)). Similarly, WMO will develop principles of cooperation with the private sector in this issue.

B.2 A framework is developed for the evaluation of gaps and needs of national flood forecasting and early warning systems

2.2.11 Assessment guidelines will be developed, completed by a community supported web-based tool for self-evaluation.

B.3 Increased exchange of knowledge and technical expertise in flood forecasting among Members

2.2.12 Knowledge transfer will be realized through the community of practice on end-to-end EWS for Flood Forecasting, including guidance on emerging technologies and services for data acquisition and analysis.

B.4 Enhanced collaboration among NHSs, NMSs and other organizations (e.g. DRR authorities) at the national level to develop and operate E2E MHEWS, particularly with respect to floods

2.2.13 Support will be provided for inclusion of different stakeholders' requirements (energy-water-food nexus) by compilation of success stories of collaboration among NMHSs and DRR and other relevant authorities. Promotion of the MHEWS approach (e.g. with the integration of FFGS/the Coastal Inundation Forecasting Initiative (CIFI)/the Severe Weather Forecasting Programme (SWFP)) for integration of hydrology in GMAS (including application of the CAP, humanitarian support and reflecting hydrological hazards in the catalogue of hazardous events) by explaining the concept of EWS and showcasing benefits of co-production of MHEWS services between communities will be pursued.

B.5 Increased availability and international exchange of hydrometeorological data for operational flood forecasting and early warning and enhanced international cooperation in flood management especially for transboundary basins, on a free and unrestricted basis.

2.2.14 See A.10.

B.6 Enhanced resource mobilization (increased expertise, financial resources, establishment of partnerships) for capacity building, technical assistance, training of personnel and sustainability of E2E MHEWS

2.2.15 See A.7 (Project proposals development will be supported by a framework mechanism to sponsor development initiatives through provision of Reimbursable Advisory Services via the Integrated Flood Management (IFM) and IDMP Helpdesks, Regional offices and in cooperation with other partners).

B.7 Flood related data and products with global and regional coverage are available for use at the national scale by Members

2.2.16 The establishment of hydrological centres with responsibilities in the field of operational flood and flash flood forecasting within the Global Data-processing and Forecasting System (GDPFS) (including integration of ongoing projects like FFGS) to support Members with global and regional product and verification will be pursued. Development of an inventory of worldwide and regional free and public data and products for flood forecasting; and an inventory of international interoperable models and platforms will be finalized.

B.8 Increase in Members' capacities to deliver and communicate information to the public and to raise awareness (to enable action in response to warnings)

2.2.17 A set of guidelines, best practices and training materials will be prepared including flood risk assessment and mapping, Common Alerting Protocol (CAP) application to hydrological hazards, communication of uncertainty, impact-based forecasting, and communication with users on their requirements as well as on interpretation of forecasting results and related risks.

B.9 Increased application of integrated flood risk management principles in flood prevention, preparedness and response by Members and regions (basin authorities).

2.2.18 Continuing APFM activities in capacity building in integrated flood management will be enhanced and provision of additional guidance material will be pursued.

Ongoing activities

2.2.19 The **WMO Flood Forecasting Initiative** and **APFM** have been the major contributions to flood related disaster risk management activities that need to continue and further develop in order to achieve the long-term ambition 'no one is surprised by a flood'. For example, FFGS regional projects proved to be a viable solution for cooperation of meteorological and hydrological forecasting services (in over 60 countries) on the issue of flash floods that needs to be included in integrated and sustainable operation in the future[3]. Relevant activities need a continuing support by **Capacity building in hydrology and water management**, which helped increase capacities of Members in flood risk assessment and flood forecasting and warning in previous years. However, reliable flood forecasting service can be built only if **Hydrological data operations and management** provides sufficient (amount, quality, resolution) data in near-real time and **Quality management framework – Hydrology** properly addresses users' requirements and helps establish and maintain processes to deliver products and services.

Assumptions and risks

2.2.20 We assume that preventing water and hydrometeorological disasters will continue to be considered both short-term and long-term priority issues to be addressed to respond to societal needs.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in changes in priorities in the DRR agenda and decreased involvement in the water-related agenda.
- The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.
- Lack of alignment with other initiatives (including data and products portals) in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, EU-Copernicus etc.) leads to competition for attention of governments.
- Technological innovations might change ways of delivering products and services currently provided by National Hydrological Services.
- In the case of the Community of Practice, insufficient contributions from Members and competition from other communities of practices outside WMO for resources (mostly human).
- Lack of candidates to become centres operating under GDPFS rules and development of centres outside the umbrella of GDPFS (including in the private sector), which undermines the idea of GDPFS as well as lack of acceptance of the GDPFS hydrology structure by NHSs.
- Lack of financial resources for the core activities of the Secretariat.

[3] The Flash Flood Guidance System Sustainability Strategy should be considered by the EC and Congress in 2021.

2.3 Ambition/goal: Everyone is prepared for drought

"I believe, we can start somewhere, and we can start simple".
Ram Dhurmea, consultation on needs and gaps.

2.3.1 Although drought can cause severe water and food shortages, impact the health of the population (including increased morbidity and death), and have socio–economic and political consequences, many drought-affected countries do not yet have national drought policies or existing policies may need to be updated; countries need further assistance in enacting policies that incorporate the three pillars of drought management (monitoring and early warning systems, vulnerability and impact assessments, and mitigation, preparedness, and response measures).

2.3.2 Drought is a complex phenomenon connecting meteorological, climatological, hydrological and other communities to support resilience of communities and nations by provision of relevant data and information including on precipitation, low-flows, groundwater, soil moisture, lakes and reservoirs, cryosphere, water withdrawals, etc. WMO activities support Members drought preparedness, using (for instance) current capabilities in seasonal to multi-year climate predictions or in drought risk assessment.

Outcome:

Members reduce adverse impacts of drought at all levels by implementing integrated drought management systems, including drought monitoring, early warnings, vulnerability and impact assessments, and drought mitigation, preparedness and response measures.

Metrics: Success in this outcome will be measured by:

Number of Members providing their drought preparedness, monitoring and assessment products and services that include the water resources (hydrological) component, making them available through the WMO infrastructure (Regional Climate Outlook Forums (RCOFs), GMAS, the Global Hydrological Status and Outlook System (HydroSOS)).

Needs and Gaps

2.3.3 Members sometimes struggle to establish a strategy and process to enhance their drought management systems including drought monitoring and assessment. It is usually expected that the National Hydrological Services (NHS) and National Meteorological Services provide products for drought-related decisions on a seasonal scale. But, capacities to run seasonal drought-related forecasts at Members' level are often not available. one of the causes is the difficulty to reach users to understand their needs and requirements. Successful drought risk assessment needs close cooperation between the hazard community (met-hydro) and the impact community (agronomy, DRR, etc.), which often lacks functional platforms at national scale.

2.3.4 Furthermore, insufficient amount and quality of data to perform drought hazard, vulnerability and risk assessment, is an obstacle for developing drought policies and establishing drought management systems. Despite substantial progress in remote sensing methods and Earth system modelling, drought-related data/estimates from satellites are not well verified on the ground; access to global (satellite and other) products is limited – due to data policies, limited broadband, or lack of know-how. In addition, graphical products are not enough – some consequent quantitative interpretation is often needed, but access to basic data (of hydrological meaning) at reasonable scale is often not available. Similarly, climate (seasonal) forecasts are not always detailed enough (e.g. global products are not easily accessible in quantitative form at useful scales) to be of use for sound hydrological interpretation at national or subnational level. There's also a challenge in building thrust in seasonal products through demonstration of their benefits for water management.

2.3.5 Groundwater remains often under-represented in drought management activities (monitoring and assessment) although unsustainable ground water withdrawal and recharge proved to be a critical issue in various areas with intensive agriculture production based on groundwater resources. Better understanding of the interaction between surface and groundwater is needed to fully understand the phenomenon of hydrological drought.

2.3.6 When designing and implementing capacity development projects, coordination remains suboptimal in some activities at all levels – national, regional as well as global (e.g. among the Food and Agriculture Organization (FAO), WMO, United Nations Convention to Combat Desertification (UNCCD), UNESCO) leading to duplication or implementation of different tools and systems in one country resulting in obstacles for an effective operation and maintenance. A critical issue is often the sustainability of projects after the first few years (investment costs of projects are secured, but financing of maintenance and operation often fails).

2.3.7 Training of experts in various aspects of drought managements and their support through community of practice and provision of tools and methods remains a challenge for future years.

2.3.8 Finally, applied research should provide tools and methods to enhance capabilities to manage water resources under drought conditions and to adapt to changing climate, as well as societal changes and dynamics affecting water demand and use.

Outputs:

C.1 Enhanced coordination, effectiveness and governance of all WMO activities to support Members with respect to integrated drought management

2.3.9 Streamlining of ongoing activities on droughts across the WMO constituent and subsidiary bodies will ensure coherence, consistency, and efficient use of resources, building on the IDMP continuing community of practice and Helpdesk. Building of partnerships for effective joint planning and implementation mechanisms with major partners and initiatives (the International Drought Initiative (IDI), UNDRR, FAO, UNCCD, the International Fund for Agricultural Development (IFAD), etc.) as well as with the private sector to support drought risk management is needed. Organization of the High-Level Meeting of National Drought Policies – 10 years Later (HMNDP+10) with partners should be explored.

C.2 Drought-related data and products with global and regional coverage are available for use at the national scale by Members

2.3.10 Drought-related GDPFS centres should support NMHSs to process and apply the information to the local context. Initiating from an identification of requirements from NHSs on globally/regionally produced information for their use in drought assessment, modelling and prediction at national scale, an interface, guidelines, and training materials for NHSs will be developed to search, use, interpret and verify products.

C.3 Gaps in Members capabilities with respect to drought assessment, monitoring, modelling and prediction are known

2.3.11 A checklist to enable reviewing current capacities of Member will be developed within the framework for evaluation of gaps and needs of national drought forecasting and early warning systems. Review of available and reliable methodologies to be used for specialized applications of seasonal forecasts will be done as an initial step to decide on further actions in supporting sectors such as agriculture, inland navigation, energy, or health by specialized outlook products.

C.4 The need for an effective national drought policy is understood by Members

2.3.12 Support to Members will be provided in developing proactive drought impact mitigation, preventive and planning measures (within the frame of local/national development policies), drought risk management, to improve the public awareness of drought risk and its preparedness for drought.

C.5 Training to increase the capacities of Members in drought management (drought monitoring, modelling and early warnings, drought vulnerability and impact assessments, and drought adaptation, mitigation, preparedness and response measures)

2.3.13 Capacity building activities related to drought management will be organized through the IDMP and regional cooperation, including development of curricula and training material based on Members' needs identification; and support to twinning projects in user driven drought-related products development.

C.6 Increased capacities of Members through development projects in the areas of drought monitoring, early warnings, vulnerability and impact assessments, adaptation and mitigation, preparedness and response measures

2.3.14 See A.6

C.7 Increased cooperation (and co-production of services) among the hydrological, meteorological and climatological communities and international exchange of experiences (e.g. increased involvement of hydrologists in climate outlook forums, increased involvement of meteorologists and climatologists in river basin commissions)

2.3.15 Increased co-production of services at regional level through implementation of water segments within RCOFs to provide complete outlooks on climate and water availability to users. Regional Associations will be assisted in producing regular (annual/seasonal/monthly) statements on status and outlook of water resources.

C.8 Increased Members capabilities in drought vulnerability of, and impact assessment on, different sectors by meaningful drought indicators and indices used at all relevant scales.

2.3.16 Development of a Global Drought Classification System and guidance on drought indicators, including a water scarcity and other hydrological indicators, will be supported by development of guidelines on harmonizing drought early warning and risk information for end-user communication, with special attention to transboundary basins and aquifers.

Ongoing activities

2.3.17 **The IDMP** has been developed to support activities in drought-related disaster risk management across domains. Recently, the hydrological community has started developing a major contribution to drought management by designing and promoting the **HydroSOS**. As for other ambitions, **Capacity building in hydrology and water management** and **Quality management framework – Hydrology** traditionally helped in establishing services at Members' and basin's levels supporting drought management activities.

Assumptions and risks

2.3.18 We assume that integrated drought management is a priority at national level for Members.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda.
- The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.
- Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, FAO) leads to competition and duplication of work and funding.
- Lack of candidates to become centres operating under GDPFS rules and development of centres outside the umbrella of GDPFS (including in the private sector), which undermines the idea of GDPFS as well as lack of acceptance of the GDPFS hydrology structure by NHSs.
- Lack of financial resources for the core activities of the Secretariat.

2.4 Ambition/goal: Hydro-climate and meteorological data support the food security agenda

2.4.1 Resolving the equation of satisfying water demand for environment and ecosystems, human consumption, irrigation requirements, water availability and potential water storage, needs support and advice to optimize rain-fed and irrigated agriculture. A multidisciplinary approach, by integrating the agrometeorological, climatological and hydrological expertise with socioeconomic and geophysical data and water resources management practice, should be developed.

Outcomes:

(a) Food security is enhanced by informed end-users' decisions at all levels from regional to local;

(b) The concept of Integrated Water Resources Management (IWRM) including water use and allocations for supporting food production is widely accepted and followed.

Metrics: Success in this outcome will be measured by:

(a) Decreased number and magnitude[4] of famine/hunger emergencies due to drought and water scarcity (in 2021–2030 relative to 2001–2020);

(b) Number of Members monitoring and accounting for water consumption in their water budgets at the basin scale.

Needs and Gaps

2.4.2 Drought and floods were historically, together with violent conflicts, the most common causes of food insecurity. While droughts remain at the centre of focus when

[4] Number of affected people, duration of the emergency

speaking about food security, a wider understanding of processes and feedbacks within the water-food-energy nexus is needed to enable water management to support food production in general. Water is understood to be a strategic commodity by some countries and mostly for this reason water and hydrological data remains unshared.

2.4.3 Successful agrometeorological and climatological products and services were developed in the past decades to support rain-fed agriculture, like those developed by RCOFs. Hydrological data, products and services need to complement these, in particular in regions where production depends on irrigation and water allocation schemes depend on water availability and its prediction, concerning both surface and groundwater.

2.4.4 Users' needs and requirements are a critical factor in developing and delivering products and services. In this aspect, there is no universal solution, as priorities and preferences of society are different in different parts of the world. On the other hand, benefits of hydrometeorological services for food production can be easily demonstrated and assessed on the basis of yields.

2.4.5 At global level, coordination of development projects and cooperation in operational activities needs to be ensured with relevant partners, in particular FAO and the World Food Programme (WFP).

2.4.6 Finally, applied research should provide tools and methods to enhance capabilities to maintain and expand agricultural productivity under a changing climate, understanding the water-food-energy nexus and its consequences.

Outputs:

D.1 Increased production and availability of agrometeorological and hydrological forecasts from sub-seasonal to seasonal

2.4.7 Methodology and tools will be developed to interpret HydroSOS data and information (including snow, ice, soil moisture, groundwater, irrigation, water storage) for agricultural applications.

D.2 Effective dialogue between users and providers established

2.4.8 Guidelines based on good practices on dialogues with users will assist Members to establish consultation platforms and communication with users, including research on user requirements and expectations, case studies of product and service development, marketing strategies, and processes to support strategic service planning of NMHSs (including e.g. catalogue of products and services).

D.3 Strengthened capacity of NMHSs personnel in user-driven product and service design and delivery (to support food production and security)

2.4.9 See C.5.

D.4 Water-food-energy nexus and ecosystem services are better understood and inform water resources management

2.4.10 Activities will facilitate discussion on the role of hydrology in providing the required data for optimizing the management of water resources to accommodate the three sectors' needs; through symposia, open panels, TED talks, or case studies (e.g. building on UNECE Water convention work) on the water-food-energy nexus.

Ongoing activities

2.4.11 Food security is closely connected to water resources availability and droughts, therefore the **IDMP** might again be seen as a major contributing activity in this regard, together with the continued implementation of the **HydroSOS** and relevant activities in the frame of **capacity building in hydrology and water management,** targeting development and delivery of food production relevant services at Members' level.

Assumptions and risks

2.4.12 We assume that food security remains a priority at the national level for Members.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda.
- The COVID-19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.
- Lack of alignment with other activities in the field of supporting food production (e.g. FAO) leads to competition for attention of governments and confusing of users.
- In case of RCOFs, lack of coordination and linkages to stimulate necessary involvement of hydrological services to the established format of cooperation and lack of acceptance of the RCOF hydrology activities by NHSs.
- Lack of financial resources for the core activities of the Secretariat.

2.5 Ambition/goal: High-quality data supports science

"Globally accepted and free accessible data infrastructure is lacking – monitoring data from NHSs and research is not brought together".
Harald Köthe and Stephan Dietrich, consultation on needs and gaps

2.5.1 The interoperability between science and data generates knowledge and progress. The value of data accessibility, usability and reliability has been proved to be a strong driver for science development.

2.5.2 Core data availability policy has been established and enforced in some sectors, but increased efforts are still needed to establish common standards and policies for data management and sharing, to support generation of high-quality hydrometeorological data as well as corresponding information products and services development for the benefit of Members.

Outcome:

Increased discoverability, availability, and use of high-quality hydrological and hydrometeorological data for scientific analysis.

Metrics: Success in this outcome will be measured by:

- Number of river discharge/groundwater/lakes and reservoirs/cryosphere time series with data available for the 2021–2030 period that are accessible via the WMO infrastructure and programmes (such as WIS, WMO Hydrological Observation

System (WHOS), the Global Cryosphere Watch (GCW), the Global Runoff Data Centre (GRDC), the International Groundwater Resources Assessment Centre (IGRAC), HYDROLARE, the Global Terrestrial Network – Hydrology (GTN-H)) for scientific purposes on a free and unrestricted basis;

- Number of Members performing routine hydrological data quality assessments in line with Quality Management Framework – Hydrology (QMF-H) recommendations.

Needs and gaps

2.5.3 To ensure production of quality data, the concept of QMF-H was developed and promoted by WMO, however it is likely still not well understood or not considered to be a priority by all Members. Guidance material is not easily implementable (among other reasons due to the language barrier) or the implementation cost is too high.

2.5.4 At the same time, the variety of hydrological conditions and regimes is extreme, finding one fit-for-all solution for hydrological observation standardization and quality control procedure is a challenge. While developed countries concentrate often on the accuracy of measuring devices, a need for development of low-cost measuring instruments is often expressed from developing countries. In addition, differences in development and capacities among Members are great – application of methods from developed countries might be too demanding for some developing Members, while on the other hand, low-cost but imprecise methods might not suite countries with developed monitoring programmes. Naturally, the ultimate goal is for all countries to be capable of producing quality data.

2.5.5 Exchange of data for the scientific community remains limited at global level, due to restricting data policies of some Members, but also due to lack of flexible, easy to use technical platforms. In addition, the research community requirements on data (and its characteristics) is not always well defined and may differ from day-to-day operational needs.

2.5.6 Research institutes and operational agencies under certain conditions compete for resources – both financial (funding) and human. It is usual that NHSs perform some research activities, as work at the NHSs might be feared to degrade to routine operation only, which would cause decreased motivation for staff and decreased prestige for the institution. This competition might be overcome by balanced partnership and mutual cooperation on applied research. Similarly, combination of data from long-term in-situ observing networks with short research observations, experimental data, and other sources of information (e.g. satellite) to a 'common stock' is an opportunity for better cooperation towards shared goals.

Outputs:

E.1 Methods for standard assessment of data quality developed

2.5.7 Guidelines on assessment and flagging of hydrological data reflecting its quality will be developed, including practical methods for such assessment. Continuous process of revision and updating of *Basic Documents No. 2, Technical Regulations Volume III: Hydrology* (WMO-No. 49) will be initiated, targeting in particular the annex on Hydrometry. Other hydrology related materials/documents will be revised for QMF-H compliance.

E.2 Quality assured hydrometeorological data by NHSs are generated through increased compliance with the culture of Quality Management Framework – hydrology (QMF-H)[5]

[5] The goal of Quality Management Framework – Hydrology (QMF-H) is to provide strategy, advice, guidance and tools for the National Hydrological Services to attain quality, efficiency and effectiveness in their functioning. As such it provides documentation on approaches to a Quality Management System

2.5.8 Activities will support Members to achieve QMF compliance by development of generic data production processes (schemes), metrics and internal guidelines for easy customization for NMHSs. Training materials and e-learning on QMF will be produced, including basic field safety manual/training course. Members will be encouraged to implement QMF through the dissemination of information highlighting the benefits of QMF.

E.3 Improved development and maintenance of technical platforms to support data discovery and accessibility for exchange for research and science

2.5.9 Integration of hydrological networks to relevant WMO platforms through implementation of WHOS. Role of existing global data centres will be redefined to better support needs of Members in data sharing and joining WIS/WIGOS, including sharing of data from research basins and projects by academia and targeted monitoring projects.

E.4 Improved coordination on observing networks to fit research purposes

2.5.10 Based on a colloquium/conference on data for scientific purposes that would identify what and how to measure to enhance the scientific progress of hydrology, a concept paper on a joint distributed hydrological laboratory will be developed for further consideration.

E.5 Enhanced culture of research & development projects co-design and joint management (operational hydrology and academia)

2.5.11 See F.1.

Ongoing activities

2.5.12 **Quality management framework – Hydrology** has been promoted as a key principle to ensure production of high-quality and quality-controlled data for various purposes, including research. As measurement technology developed, **Assessment of the performance of flow measurements** has become a major initiative to support NHSs in the correct and effective use of new equipment in everyday operation. It needs to continue supporting hydrologists by providing guidance on methods of hydrometric measurements and their quality and uncertainty assessment. At the same time a need for new possibilities of measuring data, where conventional methods are not available or too expensive, was recognized. **The Global Hydrometry Support Facility (HydroHub)** has been initiated in response helping developing Members to increase the number and reliability of observations. The **WMO Hydrological Observation System (WHOS)** ensures hydrological data operations and management in the frame of WIS/WIGOS with foreseen continuation of its implementation (phase II).

Assumptions and risks

2.5.13 We assume that Members will continue to be motivated to adequately support research and monitoring in order to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda and thus in

(QMS) and guidance on its adoption and implementation by NHSs; documentation and guidance on management of NHSs; documentation on technical approaches for the provision of hydrological data, products and services; and development of training modules and materials.

the sustainability of monitoring networks (especially at long-term-observing sites) and in projects in the field of hydrology and water management.

- The increase in automated data availability and alternative sources of data is not accompanied by an equivalent increase in competence and capacity to manage data quality control and QMF-H compliance.

- Satellite data will replace in situ observations without sufficient verification, and continuity of the long-term observation series is not maintained.

- Technological solutions of monitoring (e.g. satellites), data transfer (internet, cell phone networks) and data storage (cloud solutions) will become more vulnerable to cyber-security incidents (hacking attacks, single point of failure).

- Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP) leads to competition for attention of governments.

- Lack of financial resources for core activities of the Secretariat.

2.6 Ambition/goal: Science provides a sound basis for operational hydrology

2.6.1 The development of operational services needs to be based on the state of knowledge of the water resources and the current and foreseeable pressures on them. Fundamental research, on the other hand, needs to be tailored to user needs, in an applied research approach. Earth system science in an integrated perspective broadens the hydrological perspective and the advancement of hydrological science.

Outcomes:

- Reduced gap between research and operational hydrology applications; operational hydrology uses improved understanding of Earth system science

- There is a greater understanding of how the hydrological system responds to extreme conditions.

Metrics: Success in this outcome will be measured by:

- Number of WMO (co-)sponsored research programmes/projects that include implementation of operational hydrological applications at Members' level during 2021–2030

- Number of cooperation agreements between NHSs and research institutions at the national, regional and global levels; exchange of scientific personnel, increase of staff with a science-based education and training at MSc and higher levels.

Needs and gaps

2.6.2 The gap between research and practice paradoxically increases. One of the reasons is that NHSs are not always recognized as beneficiaries (clients) and users of research results. It points to possible weak customer orientation of some research teams towards operational services, and to limited understanding of the production/value chain from meteorology/climatology to hydrology/water management in case of research topics stretching over scientific domains. Obviously, a separation of scientific and operational communities is recognized as a problem that needs to be overcome by closer cooperation and twinning. It is agreed that enhancement of operational hydrology calls for an interdisciplinary approach not limiting the scope to hydrological sciences.

2.6.3 Among identified research needs for operational purposes, there is an urgent need for inexpensive sensors and telemetry, cloud-based platforms and free satellite data reception. Satellite observation and other emerging types of data are a promising source of information but demand appropriate calibration and ,merging with in-situ observations. It is also recognized that Earth system science has developed significantly over last decades, yet the transfer to practice lacks behind in many parts of the world. Due to the extreme dynamism of research, it has become impossible for practitioners from NHSs to observe, follow, test and use all relevant products and outputs. In addition to those products operationally available, few other fit operational hydrological needs as regards resolution (basin scale), sets of parameters, frequency of data, formats, etc. A big challenge for use of meteorological and climate data for hydrological applications remains the fact that, without bias correction, the water balance might be disturbed, but bias corrected data do not always keep a physical sense.

Outputs:

F.1 Enhanced culture of research and development-to-operation projects to be co-designed by the operational hydrology and academia sectors) – (demonstration) projects are developed, with beneficiaries being National Meteorological and Hydrological Services

2.6.4 Implementation of the research strategy for hydrology being developed by the Research Board in the frame of the overall WMO research programme, will help closing research to operation gap (including close cooperation with UNESCO-IHP, UNEP, FAO, the International Association of Hydrological Sciences (IAHS) and International Association for Hydro-Environment Engineering and Research (IAHR)). It will be supported by developing a catalogue of case studies/best practices of cooperation for direct enhancements of NHSs operations by targeted/customized research and continuous updating of a database of research needs from NHSs as a repository of project topics for scientists.

F.2 Enhanced collaboration between hydrology and meteorology communities of practice, including academia

2.6.5 See B1.4 and B2.7.

F.3 Inventory of the compiled data and products from Earth systems science projects for hydrological applications

2.6.6 See B0.11, B1.7 and B2.2.

F.4 Improved Earth system models at high resolution for local and regional applications

2.6.7 NHSs should have the tools to assess and predict the current and future state of the water resources. Information should be available to fully integrate surface and groundwater resources to improve Earth system modelling and forecasting, in particular Quantitative Precipitation Estimation (QPE) and Quantitative Precipitation Forecast (QPF).

F.5 There is a greater understanding of how the hydrological system responds to extreme conditions

2.6.8 Tools and modules to assess and analyse uncertainty of extreme conditions should be available. The research community will be encouraged to further develop uncertainty and scenario analysis that can be directly used to design/manage infrastructure and water systems.

Ongoing activities

2.6.9 **Assessment of the performance of flow measurements** represents an example of applied research transformation for the benefits of operational hydrology by evaluation of performance and uncertainties associated with new technologies for flow measurement. With a broader scope, **the Global Hydrometry Support Facility (HydroHub)** is intended to stimulate applied science for operational hydrology through development of new methods, instruments, and tools for practice. In the field of floods, several research demonstration projects were developed within the frame of the **WMO Flood Forecasting Initiative (FFI)**. However, in the field of hydrology, to the main responsibility for research falls with UNESCO-IHP at the UN level. Therefore, cooperation and coordination of research activities will be necessary with external partners including UNESCO-IHP and IAHS through the Hydrological Coordination Panel and the Research Board.

Assumptions and risks

2.6.10 We assume that Members will continue to be motivated to adequately support research and development in order to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased resources for scientific projects and research;
- Increased competition between the science and operational sectors for funding and staff as a result of limited resources;
- Asymmetry in benefits from cooperation between operation (providing data free of charge) and science (e.g. paywall publications) decrease the willingness to work together;
- Unhealthy competition with UNESCO-IHP in the field of hydrological research competence;
- Globalization of research leads to "non-recognition" of NHSs as users of research outputs.

2.7 Ambition/goal: We have a thorough knowledge of the water resources of our world

2.7.1 Collecting, managing and sharing data on water resources and uses, (all the key variables associated with operational hydrology) are fundamental for a better understanding of these resources and for developing appropriate water management solutions, informing the decision-making process from local to global scale.

2.7.2 Despite the advances in technology and policy, we are far from having comprehensive information on the state of water management across the world, or regarding major characteristics, trends, constraints and prospective changes.

2.7.3 Regional analyses need to be supported by systematic, up-to-date and reliable information on water and serve as a reference for large-scale planning and predictive studies.

Outcome:

Members implement reliable water resource assessment systems and use these to complete and share information on the availability of water resources.

Metrics: Success in this outcome will be measured by:

- Number of Members completing and sharing water resource assessments, including via HydroSOS or WMO regional systems;
- Annual reports on the status of global water resources published from 2025 onwards.

Needs and gaps

2.7.4 Many Members, especially in developing countries, require investments and support to build the skills, tools and infrastructure (hydrological and meteorological monitoring networks; framework and IT infrastructure for data curation, archival and retrieval systems and quality assurance) needed to enhance their NMHS's capacity to transform hydrological and meteorological observations into actionable water resources information. This includes investments in the reporting framework (including use of common standards) for hydrological status and outlooks information and human capacities to develop and operate it.

2.7.5 As a result of the above-mentioned issues, access to water resources assessment (WRA) information for the general public and for advanced users with proper contextualization is missing. To develop it, integration and coordination between climate and hydrology communities of practice would be necessary. Improved water, food, energy security and public safety requires due consideration of the river basin scale, but at the moment, there is a lack of methods for blending high resolution datasets of streamflow, gauged rainfall, lake levels, soil moisture and evaporative demand at hydrologic relevant scales.

2.7.6 What is currently missing seems to be a 'catalogue' of hydrological tools describing capabilities and credible information on the fit-for-purpose nature of the tools and investments available to Member's NHSs for their adoption and use. There is also a need for capacity building in hydrological modelling technologies and prediction systems that focus on resolving the weather and climate to hydrology problem for empowering Member states to develop decision support systems to manage water supply and demand pressures.

2.7.7 In some cases, NMHSs struggle to understand stakeholders' and users' needs due to limited communication and cooperation (connection to) these communities. Water resources management needs to be framed in well-developed planning processes at various levels and be well linked to assessment of its impacts and benefits.

Outputs:

G.1 Current and future status/assessments of water resources are available at different spatial and temporal scales and cover a large range of products, including snow, groundwater, lakes, and reservoirs

2.7.8 Increased and enhanced WRA activities performed at national scale will provide inputs to the HydroSOS at global scale. HydroSOS will be implemented in line with its implementation plan. Future water availability will be assessed on country and river basin scale to support infrastructure and development planning.

G.2 The WMO community informs high-level policy discussions at the global scale

2.7.9 Based on a concept note, format and specification of general hydrology advisory will be developed and later implemented (including building support network/structure for regular production).

G.3 Data, products and model results, at adequate spatial and temporal resolutions, are available for actionable planning and operations at the local scale

2.7.10 WMO will develop a system of GDPFS centres that produce data and information specialized to support WRA of Members, based on their requirements. Members will be provided with training materials and tools, if needed, to interpret GDPFS products for national and local applications for water resources management.

G.4 Increased national capacities to collect water-related data and transform them to useful/relevant products through capacity building (The staff members of NMHSs understand the societal impacts of water and water resources management plans and decisions and the importance of WRAs for various stakeholders, and are well informed on the technologies available for them to best carry out their tasks and experts in those that best suit their key applications)

2.7.11 A compendium of societal, economic and ecologic relations/dependency on water/hydrological cycle will be developed based on a review of existing studies, synergizing and collating information. The community of practice for water resources assessment will support NMHSs, including support to apply available tools and products, help in selection of proper methodologies and tools for WRA by Members (including support to twinning projects between Members targeting water resources assessment and water resources management). Training curriculum for WRA will be developed as part of the capacity development strategy of WMO. Based on curricula, courses and training materials will be developed. WRA 'manual' will be kept updated online.

Ongoing activities

2.7.12 Historically water resources have been considered at national or basin level mostly. **HydroSOS** is implemented as a critical activity in the field of assessment of water resources at global and regional levels. Its implementation will be enabled by the enhancement and implementation of **WHOS** and will be supported by continued **capacity building in hydrology and water management**.

Assumptions and risks

2.7.13 We assume that Members will keep recognizing water management to be a critical service for nations and at the transboundary level.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda.
- The post-COVID situation will change Members' priorities and limit resources for the wider implementation of HydroSOS.
- The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on the efficiency of implementation of new activities due to teleworking and the impossibility of face-to-face meetings.
- Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, UNEP) leads to competition and duplication of work and funding.

- Loss of support from Members in key activities such as providing resources, data and information for shared systems.

- Lack of financial resources for the core and extra-budgetary activities of the Secretariat.

2.8 Ambition/goal: Sustainable development is supported by hydrological information

2.8.1 The availability of hydrological information does support all water–dependent sectors for optimal water resources management as well as for planning and adapting to transient environmental conditions. The majority of goals of the UN Sustainable Development Agenda have connections to water, therefore hydrological information is important for the achievement of Sustainable Development Goals (SDGs), and the monitoring and assessment of their progress.

Outcome:

Hydrological information of adequate resolution, quality and timeliness is available and is used to make informed decisions on sustainable development at all scales.

Metrics: Success in this outcome will be measured by:

- Number of Members including hydrological aspects and water budget information in their development plans at the national level;

- Number of Members reporting on SDG using reliable hydrological data and indicators.

Needs and gaps

2.8.2 When speaking about the Sustainable Development Agenda, it seems that a lack of awareness of the central role of water in the achievement of the SDGs and of the need for integrated actions prevails in the community of operational hydrologists. So far, there was no need for the creation of indicators that are monitored by hydrological services for the purpose of international SDG monitoring. In some countries, understandably, priorities are in delivering flood and drought warnings and developing capacities in these fields, while the creation of information and products to support SDG monitoring is second order priority at the moment. If such products are developed, we may face hesitation to send data to be stored somewhere else for global purposes and back-up.

Outputs:

H.1 Improved data policies and financing schemes and enhanced political arrangements to collect hydrologic data and derived products

2.8.3 Implementation of the Resolution on the WMO unified data policy will be supported by development of the reference network for hydrology and a recognition mechanism of long-term observing stations in hydrology to highlight the importance of their sustainable contribution.

H.2 Intensified national, basin, transboundary and international cooperation and activities to meet the SDGs

2.8.4 This output will be delivered by supporting the building of national, basin and transboundary partnerships for water-related SDGs through a compilation of success stories. At global level, a partnership with UN-Water, FAO and UNESCO will be established in the framework of the Water and Climate Coalition, WMO's contribution to the United Nations' SDG 6 Global Acceleration Framework, to develop a plan for hydrological data/information/products collection for support of the SDGs. For this purpose, definition of a set of parameters to monitor and support sustainable development on a long-term scale is foreseen.

H.3 Basic tools to assist Members are created, including an archive of relevant information, tools for transforming data to information, and maintenance of essential "treasury/heritage" variables to support sustainable development

2.8.5 A concept note/feasibility study will be developed to assess the possibility to develop a WMO hydrology cloud for storage of essential data of Members, for consideration of Congress and potential implementation. Sharing of data from recognized long-term observing/reference network will be supported leading to implementation of Global Basic Observing Network (GBON) and the Systematic Observations Financing Facility (SOFF) for the hydrological domain. Software tools (or cloud solutions) for computation of parameters for support of SDG, including its web presentation, will be implemented

Ongoing activities

2.8.6 **UN-Water** aims to coordinate efforts related to water agendas across UN agencies with responsibilities connected to water. **The World Water Data Initiative** of WMO aims to reply to needs of sustainable development and policy implementation in the field of water/hydrology information. While concrete tools and activities targeting sustainable development have not been fully developed yet by the WMO community, obviously the **WMO Global Hydrological Status and Outlook System (HydroSOS)** will be the central activity in this regard supported by **Hydrological data operations and management** infrastructure. There is also the necessity to improve liaison with other related UN and non-UN activities and programs (e.g. Group on Earth Observations (GEO)).

Assumptions and risks

2.8.7 We assume that the Sustainable Development Agenda will remain a key priority of the United Nations and will receive adequate support from Member states throughout its implementation. The new Unified Data policy is adopted by the Cg in 2021.

Possible risks are:

- Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda in support of SDGs;
- The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on the efficiency of implementation of new activities due to teleworking and the impossibility of face-to-face meetings, delaying development of new activities;
- Lack of alignment with other activities on SDG implementation related to water (UN-Water, UNESCO-IHP, etc.) leads to competition and duplication of work and funding;
- Loss of support from Members for developing new activities (including HydroSOS, GBON, SOFF etc.) by providing resources, data and information for shared systems;

- Lack of expertise mobilized by Members for the WMO Expert Network to deliver on planned activities given the fact that SDG support is not a common responsibility of NHSs;

- Lack of financial resources for the core and extra-budgetary activities of the Secretariat.

2.9 Ambition/goal: Water quality is known

"Without water quality information, the decisions made on the use of the water resource will be partial and biased".
José Alberto Zúñiga, consultation on needs and gaps.

2.9.1 Water quality is an integral part of the water cycle. The monitoring of surface and groundwater quality is a necessary condition for the basic requirements of society and ecosystems, and the possibility to adopt timely corrective solution whenever needed.

Outcome:

Increased cooperation at the national, regional and global level on water quality monitoring and water quality data exchange.

Metrics: Success in this outcome will be measured by:

- Number of Members running water quality monitoring programmes, performing water quality assessments and sharing their data.

Needs and gaps:

2.9.2 The main gap in this area is the limited awareness of society and politicians of the need for water quality assessments resulting in limited financial resources for this field and the lack of a coordinated and integrated monitoring programme in water quality in some Member Countries. Water quality monitoring is technically and financially demanding and in many parts of the World it has not become a priority due to limited resources. This might be connected to a missing or limited understanding of the principles of IWRM and of the interconnection of all water-related processes at decision-making level as well at the level of relevant institutions.

2.9.3 It is often a different authority, other than the Hydrological Service, that bears responsibility for water quality (and related health issues). In some cases, functional partnerships of responsible organizations at national/regional level have not been established yet. In the past, there has been a lack of impetus of the majority of hydrological services to start their involvement in water quality monitoring, resulting in limited coordination between quantity and quality monitoring networks and separate assessments of quality and quantity aspects of water.

2.9.4 At WMO, water quality has not been given the priority it deserves so far, mostly due to a lack of demand from Members' NHS. While basic cooperation with UNEP, UNESCO-IHP, UNECE and World Health Organization (WHO) exists, NHSs have limited knowledge of programmes and activities from outside of WMO (such as the Global Environmental Monitoring System (GEMS)). In addition, development projects are usually not designed to address the solution of joint quantity-quality complex issues. A need to cooperate with existing water quality activities at global level, in particular with UNEP GEMS, is well recognized. At the same time, there are no internationally agreed standards for exchanging water quality sampling data and sharing of water quality data is limited – likely also due to the variety of responsibilities distributions at national scale in the field of water quality.

2.9.5 As a consequence, it seems that the scarcity of water quality data, even in major water bodies (surface and underground), does not allow to perform the environmental baseline studies required for Environmental Impact Assessment and Environmental Management Programmes of engineering projects etc. And finally, unavailability of water quality data limits the applicability and enforcement of relevant environmental policies and regulations of industrial/domestic effluents.

2.9.6 In addition, the lack of water quality standards (limits) for environmental water quality is limiting the effort of many Members to improve in this area. Similarly, more guidelines are demanded to help develop water quality monitoring programmes at national level differentiating between surveillance monitoring (for regulatory or enforcement purposes) and systematic monitoring of water quality (for detection of long-term changes) and to establish alarm systems for pollution accidents. All of these are important but serve different purposes and involve different stakeholders. The role of NHSs and WMO seems to be most prominent in systematic monitoring of specific parameters.

2.9.7 On the positive side, methods of space-based observations of selected water quality parameters have developed in recent years and seem to be promising to support especially developing countries in their water quality assessment efforts. Methods for continuous monitoring of water quality parameters must be one of the main focuses for research and development in the coming years. Finally, it is recognized that sediment load demands specific attention, in particular with respect to reservoirs.

Outputs:

I.1 Partnership at the United Nations level exists and promotes the provision of water quality data from NHSs to existing information systems (such as WHOS, UNEP GEMS/Water, the UNESCO-IHP International Initiative on Water Quality (IIWQ) and the International Sediment Initiative (ISI))

2.9.8 Responsibility on Water Quality at UN level is shared between WMO, UNESCO, WHO and UNEP. Establishing a WMO-UNEP-WHO-UNESCO partnership or coordination mechanism on water quality building on the World Water Quality Alliance is a key to enhance availability of water quality information at global level and increase the effectivity of development activities through a joint work plan. Existing systems (WHOS, GEMS, IIWQ) need to be interconnected to share and exchange data in standardized formats and procedures.

I.2 Increased NHS involvement in the co-production of water quality related data and products thanks to promotion of IWRM principles

2.9.9 Not all NHSs hold responsibilities in the field of water quality currently, but water quality aspects are becoming more important in the frame of national policies and the SDGs and thus monitoring, and assessment systems are being developed by Members. Activities aim to support the building of partnerships for water quality at national and international basin scale, to support formulation of the National Water Quality Management Strategy, Action Plans and Monitoring Programs including data policies. Based on identified needs water quality training materials will be developed.

I.3 Increased joint water quantity and water quality assessment (monitoring and modelling) for operational management and for planning

2.9.10 A review of the state of operational monitoring, modelling and assessment of water quality at Members and basin level and its systematic update will inform other activities on needs and gaps at Members level and will help to develop joint WMO-UNEP-WHO-UNESCO strategy to increase availability of water quality assessments from Members and on international basins. A concept paper for inclusion of water quality in HydroSOS will be developed for further consideration of the WMO water community.

I.4 Water quality aspects are included in country support activities/projects in the spirit of IWRM and in cooperation with other organizations

2.9.11 Water quality determines availability of water resources just as water quantity. Both needs to be considered adequately in development projects to ensure successful enhancement of Members' abilities to manage water resources and achieve SDGs. Through the partnership with UNEP, UNESCO, WHO, and in cooperation with the United Nations Development Programme (UNDP) and the World Bank (WB) a definition of minimum requirements/checklist for water quality aspects to be included in country support activities will be developed and applied.

I.5 Partnership at the United Nations level delivers co-produced guidelines related to water quality

2.9.12 WMO-UNEP partnership will gather an expertise to develop consistent guidelines for water quality monitoring and assessment for the use of responsible authorities at the national level. Most prominently to develop and update the *Basic Documents No. 2, Technical Regulations Volume III: Hydrology* (WMO-No. 49), Annex on water quality.

Ongoing activities

2.9.13 Water quality has been an underdeveloped domain among WMO operational hydrology activities so far. While it has been partly considered within **quality management framework – hydrology** documentation, it is obvious that much has to be done in **capacity building in hydrology and water management**, and **hydrological data operations and management** needs to be accommodated to include water quality information processing. There's a great potential to benefit from **the Global Hydrometry Support Facility (HydroHub)** infrastructure and mechanisms to help develop non-expensive water quality monitoring programmes of Members where these are not in place yet.

Assumptions and risks

2.9.14 The proposed activities and outputs are based on the basic assumption that relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities, aiming for the same goals and providing the necessary resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.

Possible risks are:

- The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit the development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic.

- Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react.

- An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs, and it might be difficult to approach them and to encourage them to contribute.

3. PARTNERSHIPS

Successful achievement of the Long-Term Ambitions and implementation of enhanced services will require partnerships to:

(a) Foster collaboration for sustainable, improved, tailored and affordable hydrological services;

(b) Strengthen the capacities of National Hydrological and Hydrometeorological Services;

(c) Support regional and transboundary initiatives and approaches that optimize basin-wide water management, including hydrological data exchange;

(d) Improve the general understanding of the societal benefits of hydrological services;

(e) Assist in responding to the requirements of international processes;

(f) Stimulate the establishment of partnerships at global, regional, national, and local level including partners from academia, public, and private sectors to enhance monitoring and use of data and products.

4. WAY FORWARD

Monitoring and assessment of the Action plan implementation

4.1 The monitoring and assessment of the Action plan implementation will be done by the Hydrological Coordination Panel based on inputs and monitoring of progress of work plan of Technical Commissions, Research Board, Regional Associations and other implementing bodies and by assessment of defined milestones and success criteria for all activities, outputs and outcomes. Report on progress will be produced biannually for consideration of EC and Congress (CG)/Hydrological Assembly.

Review of the Action plan

4.2 Based on the monitoring and assessment, the Hydrological Coordination Panel will develop in coordination with the Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM), the Commission for Observation, Infrastructures and Information Systems (INFCOM), Research Board and Regional Associations a periodic update of the Action plan and submit it to the Hydrological Assembly for endorsement and to Cg-19 (2023) and Cg-20 (2027) for adoption.

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Annexes: 3

ANNEX I – ACTIVITY TABLES

Cross-cutting issues

Outcome	(a)	National Hydrological Services operations are sustainable and visible for societies and governments, and the benefits provided are recognized and valued;
	(b)	The financing schemes of hydrological services are improved to ensure operational sustainability and attractiveness for professional staff;
	(c)	There is increased sharing of hydrometeorological data for operational hydrology on a free and unrestricted basis across political borders;
	(d)	There is increased involvement of hydrological communities of Members in the global activities of WMO and greater consequential benefits to national scale services;
	(e)	There is increased involvement by and cooperation with private sector entities which are responsible for the hydrological operations of their own facilities and do not always share their data (e.g. hydropower).
Measure of success	(a)	Number of Members reporting through the Country Profile Database a sustainable financial (budgeting) situation for their core operations;
	(b)	Number of stations registered by Members in the reference hydrological network and sharing data;
	(c)	Number of Members providing operational and historical data and products to the WMO Hydrological Observing System (WHOS) (phase II);
	(d)	Number of experts registered in the WMO Expert Network with hydrological skills;
	(e)	Number of experts with hydrology expertise involved in the working structures of technical commissions and regional associations.

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
A.1 Increased presentation/communication and understanding of value proposition, benefits and risk analysis, and value of hydrological services to foster understanding by ministries and governments	High-level regional association forums	A.1.1	Organization of high-level forums at each regional association session to involve politicians and better describe the value and benefits provided by the NMHSs to decrease the risk of hydrometeorological disasters	1,2,3,4,5,6,7,8	1.3, 4.1, 4.2, 5.1	Number of governments represented at high-level forums (20 % of countries participated)	Regularly starting from 2021	Regional associations		Member, WB, UNDP	Regional programme, regional offices		
	Hydrological Assembly	A.1.2	Water and Climate Coalition: Presentation			Number of relevant high-level participants	Next Congress (Cg-19)						

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			of the Water and Climate Leaders group in Cg-Ext. Present Declaration and to broaden hydrological community to participate in WMO work at Cg-Ext.										
	Creation of communication materials for NHSs to use with their governments	A.1.3	Development of easy-to-digest presentations of benchmarking and success stories demonstrating benefits of NMHSs and their services	1,2,3,4,5,6,7,8	1.3, 4.1, 4.2, 5.1	NHSs use materials for national argumentation	2023, with updates every two years	Secretariat		WB			
	Emphasize the convenience of linking flood and drought management plans to local/national development policies	A.1.4	Organization of regional seminars and other educational and practice-oriented actions	1, 2, 3,				HCP		NHSs			

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Creation of a toolkit to evaluate service quality and inclusion of self-guided benchmarking in the WMO Country Profile Database	A.1.5		1,2,3,4,5,6,7,8	1.3, 4.1, 4.2, 5.1	Analysis available in country profile database, continuously in support of strategic planning of NHSs	2023	HCP, Secretariat		NHSs		QMF-H	
	Using the Water and Climate Leaders group and the coalition to communicate effective WMO messaging to governments and ministries.	A.1.6	Proper communication materials that can be used by the coalition and at the national level	1,2,3,4,5,6,7,8	1.3, 4.1, 4.2, 5.1			Secretariat		Members governments, UN			Water and Climate coalition
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda. • Lack of alignment with other activities in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, UNECE-Water Convention) leads to competition for attention of governments and hydrological experts. • Technological innovations might change ways of delivering products and services currently provided by national hydrological services and might change the market in the field of operational hydrology												
A.2 Increased management skills of NHS managers (including middle and lower management managers) supports the effectiveness and development of NHSs	Development of a curriculum for top and middle management training	A.2.1	A basic instruction package (similar to the basic instruction package for meteorology and hydrology) should be	Cross-cutting	1.3, 4.1, 4.2,	Curriculum approved by Hydrological Assembly in 2023	2023	CDP, in cooperation with HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			developed regarding NHS management. This package should include a description of the skills needed in the areas of HR, operations, project management, strategy, finance, and information marketing and should be tailored to the conditions of NHSs.										
	Development of e-learning training courses for the management of NHSs	A.2.2	Development of e-learning courses to enhance the management skills of NHS staff (including in the areas of HR, operations, project management, strategy, finance, and information marketing and should be tailored to the conditions of the NHSs.	Cross-cutting	1.3, 4.1, 4.2,	Participation or at least 50 NHS representatives in the e-learning courses in 2025	2025	CDP, in cooperation with HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Guidance on managing NHSs	A.2.3	Basic guidance on needed management skills for NHS staff (including in the areas of HR, operations, project management, strategy, finance, information marketing and should be tailored to the conditions of the NHSs	Cross-cutting	1.3, 4.1, 4.2,	Guidance published	2025	CDP, in cooperation with HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	
	Twinning projects targeted at management skills	A.2.4	Twinning projects used for knowledge transfer among Members, including management skills of the NHS staff.	Cross-cutting	1.3, 4.1, 4.2,	Number of twinning projects that include management skills training	2027	CDP, in cooperation with HCP		Members NHSs	Capacity development programme	CB, QMF-H	
	Management programme TED Talks	A.2.5	Sharing experience through videos in the TED Talks format videos explaining basic management issues of NHSs and methods to cope with them, etc.	Cross-cutting	1.3, 4.1, 4.2,	25 videos	2025	HCP		UN System Staff College, UNOG, Members NHSs		CB	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
Assumptions	QMF-H remains a top priority activity supporting hydrology in WMO, and Members recognize the importance of management and governance at the institutional level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda. NHSs do not recognize the increase of management skills to be an important factor in the operation and development of services (due to a preference for operational issues only or internal, cultural conditions and other external conditions)												
A.3 Enhanced regional cooperation, planning and implementation of NMHS-led activities	Hydrological activities of regional associations (e.g. Hydro Conference in RAVI) and provision of support by regional associations to other technical symposia organized at the regional level	A.3.1	Conference to promote knowledge sharing					RAs, HCP		NHSs			
Assumptions	Reform of the working structure of regional associations creates a reliable and viable platform for hydrologists to meet and cooperate on operational hydrology issues.												
Risks	• Lack of alignment with other activities in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, UNECE-Water Convention) leads to competition for attention of governments and hydrological experts; • Perception of marginalization of hydrological issues in implementing the Earth system approach may arise if hydrological requirements are not considered adequately in the work of various WMO bodies.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
A.4 Enhanced customer orientation and better marketing skills generate better services and products with higher added value.	E-learning training course(s) on marketing	A.4.1	E-learning courses are developed to enhance management skills of NHS staff in marketing tailored to the conditions of NHSs	Cross-cutting	1.3, 4.1, 4.2,	Participation of at least 30 representatives of NHSs in the e-learning courses in 2025	2025	CDP, in cooperation with HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	Part of the curriculum for top and middle management training
	TED Talk format management programme on marketing and customer orientation	A.4.2	Sharing experience through TED Talk format videos targeting explaining basic marketing principles and methods to cope with them, etc.	Cross-cutting	1.3, 4.1, 4.2,	7 videos available	2025	HCP		UN System Staff College, UNOG, Members' NHSs			Part of the TED Talk format management programme
	Catalogue of case studies of product and service development as well as marketing strategies for customers and development of process/checklist, methodology to support strategic service planning of NMHSs, including	A.4.3	Demonstration of good practice in the development of customer/user-oriented products and services	Cross-cutting	1.3, 4.1, 4.2,	Catalogue made available	2025	HCP		UN System Staff College, UNOG		CB, QMF-H	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	catalogues of products and services in response to customer requirements												
Assumptions	QMF-H remains a top priority activity supporting hydrology in WMO, and Members recognize the importance of management and governance at the institutional level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda. • Technological innovations might change ways of delivering products and services currently provided by national hydrological services and might change the market in the field of operational hydrology. • NHSs do not recognize the increase of management skills to be an important factor in the operation and development of services (due to a preference for operational issues only or internal, cultural conditions and other external conditions). Skills drain of NHSs to better (paid and supported) positions in private entities (e.g. water boards, water agencies, hydropower operators).												
A.5 The end users of hydrological information/data have a clear understanding of what the data means and its relative (un)certainty	Development of unified communication standards for hydrological information	A.5.1	Development of unified communication standards for hydrological information based on the definition of guidelines and regulatory material to ensure that communication is based on uptake requirements defined by end users	Cross-cutting		Guidelines available	2025	RB, SERCOM			HCP, CDP		From research strategy
Assumptions	QMF-H remains a top priority activity supporting hydrology in WMO, and Members recognize the importance of management and governance at the institutional level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda. • Technological innovations might change ways of delivering products and services currently provided by national hydrological services and might change the market in the field of operational hydrology.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
A.6 Institution development plans and monitoring network development programmes are in place and implemented, taking into account the catalogue of products and services	Guidance on how to write development plans for various aspects of NHS operation	A.6.1	Guidance should support enhancement of managerial capabilities within NHSs and provide general advice on strategy development and planning tailored to the conditions of NHSs	Cross-cutting	1.3, 4.1, 4.2,	Guidance published	2025	HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	Part of the curriculum for top and middle management training
	E-learning training course(s) for management of NHSs	A.6.2	E-learning courses are developed to enhance the management skills of NHS staff in strategic and operational planning, project development and management.	Cross-cutting	1.3, 4.1, 4.2,	Participation of at least 30 NHS representatives in the e-learning course in 2025	2025	CDP, in cooperation with HCP		UN System Staff College, UNOG	Capacity development programme	CB, QMF-H	Part of the curriculum for top and middle management training
	NHS providers have the tools to plan and construct hydrological networks that can grow/adapt as needs and resources change	A.6.3	Delivered by targeted research, guidelines on hydrological monitoring network design, implementation and maintenance are available.	Cross-cutting		Guidelines published	2024	RB, INFCOM		UNESCO-IHP, IAHS, IAHR	HCP, Hydro-Hub	CB, QMF-H	From research strategy

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
Assumptions	QMF-H remains a top priority activity supporting hydrology in WMO, and Members recognize the importance of management and governance at the institutional level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda. Technological innovations might change ways of delivering products and services currently provided by national hydrological services and change the market in the field of operational hydrology.												
A.7 Enhanced resource mobilization (increased expertise, financial resources, establishment of partnerships) for capacity building, technical assistance, training of personnel and sustainability of E2E MHEWS, flood, drought and water resources management	Project proposals development support	A.7.1	Put in place a framework mechanism to sponsor development initiatives through Project Proposal development and provision of Reimbursable Advisory Services through e.g. the IFM Helpdesk			Number of projects developed	Review of progress by 2025	Secretariat, HCP		WB, UNDP, UNECE, EU, USAid, GWP	APFM		
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda.												
A.8 Sustainable projects helps build capacities of NHSs	Capacity development project are coordinated to support achievement of long-term ambitions and sustainability	A.8.1	SOFF supports hydrological development projects	cross-cutting	1.3, 4.1, 4.2,	Number of projects financed through SOFF that target floods, drought and water resources management	Review at 2025	SOFF	SOFF	NHSs		HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Support of local production of monitoring equipment to enhance maintenance availability and reduce cost.	A.8.2	HydroHUB supports development of locally producible low-cost instruments	cross-cutting	1.3, 4.1, 4.2,	Number of projects finalized in frame of the HydroHUB	Review at 2025	INFCOM (Hydro-HUB]		Private companies, HRC	HCP	HDOM	
	Support to twining projects between national hydrological services	A.8.3		Cross-cutting		Number of twinning projects reported from Members	Review at 2025	RAs, HCP		NHSs			
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water-related agenda.												
A.9 Effective and efficient, low-cost methods for hydrological observations are broadly available	Guidance on how to amplify the information through citizen science, proxy data, and innovation.	A.9.1		Cross-cutting		Guidance published	2025	RB, INFCOM		UNESCO-IHP, IAHS, IAHR	RAs, HCP, Hydro-Hub	GHSF	
	HydroHub Innovation hub will stimulate the development and deployment of low-cost technologies	A.9.2	HydroHub Innovation Platform	cross-cutting		Number of HudroHub innovation calls that are successfully implemented at the site	Regular review at each Cg/HA	INFCOM, RB		IAHS, IAHR	RAs, HCP, Hydro-Hub	GHSF	Explore potential for 3D printing of equipment, etc.

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	for hydrometric monitoring.												
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and long-term priority for societies.												
Risks	• Replacement of technology of long-term observing stations may cause inhomogeneity in time series.												
A.10 Increased involvement and enhanced cooperation with the private sector supports Members' flood, drought and water resources management	Compilation of success stories on mutually beneficial cooperation in the field of hydrology	A.10.1	Examples to describe functional data sharing models and coproduction of services with socioeconomic assessments of generated benefits	Cross-cutting		Compilation presented on the web page of the WMO and used in training materials	2024	HCP		NHSs, RAs	PWS	QMF-H	
	Invitation of private sector partners to meetings and sessions such as RA Hydrological Forum, RA session, etc. to share knowledge	A.10.2		Cross-cutting		Number of private partners participating in RAs activities	2025	RAs		Private sector	HCP	QMF-H	
Assumptions	Private companies will further cooperate with WMO Members in the spirit of the WMO new unified data policy.												
Risks	• Differing interests of private and public partners causes asymmetry in cooperation												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
A.11 Increased availability and national and international exchange and use of hydrometeorological data for operational flood forecasting and early warning purposes and enhanced international cooperation in flood and water resources management, especially for transboundary basins	Basic observation network – hydrology and cryosphere established	A.11.1	In the spirit of (and to support) Resolution 42 and its implementation, a network of reference observations is established from which Members commit themselves to mandatory sharing of data – GBON hydrology and cryosphere data (snow melt floods, ice related flood risks)	1,2,3		At least 50 members with their stations registered with the network by 2024	Concept note: 2022, implementation plan: 2023, update of Tech Regs vol III: 2023	INFCOM		UNESCO, EU (Copernicus UNEP)	GBON, GRDC, IGRAC, HYDRO-LARE, GEMS, WWDI	HDOM	
	WHOS – operational data exchange	A.11.2	Development of WHOS as the common platform for international sharing of operational data among Members.	1,2,3		At least 50 Members providing operational data through WHOS by 2025	2025 for review	INFCOM				HDOM	
	Increased additional voluntary data sharing, including forecast products and satellite data/products; availability for flood forecasting	A.11.3	"Resolution 42" promotion in hydrology for forecast products. Further development of transboundary policy issues (Legal Paper on IFM,	1		Number of Members sharing additional data		INFCOM, SERCOM, RAs		UNECE Water Convention	HCP	HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			transboundary flood risk management). Demonstration project in selected basins built using WHOS.										
	Statement on network design with respect to flood forecasting and management	A.11.4	Easy to understand advice on how to best design a network for flood forecasting and warning purposes (location of gauges, reporting frequency, etc.)			Statement presented	2023	INFCOM, SERCOM			HCP	QMF-H, HDOM	
Assumptions	Resolution 42 on data policy will be adopted by Cg-2021. Members support the development, maintenance and sustainability of hydrological networks, including near-real-time data transmission.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, decrease the involvement of politicians in the water–related agenda. • Differing interests of private and public partners cause asymmetry in cooperation.												
A.12 The operational hydrology community at the national scale knows how to access global and regional products, services and tools and actively	Entry point up to date; catalogue/directory available	A.12.1	Catalogue provides information and describes where to find relevant information and products generated by WMO and its	Cross-cutting		Catalogue available and up to date by 2023		INFCOM, SERCOM, HCP, RAs				HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
participates in the activities of the WMO community.			community for use by NHSs										
	Motivation, benefits clearly described and understood	A.12.2		Cross-cutting		More representatives of NHSs participate in WMO intergovernmental sessions		INFCOM, SERCOM, HCP, RAs					
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	Lack of alignment with other activities in the field of water (e.g. UN-Water, United Nations Educational, Scientific and Cultural Organization -Intergovernmental Hydrological Programme (UNESCO-IHP), the United Nations Environment Programme (UNEP), the United Nations Economic Commission for Europe (UNECE) Water Convention) leads to competition for the attention of governments.												

Ambition/goal: No one is surprised by a flood

Outcome	(a)	Impact based end-to-end Early Warning Systems (EWS) for flood forecasting in the context of a broader integrated flood management strategy implemented by Members;
	(b)	Public, communities and businesses have enhanced access to and better capacity to react to official national flood forecasts and warnings locally and globally.
Measure of success	(a)	Number of Members having the Multi-hazard Early Warning System set up for floods;
	(b)	Number of Members providing their flood warnings using the Common Alert Protocol (CAP) to be integrated into the Global Multi-hazard Alert System (GMAS) (at least 50% of Members doing so).

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
B.1 Enhanced coordination, effective-ness and governance of all WMO activities in supporting Members in with respect to Flood Risk Assessment and Flood Forecasting and Warning	FFI-AG reinforced coordination mechanisms of activities for Flood Risk Assessment, Forecasting and Warning across WMO, as well as in collaboration with international actors	B.1.1	To streamline ongoing hydrological programmes and initiatives, ensuring coherence and consistency, alignment to the plan, effectiveness and efficient use of resources, and support for the international agenda for DRR, establishing new coordination mechanisms	1	1.1, 1.3, 3.1, 3.2, 4.3, 5.1,5 .2	Report presented regularly to EC FFI workplan fulfilled.	2023	SERCOM	Budget needed for at least one face-to-face meeting per intersessional period	See Annex to Res. 3 (EC-72), IFI, UNDRR, UNEP, UNECE, UNESCO, regional organizations	SC-HYD. SC-DRR. RHAs RB	FFI	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
	Establish effective joint planning and implementation mechanisms with major partners and activities (IFI, UNDRR, UNEP….)	B.1.2	Better coordination of UN flood-related activities brings more effective delivery on flood risk assessment and forecasting around the globe.	1	1.1, 1.3, 3.1, 3.2, 4.3, 5.1,5 .2			SERCOM via FFI		IFI, UNDRR, UNEP, UNECE, UNESCO, regional organizations, UN- WATER	RAs, RB	FFI	
	Establish guiding principles and agreements with the private sector to support flood-related early warnings and risk management	B.1.3	The private sector could offer technologies such as AI or cell phone applications, social network analysis, to enhance services in flood forecasting. Searching for opportunities for cooperation via agreements and pilot projects.	1				SERCOM		Private sector, NMHSs		FFI	
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in changes in priorities in the DRR agenda and decreased involvement in the water-related agenda. • Lack of alignment with other initiatives (including data and products portals) in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, EU-Copernicus etc.) leads to competition for the attention of governments. Technological innovations might change ways of delivering products and services currently provided by national hydrological services.												
B.2 A framework is developed for the evaluation of gaps	Assessment Guidelines web-based tool and community	B.2.1	Further development and implementation of the assessment guidelines as a tool for self-	1	1.3	Web tool available on the WMO website; assessment teams	2023	SC-HYD (to finalize the Assessment Guidelines), Secretariat (to manage requests and	Resources to respond to the Members' requests will have to be mobilized/allocated on a	Experts of TCs, Support Base Partners	Checklist for MHEWS	FFI	Members' gaps and needs will also be identified through the Hydro Assembly and the RA

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
and needs of national flood forecasting and early warning systems			assessment (or assessment by expert teams through WMO) to identify capabilities and needs regarding national capabilities to deliver flood forecasting services and warnings; implementation of a web-based tool based on simplified assessment guidelines to identify national capabilities and needs			available for deployment once request received through the Helpdesk; repository of assessed NMHSs.		coordinate the requested expertise)	case-by-case basis. Possibility to provide RAS (reimbursable advisory services) for the implementation of assessments				Hydrological Fora
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	None												
B.3 Increased exchange of knowledge and technical expertise in flood forecasting among Members	Community of Practice on End-to-End Early Warning Systems for Flood Forecasting, including guidance on emerging technologies and services for data acquisition and analysis	B.3.1	Developing mechanisms on implementing recommended practices via a team of experts to support knowledge exchange. This will be complemented by a repository of capacity building materials (guidance, e-learning),	1				SERCOM	Technical platform for the Community of Practice (webpage, discussion fora, wiki, social network), training materials and targeted workshops	UCAR		FFI	Guidance on, e.g. selection of hydrological/hydraulic models, developing holistic flood intelligence systems, selection and appropriate use of different weather products, ensemble flood prediction methods and verification,

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
			including those relating to the role of the new technologies intended to address geographical constraints or insufficient local resources.										network design with respect to flood forecasting and management; development of global hydrological characteristics usable to derive parameters of hydrological models.
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	In the case of the Community of Practice, insufficient contributions from Members and competition from other communities of practices outside WMO for resources (mostly human).												
B.4 Enhanced collaboration among NHSs, NMSs and other organizations (e.g. DRR authorities) at the national level to develop and operate E2E MHEWS,	Inclusion of the needs and requirements of different stakeholders (energy, water, food), moving towards an MHEWS approach (e.g. with the integration of FFGS/CIFI/SWFP) for the possible future integration of hydrology in GMAS (including the application of CAP (see B.8) and reflecting hydrological hazards in the catalogue of hazardous events)	B.4.1	Compilation of success stories for collaboration among NMHSs and DRR authorities Creation of incentives to work together and share data/information and services	1		Compilation of success stories available	2025	SERCOM		Members	Links to FFI in terms of improved cooperation among NHSs and NMSs	FFI	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	linkages	MOA	Comments
particularly with respect to floods	Support to humanitarian organizations for real time risk assessments	B.4.2	Contribution to GMAS related to flood hazards relevant for humanitarian activities around the world			Number of flood events interpreted for humanitarian activities through GMAS	2025	SERCOM		UNHCR	GMAS	FFI	
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in changes in priorities in the DRR agenda and a decreased consideration of water-related disasters in the DRR agenda. • Lack of alignment with other initiatives (including data and products portals) in the field of water (e.g. UN-Water, UNESCO-IHP, UNEP, EU-Copernicus etc.) leads to competition for the attention of governments. • Technological innovations might change ways of delivering products and services currently provided by national hydrological services.												
B.5 Increased availability and international exchange of hydro-meteorological data for operational flood forecasting and early warning purposes and enhanced international cooperation in flood manageme	See cross-cutting issues	B.5	See cross-cutting issues, points A.10.1, A.10.2, A.10.3, A.10.4										Will be considered in the context of the Earth system approach

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
nt, especially for transboundary basins on a free and unrestricted basis.													
B.6 Enhanced resource mobilization (increased expertise, financial resources, establishment of partnerships) for capacity building, technical assistance, training of personnel and sustainability of E2E MHEWS	Development support of project proposals	B.6.1.	See A.7.1			Number of projects developed with the support of WMO	Review in 2023 and 2027	Secretariat	Secretariat staff	UNDP, WB, UNECE, FAO	HCP, APFM, IDMP	FFI	
B.7 Flood-related data and products with global and regional coverage are available	GDPFS – development of hydrological centres, including regional forecasting centres/systems	B.7.1	Establishment of RSMC centres which include, among their functionalities, the issuing of operational flood forecasting to support Members with global and	1		At least 2 specialized centres operational by 2024	2024	SERCOM, INFCOM		Members, RSMC	GDPFS, HYDROSOS, RCOFS, FFGS	HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
for use at the national scale by Members			regional products and verification.										
	Creation of an inventory of worldwide and regional free and public data and products for flood forecasting and an inventory of international interoperable models and platforms	B.7.2	Development of an update the inventory of state of the art tools that are freely available for use in flood forecasting or products that might be used at the national and local scale to support flood forecasting activities (such as DEWETRA, Glofas, efas, DHI-UNEP, Sustainable FFGS) as an entry reference page	1		Inventory accessible for NHSs	2025	SERCOM		Members, academia	GDPFS, RCOFS, NMHSs	HDMO	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Timeframe	Responsibility	Resources	Partners	linkages	MOA	Comments
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	• Lack of candidates to become centres operating under GDPFS rules and development of centres outside the umbrella of GDPFS (including in the private sector), which undermines the idea of GDPFS, as well as a lack of acceptance of the GDPFS hydrology structure by NHSs.												
B.8 Increase in Members' capacities to deliver and communicate information to the public and to raise awareness (to enable action in response to warnings)	Collection of success stories, challenges and needs	B.8.1	Inclusion of case studies on CAP application to hydrological hazards, showcasing good ways to communicate uncertainties to authorities and the public	1		Document published	2025	SERCO, INFCOM		UNDRR, Meteo-ALARM (EUMETNET), NMHSs	Public weather services programme, GMAS	FFI	
	Guidelines on flood risk assessment/mapping and "Impact Based Forecasting"	B.8.2	Better understanding of flood hazards and flood risks and their changes within the year, season, day, as well as long-term trends based on concepts used, e.g. EU Floods Directive, etc.	1		Document published	2025	SERCOM		UNDRR, EU	PWS	FFI	

	Enhanced national consultations/communication between forecasters and users	B.8.3	(i) Guidelines based on good practices developed and implemented (ii) Compilation of a list of requirements from users and their decisions/expectations and how to research on these (guide) (iii) Catalogue of case studies of products and service development as well as marketing strategies for customers and development of processes/check lists, methodology to support strategic service planning of NMHSs, including a catalogue of products and services in response to customer requirements, including: raising awareness regarding flood risk management (follow up from previous APFM activities, such as Capacity Building in Flood Management)	1		Documents published	2025	SERCOM				FFI	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	linkages	MOA	Comments
	Guidelines for harmonizing information and products that are used to communicate forecasting results and related risks	B.8.4		1		Guidelines published	2025	SERCOMINFCOM	RB, RAs	UNDRR, OGC, academia	APFM, FFI	FFI	
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	None												
B.9 Increased application of integrated flood risk management principles in flood prevention, preparedness and response by Members and regions (basin authorities).	APFM capacity building	B.9.1	Capacity building activities in flood forecasting and integrated flood management	1		Indication by Members of their satisfaction; number of helpdesks satisfied		APFM	Support to APFM technical unit	GWP	APFM	FFI	
Assumptions	Preventing water and hydrometeorological disasters will continue to be considered both a short-term and a long-term priority for societies.												
Risks	Lack of financial resources for core activities of the Secretariat.												

Ambition/goal: Everyone is prepared for drought

Outcome	(a)	Members reduce adverse impacts of drought at all levels by implementing integrated drought management systems, including drought monitoring**, early warnings, vulnerability and impact assessments, and drought mitigation, preparedness and response measures.**
Measure of success	(a)	Number of Members providing their drought preparedness, monitoring and assessment products and services that include the water resources (hydrological) component, making them available through the WMO infrastructure (Regional Climate Outlook Forums (RCOFs), GMAS, the Global Hydrological Status and Outlook System (HydroSOS)).

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
C.1 Enhanced coordination, effectiveness and governance of all WMO activities to support Members with respect to integrated	Streamline ongoing activities on droughts across WMO constituent and subsidiary bodies, ensuring coherence, consistency, and efficient use of resources.	C.1.1		2, 3	5.1	Map of activities with potential overlaps identified	2022	SERCOM, INFCOM		GWP, FAO, UNESCO	IDMP,	FFI-DRR	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
drought management	Ensure that IDMP continues providing a technical resource for drought management through a Community of Practice and a helpdesk providing: (i) expert advice and exchange of experiences (Joint Technical Support Unit of GWP and WMO), (ii) guidelines and tools, (iii) project preparation support, (iv) capacity development	C.1.2		2, 3	5.1	Indication by Members of their satisfaction; number of helpdesks satisfied	Continuous, review on biannual basis	SERCOM (SC-HYD, SC-AGR, etc.)		GWP		FFI-DRR	
	Establish effective joint planning and implementation mechanisms with major partners and activities (IDI, UNDRR, FAO, UNCCD, IFAD, European Commission, etc.)	C.1.3	Better coordination of UN drought-related activities brings more effective delivery on drought monitoring and EWS and forecasting around the globe.	2,3	5.1	Joint plans available for drought actions		SERCOM		IDI, UNDRR, UNCCD, FAO, IFAD, European Commission	RAs	FFI-DRR	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Establish guiding principles and agreements with the private sector to support drought-related early warning and risk management measures	C.1.4	The private sector could offer technologies such as AI or cell phone applications to enhance services in flood forecasting. Searching for opportunities for cooperation via agreements and pilot projects.	2,3	5.1	Number of joint collaboration projects/activities		SERCOM		I Private sector, NMHSs	RAs	FFI-DRR	
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, FAO) leads to competition and duplication of work and funding. Lack of financial resources for the core activities of the Secretariat.												
C.2 Drought-related data and products with global and regional coverage are available for use at the national scale by Members	(i) Identification of requirements on globally/regionally produced information for use in drought assessment, modelling and prediction at the national scale by NHSs, and (ii) Development of an interface for NHSs to search, use and interpret the products.	C.2.1	The identification of requirements includes, at a minimum, an indication of the data required, their temporal and spatial resolution, latency, formats, and transfer/access mechanisms.	2, 3	2.1, 1.1., 1.2, 4.1	Requirements known and reflected to GDPFS manual	2023	INFCOM				IDMP	
	Establishment of global centres on drought within GDPFS and training of NMHSs to process and apply the information to the local context	C.2.2	Global centres must have the capacity to regularly produce/make available the required data and products.	2, 3	2.3, 1.1, 1.3	Number of drought centres in GDPFS supporting Members with	2025	INFCOM, SERCOM			Activity 1 (outcome 7 on GDPFS)	IDMP	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			NMHSs need the capability and tools/methodology to apply global/regional info effectively			hydrologically relevant products							
	Operational guidance and tools for verification of available products	C.2.3	Guidelines / training materials / tools for interpretation for using products of GDPFS drought centres are available together with a tool and guidance how to verify derived products at National/local scale.	2	2.3, 1.1., 1.3, 3.2	Guidelines published	2025	INFCOM, SERCOM				IDMP	
Assumptions	Integrated drought management is a priority at the national level for Members.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings. • Lack of candidates to become centres operating under GDPFS rules and development of centres outside the umbrella of GDPFS (including in private sector), which undermines the idea of GDPFS as well as a lack of acceptance of the GDPFS hydrology structure by NHSs.												
C.3 Gaps in Members' capabilities with respect to drought assessment, monitoring, modelling and prediction are known	Development of a checklist to enable current capacities to be reviewed by experts	C.3.1	Inspired by MHEWS checklist and Sendai monitoring evaluation of Global Target G	2	4.1	Checklist online	2024	SERCOM		GWP, FAO, UNDRR, UNESCO-IHP		FFI-DRR	
	Development of a framework for the evaluation of gaps and needs with respect to national drought forecasting and early warning systems	C.3.2	Provision of guidance on how to make use of the framework in order to perform the evaluation.	2	4.1	Framework approved at SERCOM	2024	SERCOM		GWP, FAO	Country profile database	FFI-DRR	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			Establishment of a repository of assessed NMHSs.										
	Incorporate specialized forecasting abilities for relevant sectors such as agriculture, inland navigation (forecast of the depth of water in navigable rivers), energy, health, etc.	C.3.3	Review of available and reliable methodologies to be used for specialized applications of seasonal forecasts as an initial step before deciding on further actions.	2, 3, 6	1.3, 1.2	Number of applications for sectors	2027	SERCOM		Stakeholders, Members	SG-ENE, SG-HEA, SC-AGR,, SG-CRYO	Hydro SOS	
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
C.4 The need for an effective national drought policy is understood by Members	Support Members in the development of proactive drought impact mitigation, preventive and planning measures and risk management measures including possible organization of HMNDP+10	C.4.1	Good examples of national drought policies and plans are compiled in cooperation with partners (FAO, UNESCO, UNCCD, UNDRR) and communicated to policy makers – e.g. via side meetings on droughts at high-level meetings, such as COP or the Global Platform for DRR	2	4.1, 4.2, 1.2, 1.3	SERCOM, Secretariat	2025	SERCOM		GWP, FAO, UNCCD, UNDRR, UNESCO-IHP		FFI-DRR	
	Help increase public awareness of drought risk and preparedness issues	C.4.2	Making available examples/templates of communication materials (toolkit)	2	1.3, 1.2, 1.4	Toolkit available in English	2025	SERCOM		GWP, FAO, UNDRR, UNESCO-IHP		FFI-DRR	
	Demonstrate the convenience of linking drought management plans to local/national development policies	C.4.3	Compilation of success stories	2	1.2	Compilation published	2025	SERCOM		GWP, FAO, UNDRR, UNESCO-		FFI-DRR	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
										IHP			
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda.												
C.5 Training to increase the capacities of Members in drought management (drought monitoring, modelling and early warnings, drought vulnerability and impact assessments, and drought adaptation, mitigation, preparedness and response measures)	Capacity building activities organized through IDMP, including curricula and training material based on needs identification, developed to enhance Members' drought management capacities and capabilities	C.5.1	Training materials are to be included for: (i) drought monitoring, modelling and early warnings, (ii) drought vulnerability and impact assessments, and (iii) drought adaptation, mitigation, preparedness and response measures	2,3	4.1, 4.2	Curricula developed	2023	CDP, SERCOM		GWP, UNESCO-IHP, FAO	IDMP	Capacity Development	
	Training materials based on curricula developed to support Members	C.5.2	Training materials (e-learning) are to be included for: (i) drought monitoring, modelling and early warnings, (ii) drought vulnerability and impact assessments, and (iii) drought adaptation, mitigation, preparedness and response measures (iv) food production industry support	2,3	4.2, 4.1	Number of e-learning courses, Number of participants	2025, 2027	CDP, SERCOM		GWP, UNESCO-IHP, FAO	IDMP	Capacity Development	
	Twinning projects in user-driven product development	C.5.3		2,3	4.2, 4.1	Number of twinning projects reported	2027	RAs		Members			

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
C.6 Increased capacities of Members through development projects in the areas of drought monitoring, early warnings, vulnerability and impact assessments, adaptation and mitigation, and preparedness and response measures	See A.6	C.6											
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
C.7 Increased cooperation (and co-production of services) among the hydrological, meteorological and climatological communities and international exchange of experiences (e.g. increased involvement of hydrologists in climate outlook fora, increased involvement of meteorologists and climatologists in	Widen the implementation of a water segment in the creation of Regional Outlook Fora (ROFs) based on the successful experience of RCOFs with the water segment in Central America	C.7.1		2, 3	1.3, 1.2	Number of ROFs with hydrology	2025	RAs, SERCOM		GWP, FAO, Members	RAs, SERCOM	Hydro SOS, HDOM	
	Regular (annual/seasonal/monthly) RA statements on water resources	C.7.2		2, 3	1.3, 1.2	Number of RAs producing statements	2025	RAs		Members, FAO, GWP	RCOFs, RCCs,	Hydro SOS, HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
river basin commissions)													
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
C.8 Increased Members capabilities in drought vulnerability of, and impact assessment on, different sectors by meaningful drought indicators and indices used at all relevant scales.	Development of Global Drought Classification System and guidance on drought indicators, including water scarcity and other hydrological indicators – regional/national/basin indicators to be developed	C.8.1		2, 3, 6	1.3, 1.2	Drought indicators for hydrological drought approved by SERCOM	2025	SERCOM		GWP, FAO	RCOFs, RCCs	FFI-DRR, SC-AGR, IDMP	
	Development of guidelines on harmonizing drought early warning and risk information for end user communication including decision-making support to the relevant authorities	C.8.2	How to best communicate drought information in a form to enable informed decision-making, including advice to authorities on setting decision criteria and systems (including the use of other types of data and information on water demand and impacts from the local level)	2, 3	1.1, 1.2, 1.3	Guidelines published	2025	SERCOM		GWP, UNDRR, FAO	RCOFs, RCCs	FFI-DRR SC-AGR. IDMP	
Assumptions	Integrated drought management is a priority at the national level for Members												
Risks	The COVID 19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												

Ambition/goal: Hydro-climate and meteorological data support the food security agenda

Outcomes	(a)	Food security is enhanced by informed end users' decisions at all levels from regional to local;
	(b)	The concept of integrated water resources management, including water use and allocations supporting food production, is widely accepted and followed.
Measure of Success	(a)	Decreased number and magnitude of famine/hunger emergencies due to drought and water scarcity (in 2021–2030 relative to 2001-2020);
	(b)	Number of members monitoring and accounting for water consumption in their water budgets at the basin scale.

Output	**Activity**	**ID**	**Description**	**LTA**	**SOP**	**Success criteria**	**Time frame**	**Responsibility**	**Resources**	**Partners**	**linkages**	**MOA**	**Comments**
D.1 Increased production and/or availability of agrometeorological and hydrological forecasts from sub-seasonal to seasonal	Provide methodology and tools to interpret HYDROSOS data and information for agricultural applications (snow, ice soil moisture, groundwater, irrigation, water storage, etc.)	D.1.1		2, 3, 6	1.3, 1.2	Guidelines /advice on interpreting hydrological data and outlooks for agriculture	2024	SERCOM, INFCOM			Link to output 5 above	Hydro SOS SC-AGR	
Assumptions	Food security remains a priority at the national level for Members.												
Risks	• The COVID-19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
D.2 Effective dialogue between users	National consultations between forecasters and users in the agricultural sector:	D.2.1		2, 3, 6	1.3, 1.2	Guidelines published	2025	SERCOM		FAO	IDMP	FFI-DRR, Hydro SOS,	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	linkages	MOA	Comments
and providers established	(i) guidelines based on good practices developed and implemented (ii) compilation of list of requirements from users and their decisions/expectations and how to research these (guide) (iii) catalogue of case studies of product and service development as well as marketing strategies for customers and development of processes/checklists, methodology to support strategic service planning of NMHSs, including catalogue of products and services in response to customer requirements											SC-AGR	
Assumptions	Food security remains a priority at the national level for Members.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID-19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
D.3 Strengthened capacity of NMHS personnel in user-driven product and service design and delivery (to support food production and security)	See C.5 "Training to increase the capacities of Members in drought management…"	D.3											
Assumptions	Food security remains a priority at the national level for Members.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	linkages	MOA	Comments
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • The COVID-19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												
D.4 Water-food-energy nexus and ecosystem services are better understood and inform water resources management	Facilitate discussion on the role of hydrology in providing the required data for optimizing the management of water resources to accommodate the three sectors' needs (through symposia, open panels, TED talks, etc. on the water-food-energy nexus)	D.4.1		3	1.3	TECO or side event on the topic at SERCOM-2	2023	SERCOM (Sc-HYD, SC-AGR, SG-ENE, etc.)		---	CEPAL, FAO, SG-ENE, SC-AGR	FFI-DRR, Hydro SOS	
	Showcase case studies on the water-food-energy nexus (CEPAL, ENANDES, other)	D.4.2		3	1.3	Studies promoted via community of practice by 2023	2023	SERCOM (Sc-HYD, SC-AGR, SG-ENE, etc.)		---	CEPAL, FAO, SC-AGR, SG-ENE	FFI-DRR, Hydro SOS	
Assumptions	Food security remains a priority at the national level for Members.												
Risks	• The COVID-19 pandemic is altering WMO modalities of work, with a potential impact on efficiency due to teleworking and the impossibility of face-to-face meetings.												

Ambition/goal: High-quality data supports science

Outcome	(a) Increased discoverability, availability, and use of high-quality hydrological and hydrometeorological data for scientific analysis.
Measure of success	(a) Number of river discharge/groundwater/lakes and reservoirs/cryosphere time series with data available for the 2021–2030 period that are accessible via the WMO infrastructure and programmes (such as WIS, WHOS, the Global Cryosphere Watch (GCW), the Global Runoff Data Centre (GRDC), the International Groundwater Resources Assessment Centre (IGRAC), HYDROLARE, the Global Terrestrial Network – Hydrology (GTN-H)) for scientific purposes on a free and unrestricted basis; (b) Number of Members performing routine hydrological data quality assessments in line with Quality Management Framework – Hydrology (QMF-H) recommendations

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
E.1 Methods for standard assessment of data quality developed	1.1 Guidelines on/development of practical methods for assessment (flagging) of hydrological data	E.1.1	While metadata provide some information on data quality and reliability for particular uses, additional assessments/classification of data uncertainty or reliability (e.g. by flagging) might help the research community in data processing. Providing guidelines and assessing the potential benefits of harmonized data assessments/classification systems/tools	5	2.1, 2.2	Guidelines published Assessment of benefits provided for further decision on the issue	2025	INFCOM		RB, RAs, SERCOM	OSCAR, WIS, WHOS, Capacity development programme	HDOM, QMF-H	Development of automated processes for data QC, with AI/big data and training for members in how to use them should be considered by the research community

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Respon sibility	Resources	Partners	Linkages	MOA	Comments
	1.2 Continuous development and update of Technical Regulation Vol. III and its annex on hydrometry and other materials (including QMF-H compliance)	E.1.2		1, 2, 3, 4, 5, 6, 7, 8	2.1, 2.2	TechReg updated each CG	2023, 2027	INFCOM, SERCOM , HCP		ISO, UNEP	RAs	QMF-H	
Assumptions	Members will continue to be motivated to adequately support research and monitoring in order to better understand the behaviour and changes of the water cycle												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda and thus in the sustainability of monitoring networks (especially at long-term-observing sites) and in projects in the field of hydrology and water management. • The increase in automated data availability and alternative sources of data is not accompanied by an equivalent increase in competence and capacity to manage data quality control and QMF-H compliance.												
E.2 Quality assured hydrometeorological data by NHSs are generated through increased compliance with the culture of Quality Management Framework - hydrology (QMF-H)	Development of generic data production processes (schemes), metrics and internal guidelines (such as ISO 9001)	E.2.1	Internal system of QMF comprising manuals, guidelines, defined processes and metrics is necessary for each enterprise, providing products and services	1, 2, 3, 4, 5, 6, 7, 8	2.1, 2.2	Generic QMS schemes and guides develop-ped, number of Members that impleme nted QMS based on those (CPDB)	2025	HCP, INFCOM, SERCOM		ISO, Members	RAs	QMF-H	
	Training materials and e-learning on QMF	E.2.2	Review of requirements of Members on training in the field of QMF/QMS should lead to the development of a training plan for	1, 2, 3, 4, 5, 6, 7, 8	2.1, 2.2	Review of requirem ents ready by 2023, training plan	2023 review of progres s	CDP			INFCOM, SERCOM, HCP	QMF-H, CB	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Respon sibility	Resources	Partners	Linkages	MOA	Comments
			NHSs and its implementation based on identified priorities			(curricul um) by 2024, first training course launched in 2025							
	Information/promo tion campaign - TED talks, What a difference quality makes	E.2.3	What benefit investment in QMS brings, why it is key to deliver quality services, sharing of good and bad experiences with community members	1, 2, 3, 4, 5, 6, 7, 8	2.1, 2.2	10 TED talks available , number of views	2025	HCP	Technical support for recording and publishing	Members, Secretariat	Capacity developme nt programm e,		
	Field safety manual/training course)	E.2.4	Generic annotated structure of field safety manual will help Members to develop their fit for purpose guidelines. Interactive courses, describing problems, sharing bad and good examples (such as problems with cyber security) is developed for practitioners in the field	1, 2, 5	2.1	Manual publishe d, inter-active course available with at least 50 participa nts by 2025	2025	INFCOM	Technical support	Members, RAs	Capacity developme nt programm e, HCP	QMF-H	Potential to involve external partners e.g. through hackathons
Assumptions	Members will continue to be motivated to adequately support research and monitoring in order to better understand the behaviour and changes of the water cycle												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda and thus in the sustainability of monitoring networks (especially at long-term-observing sites) and in projects in the field of hydrology and water management. • The increase in automated data availability and alternative sources of data is not accompanied by an equivalent increase in competence and capacity to manage data quality control and QMF-H compliance. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP) leads to competition for attention of governments.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Respon sibility	Resources	Partners	Linkages	MOA	Comments
E.3 Improved development and maintenance of technical platforms to support data discovery and accessibility for exchange for research and science	WHOS/WIS/WIGOS as a tool for data provision	E.3.1	Including improving WIGOS OSCAR platform to suit hydrological purposes	1, 2, 3, 4, 5, 6, 7, 8,	2.1, 2.2	Number of countries implementing WHOS phase II	2025	INFCOM		WHOS		HDOM	
	Evolving role of data centres helps Members to share and rescue their data	E.3.2	Updated definition of roles of GTN-H centres to better support WHOS	4	2.2	New role definition adopted by CG	2023	INFCOM		GTN-H		HDOM	
Assumptions	Members will continue to be motivated to adequately support research and monitoring in order to better understand the behaviour and changes of the water cycle												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda and thus in the sustainability of monitoring networks (especially at long-term-observing sites) and in projects in the field of hydrology and water management. • The increase in automated data availability and alternative sources of data is not accompanied by an equivalent increase in competence and capacity to manage data quality control and QMF-H compliance. • Satellite data will replace in situ observations without sufficient verification, and continuity of the long-term observation series is not maintained. • Technological solutions of monitoring (e.g. satellites), data transfer (internet, cell phone networks) and data storage (cloud solutions) will become more vulnerable to cyber-security incidents (hacking attacks, single point of failure). • Lack of financial resources for core activities of the Secretariat.												
E.4 Improved coordination on observing networks to fit research purposes	WMO, UNESCO-IHP, IAHS, ERB, FRIEND, colloquium on data for scientific purposes - what and how to measure to enhance scientific progress	E.4.1	Building a mutual understanding and stimulating efforts to compile the largest sets of data possible for scientific assessment and research of the hydrological cycle and its changes	4	2.2, 2.1	Conclusions of colloquium leads to concept note on coordination of networks	2024	INFCOM		UNESCO-IHP	HCP, RB,	HDOM	
	same as E.3.1	E.3.1											

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Respon sibility	Resources	Partners	Linkages	MOA	Comments
	same as E.3.2	E.3.2											
Assumptions	Members will continue to be motivated to adequately support research and monitoring in order to better understand the behaviour and changes of the water cycle												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda and thus in the sustainability of monitoring networks (especially at long-term-observing sites) and in projects in the field of hydrology and water management. • The increase in automated data availability and alternative sources of data is not accompanied by an equivalent increase in competence and capacity to manage data quality control and QMF-H compliance. • Satellite data will replace in situ observations without sufficient verification, and continuity of the long-term observation series is not maintained. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP) leads to competition for attention of governments.												

Ambition/goal: Science provides a sound basis for operational hydrology

Outcomes	(a)	Reduced gap between research and operational hydrology applications; operational hydrology uses improved understanding of Earth system science;
	(b)	There is a greater understanding of how the hydrological system responds to extreme conditions.
Measure of success	(a)	Number of WMO (co-)sponsored research programmes/projects that includes implementation of operational hydrological applications at Members' level during 2021–2030;
	(b)	Number of cooperation agreements between NHSs and research institutions at national, regional and global levels; exchange of scientific personnel, increase of staff with a science-based education and training at MSc and higher levels.

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
F.1 Enhanced culture of research and development-to-operation-projects to be co-designed by the operational hydrology and academia sectors – (demonstration) projects are developed, with the beneficiaries being National Meteorological and Hydrological Services	Catalogue of case studies/best practices (or may be bad practices as well)	F.1.1	Where cooperation between scientific and operational entities led to a speeding up of practice through implementation of research (on-demand) outputs, where lack of coordination led to wasted resources and competition	5	3.2, 4.1	Catalogue published	2024	RB		UNESCO-IHP	HCP, SERCOM, INFCOM		
	Database of research needs from NHSs as a project topics repository for scientists	F.1.2		5	3.2, 4.1	Database available	2023	RB		UNESCO-IHP, IAHS	HCP, SERCOM, INFCOM		
	Implementation of research strategy for hydrology and its update based	F.1.3	In cooperation with UNESCO and IAHS	5	3.1, 3.2, 3.3, 4.1	As defined in the	Review on a bi-annual basis	RB		UNESCO-IHP, IAHS	HCP, SERCOM, INFCOM		

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	on changing requirements					research strategy							
Assumptions	Members continue to be motivated to adequately support research and development to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased resources for scientific projects and research • Increased competition between the science and operational sectors for funding and staff as a result of limited resources • Asymmetry in benefits from cooperation between operations (providing data free of charge) and science (e.g. paywall publications) decreases the willingness to work together • Unhealthy competition with UNESCO-IHP in the field of hydrological research competence • Globalization of research leads to "non-recognition" of NHSs as users of research outputs												
F.2 Enhanced collaboration between hydrology and meteorology communities of practice, including academia	Similar to activities relating to the inventory of operational products, research outputs are compiled to be accessible for operational hydrology applications where relevant	F.2.1	See A.11, B.7 and C.2: Various research activities produce data and products that are valuable as potential inputs for hydrological analysis on regime change and design and which can be used in the area of water management; making these data and products easily accessible will allow NHSs to perform their duties more effectively.	5	3.4, 4.1	Inventory is accessible	2024	RB		UNESCO-IHP, IAHS	INFCOM, SERCOM		
Assumptions	Members continue to be motivated to adequately support research and development to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
Risks	None												
F.3 Inventory of the compiled data and products from Earth system science projects for hydrological applications	Improving QPE and QPF by research focus	F.3.1	Global community of NWP and downscaling works together on providing QPE and QPF at relevant scales (< 1 square km)	5, 1, 2	3.1, 3.2	Increased performance of QPE and QPF at 1 km resolution from the perspective of hydrological applications	2027	RB		Academia, Members, NWP consortia	INFCOM, SERCOM, WWRP, WCRP		
	Guidance on coupled model systems, interfaces	F.3.2	Provision of case studies, compendium of relevant methodologies	5, 1, 2	3.1, 3.2	Applications	2027	RB			INFCOM, SERCOM, WWRP, WCRP		
Assumptions	Members continue to be motivated to adequately support research and development to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased resources for scientific projects and research • Globalization of research leads to "non-recognition" of NHSs as users of research outputs												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
F.4 Improved Earth system models at high resolution for local and regional applications	Development of tools and modules to assess and analyse the uncertainty of extreme conditions are available.	F.4.1	Research community further develops uncertainty and scenario analysis that can be directly used to design/manage infrastructure and water systems.	5, 1, 2	1.3, 3.2			RB		UNESCO, academia	SERCOM		
Assumptions	Members continue to be motivated to adequately support research and development to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased resources for scientific projects and research • Globalization of research leads to "non-recognition" of NHSs as users of research outputs												
F.5 There is a greater understanding of how the hydrological system responds to extreme conditions	Inclusion of the needs and requirements of different stakeholders (energy-water-food), moving towards an MHEWS approach (e.g. with the integration of FFGS/CIFI/SWFP) for the possible future integration of hydrology in GMAS (including reflecting hydrological hazards in the catalogue of hazardous events)	F.5.1	Same as B.4.1	5, 3	5.2, 3.2			SERCOM		UNESCO	RB	FFI-DRR	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Widen the implementation of a water segment towards the creation of Regional Outlook Fora (ROFs), based on the successful experience of RCOFs with the water segment in Central America	F.5.2	Same as C.7.1										
Assumptions	Members continue to be motivated to adequately support research and development to better understand the behaviour and changes of the water cycle as a prerequisite for making informed decisions on water management and adaptation to climate change.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased resources for scientific projects and research. • Unhealthy competition with UNESCO-IHP in the field of hydrological research competence. • Globalization of research leads to "non-recognition" of NHSs as users of research outputs.												

Ambition/goal: We have a thorough knowledge of the water resources of our world

Outcome	(a) Members implement reliable water resource assessment systems and use these to complete and share information on the availability of water resources.
Measure of success	(a) Number of Members completing and sharing water resource assessments, including via HydroSOS or WMO regional systems; (b) Annual reports on the status of global water resources published from 2025 onwards

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time-frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
G.1 Current and future status/assessments of water resources are available at different spatial and temporal scales and cover a large range of products, including snow, groundwater, lakes, and reservoirs	Implementation of HydroSOS at the global scale,	G.1.1	HydroSOS is implemented according to its implementation plan – water resource assessment activities at the national scale provide inputs to the HydroSOS.	6	1.3, 1.2	Number of Members contributing to HydroSOS	2021 – 2030	HCP			INFCOM, SERCOM	Hydro SOS	
Assumptions	Members will keep recognizing water management to be a critical service for nations and at the transboundary level.												
Risks	The post-COVID situation will change Members' priorities and limit resources for the wider implementation of HydroSOS.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time-frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
G.2 The WMO community informs high-level policy discussions at the global scale	Developing the format and specifications for a general advisory (specification of the aim, users, content, template, frequency of production, responsibilities)	G.2.1	Concept note on the general advisory will be developed as an initial step for operation	6	1.3, 1.2	Concept note presented to EC in 2022	2022	HCP, SERCOM			RAs	Hydro-SOS	
	Support network/structure for production of the advisory is established (preferably building on regional and global centres of GDPFS) based on G.2.1	G.2.2	Based on a concept note, a framework and process for production of the advisory	6	1.3, 1.2	Framework established by 2023	2023	SERCOM, HCP			RAs	Hydro-SOS, HDOM	
	Launch of the product and support of its use and sharing	G.2.3		6	1.3, 1.2	First report launched for 2023	2024	SERCOM, HCP, Secretariat			RAs	Hydro-SOS, HDOM	
Assumptions	Members will keep recognizing water management to be a critical service for nations and at the transboundary level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, UNEP) leads to competition and duplication of work and funding.												
G.3 Data, products and model results, at adequate spatial and temporal resolutions, are available for actionable planning and operations at the local scale.	Global products for local use – Regional Specialized Hydrological Centre (RSHC) of GDPFS provide to Members WRA products, including training	G.3.1	Develop a system of GDPFS centres that produce data and information that are specialized to support Members' water	6, 2, 3	2.3, 1.2, 1.3	At least one GDPFS centre provides WRM supporting products at global scale.	2025	SERCOM, INFCOM			HCP	HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time-frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	products and tools for interpretation.		resources assessments based on their requirements. Members are provided with training materials and tools if needed to interpret GDPFS products for national and local applications for WRM.										
Assumptions	Members will keep recognizing water management to be a critical service for nations and at the transboundary level.												
Risks	• The post-COVID situation might change the availability of resources for establishing new or widening the scope of current GDPFS centres to deliver desired products. • Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, UNEP) leads to competition and duplication of work and funding.												
G.4 Increased national capacities to collect water-related data and transform them to useful/relevant products through capacity building. (The staff members of NMHSs understand the societal impacts of water and water resources management plans and decisions and the importance of WRAs for various stakeholders, and	Development and implementation of WRA community of practice (which provides up-to-date information and enables knowledge transfer in the field of water resources assessment)	G.4.1	Community of practice for water resources assessment supports NMHSs, including support to apply available tools and products (such as DWAT); community of practice is vital for sharing of knowledge and tools among Members.	6	4.2, 4.1, 1.3	Number of Members participating to activities of the community	2023	SERCOM			HCP	Hydro-SOS	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time-frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
are well informed on the technologies available for them to best carry out their tasks and experts in those that best suit their key applications.)	Within the framework of G.4.1, a decision tree/checklist (comparison engine) is developed to enable the selection of proper methodologies and tools for WRA by Members	G.4.2		6	4.2, 4.1, 1.3	Checklist available through the community by 2024	2024	SERCOM				Hydro-SOS	
	Training curriculum for WRA developed as a part of the capacity development strategy of the WMO	G.4.3	Needs (topical, and on form) of Members are properly identified to propose curricula of courses and training materials in support of capacity building in the domain of WRA	6, 2, 3	4.2, 4.1, 1.3	Capacity development strategy updated in 2023	2023	CDP		Members, Ras.	HCP, SERCOM	Capacity Development, Hydro-SOS	
	E-learning training course(s) for water resources assessment	G.4.4	Based on curricula, courses and training materials are developed	6, 2, 3	4.2, 4.1, 1.3	Review of progress presented to Hydrological Assembly/Cg	2025	CDP			SERCOM	Capacity Development, Hydro-SOS	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time-frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Twinning projects targeted at WRA skills	G.4.5	Twinning projects between Members target WRA and WRM	6	4.2, 4.1, 1.3	Review of progress presented to Hydrological Assembly/Cg	2025	SERCOM		Members, RAs.	HCP		Linked to output 9, activity area 2
	Compendium of societal, economic and ecological relations/dependency on water/hydrological cycle	G.4.6	Compendium will be based on based on review of existing studies, synergizing and collating information	6	4.2, 4.1, 1.3	Compendium presented	2005	RB, SERCOM		Members, RAs.	HCP	Hydro-SOS, Capacity Development	
	WRA 'manual' published	G.4.7	Finalization of WRA manual and its publication	6	4.2, 4.1, 1.3	WRA manual published	2023	SERCOM			HCP	Hydro-SOS	
Assumptions	Members will keep recognizing water management to be a critical service for nations and at the transboundary level.												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, results in decreased involvement in the water-related agenda. • Lack of alignment with other activities in the field of water (e.g. UNESCO-IHP, UNEP) leads to competition and duplication of work and funding. • Loss of support from Members in key activities, such as providing resources, data and information for shared systems. • Lack of financial resources for core and extra-budgetary activities of the Secretariat.												

Ambition/goal: Sustainable development is supported by hydrological information

Outcome	(a)	Hydrological information of adequate resolution, quality and timeliness is available and is used to make informed decisions on sustainable development at all scales.
Measure of success	(a) (b)	Number of Members including hydrological aspects and water budget information in their development plans at the national level; Number of Members reporting on SDGs using reliable hydrological data and indicators.

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
H.1 Improved data policies and financing schemes and enhanced political arrangements to collect hydrologic data and derived products	Implementation of WMO unified data policy at Members' level (assessment of compliance with respect to the provision of essential and desirable data) to enhance the quality of local/national/regional/global observation networks and delivery systems	H.1.1	See cross-cutting activities	6,7	2.1, 2.2	Update of TechReg with mechanism for core data by 2023, number of Members providing core data by 2027	2023, 2027	INFCOM			HCP, Members RAs	HDOM	Activity needs to reflect ongoing work on data policy by SG-DIP

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Recognition mechanism of long-term observing station in hydrology	H.1.2		6,7	2.1, 2.2	First hydrological stations are recognized by Cg	2023	INFCOM			HCP	HDOM	
	For additional see action area on NHSs for cross-cutting data activities												
Assumptions	The Sustainable Development Agenda will remain a key priority of the United Nations and will receive adequate support from Member States throughout its implementation. The new WMO unified data policy is adopted by the Cg-Ext. 2021												
Risks	• Changes in overall political and societal priorities, e.g. due to the COVID-19 pandemic, result in decreased involvement in the water-related agenda in support of SDGs. • Lack of expertise mobilized by Members for the WMO Expert Network to deliver on planned activities given the fact that SDG support is not a common responsibility of NHSs.												
H.2 Intensified national, basin, transboundary and international cooperation and activities to meet the SDGs	Support building of national, basin and transboundary partnerships for water SDGs	H.2.1	Compilation of success stories and good examples (EU, basin organizations, etc.), basic advice on modes of operation for partnerships of various organizations	7	1.3	Document ready by 2025	2025	HCP		INBO		WWDI, HDOM	Output on meeting SDGs
	Partnership with FAO (AquaStat) and UNESCO established to develop a plan to define which data/information/ products produced by Members should be collected in global databases	H.2.2		7	1.3	Joint plan developed	2024	Secretariat, HCP		FAO, UNESCO WHO, UN-WATER		WWDI, HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	supporting the SDGs												
	Define set of parameters to monitor and support sustainable development on a long-term scale in cooperation with relevant organizations	H.2.3		7	1.3	Set of parameters agreed by WMO, UNESCO and FAO	2024	Secretariat, HCP, INFCOM		FAO, UNESCO UN-WATER	INFCOM	WWDI, HDOM	
Assumptions	The Sustainable Development Agenda will remain a key priority of the United Nations and will receive adequate support from Member States throughout its implementation.												
Risks	• Lack of alignment with other activities on SDG implementation related to water (UN-Water, UNESCO-IHP, etc.) leads to competition and duplication of work and funding												
H.3 Basic tools to assist Members are created, including an archive of relevant information, tools for transforming data to information, and maintenance of essential "treasury/heritage" variables to support sustainable development	Concept note for WMO hydrology cloud developed (for storage of essential data of Members (based on a review of the role of data centres role))	H.3.1	Feasibility study of hydrology cloud to support SDGs and Members, will need requirements from Members, viable technical and organizational solutions to be described	6,7	2.2, 4.1	Feasibility study submitted to EC for decision	2024	INFCOM			WHOS, HCP	HDOM	
	Eventual implementation if agreed by Cg	H.3.2			2.2, 4.1							HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Sharing of data from recognized centennial/reference (GBON-hydrology and Data centres) stations in hydrology	H.3.3	Need to be updated based on concept of data resolution implementation for hydrology – see also cross-cutting activities	6,7	2.2, 4.1, 2.1	GBON hydrology established	2025	INFCOM			WHOS, HCP	HDOM	Need to reflect results of review of the role of data centres
	Software (possibly a cloud solution) for computation of parameter defined under H.2.3	H.3.4	Supporting Members with automatic computation of selected parameters based on data they measured	6,7	4.1, 2.2,	Feasibility study presented to EC, possibly jointly with 8.1	2024	INFCOM			WHOS, HCP	HDOM	
	Presentation of data sets for evaluation - web presentation of data sets for SDGs	H.3.5		6,7	1.3	Web page launched	2027	INFCOM			WHOS, HCP		
Assumptions	The Sustainable Development Agenda will remain a key priority of the United Nations and will receive adequate support from Member States throughout its implementation. The new Unified Data policy is adopted by the Cg in 2021.												
Risks	• Loss of support from Members for developing new activities (including HydroSOS, GBON, SOFF etc.) by providing resources, data and information for shared systems. • Lack of expertise mobilized by Members for the WMO Expert Network to deliver on planned activities given the fact that SDG support is not a common responsibility of NHSs.												

Ambition/goal: Water quality is known

Outcome	(a)	Increased cooperation at the national, regional and global level on water quality monitoring and water quality data exchange.
Measure of success	(a)	Number of Members running water quality monitoring programmes, performing water quality assessments and sharing their data.

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
I.1 Partnership at the United Nations level exists and promotes the provision of water quality data from NHSs to existing information systems (such as WHOS, UNEP, GEMS/Water, UNESCO-IHP, IIWQ and ISI).	WMO participates in and contributes to the World Water Quality Alliance convened by UNEP	I.1.1	Develop a work plan to reinforce collaboration with UNEP and UNESCO and to provide expertise to WWQA on standardization methods and information systems.	8	1.3, 4.3	Working procedure and work plan presented to Cg	2023	HCP, Secretariat		UNEP and WWQA partners, UNECE Water Convention	INFCOM, SERCOM		
	WHOS interconnection to GEMS/IIWQ	I.1.2	Water quality data are registered and shared via WHOS, interconnecting national and global data portals.	8	1.3, 2.1, 2.2, 4.1, 4.2, 4.3	Number of Members providing water quality data through WHOS	2027	INFCOM		UNEP, UNESCO	INFCOM, WHOS	HDOM	
	Supporting WaterML-WQ development	I.1.3	WaterML-WQ format is further developed and adopted as standard for WQ data transfer and sharing	8	1.3, 2.1, 2.2	Standard adopted by Cg	2027	INFCOM		OGC, UNEP, UNESCO	INFCOM, WHOS	HDOM	
Assumptions	Relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities, aiming for the same goals and providing the necessary resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.												
Risks	• The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit the development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic. • Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react. • An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs, and it might be difficult to approach them and to encourage them to contribute.												
I.2 Increased NHS involvement in the co-production of water quality related data and products thanks to promotion of IWRM principles.	Water quality training materials development	I.2.1	After identification of the priority needs for training from Members' NHSs, needs training materials and activities are developed building on WWQA Capacity Development Consortium (CDCm).	8	1.3	Basic training curricula for water quality available for Members by the end of 2025, at least 25 participants finalized (e-course).	Identification of priorities - 2023, priority training materials ready by 2025	CDP		UNEP	INFCOM, SERCOM	CB	
	Supporting building of national partnerships for water quality	I.2.2	Compilation of success stories and good examples (EU, basin organizations, etc.), basic advice on modes of operation for partnerships of various organizations, compilation of WWQA partners best practices including Africa Use Cases and other examples of	8	1.3	Compilation available to Members	2023	HCP		UNEP	INFCOM, SERCOM	CB	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
			partnership building across workstreams										
	Support of development of data policies that support water quality monitoring and assessment	I.2.3	Review of the definition of essential data in view of water quality assessment needs	8	1.3	Hydrological data requirements for water quality monito-ring programmes and essential water quality data identified and adopted in Annex to Res. 42	2023	INFCOM		UNEP (GEMS)	HCP, SERCOM	HDOM	GEMS/ Water and GEMStat need to be considered together with a United Nations Environment Data Strategy /Policy to make sure data can be used across the board and in various contexts and easily feed into GEMStat while considering interoperability
	Supporting basin organization in the water quality agenda	I.2.4	Compilation of success stories and good examples (EU, basin organizations, Africa etc.), basic advice on water quality monitoring and assessment programmes and action plans	8	1.3	How to handbook available to Members	2025	HCP		UNEP	SERCOM, INFCOM	HDOM	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Supporting formulation of the National Water Quality Management Strategy, action plan and monitoring programs (Task #1)	I.2.5	Guidelines supporting Members NHSs in developing complete frameworks for water quality monitoring from definition of strategy, through development of National Water Quality Management Plan/Framework and screening of relevant issues (pollutants, processes etc.), to design and systematic realization of monitoring programmes	8		Guidelines published	2027	INFCOM, HCP		UNEP		HDOM	Synergies with GEMS/ guidelines on water quality monitoring must be assured
Assumptions	Relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities aiming for the same goals and providing the necessary adequate resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.												
Risks	• The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic. • Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react. • An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs and it might be difficult to approach them and to encourage them to contribute.												
I.3 Increased joint water quantity and water quality assessment	Review of the state of operational monitoring, modelling and	I.3.1	Based on I.2.5, a review of the state of operational monitoring, modelling and	6, 7, 8	1.3, 4.1	Review presented to Cg	2023	HCP, Secretariat		UNEP, UNESCO	INFCOM, SERCOM	HDOM, Hydro SOS	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
(monitoring and modelling) for operational management and for planning	assessment of water quality at the Member and basin level building on the World Water Quality Assessment undertaken by the WWQA		assessment of water quality will be done to inform other activities										
	Development of joint WMO-UNEP-UNESCO strategy to increase water quality assessment availability from Members and basins	I.3.2	SDGs 3.9, 11.6, 12.4, 14.1, 14.2, 6.3, 6.5 are closely related to water quality. Their achievement requires a coordinated effort from all United Nations agencies involved to develop projects to establish sustainable system of monitoring and assessment of water quality in countries where such a system does not exist. Based on the World Water Quality Assessment and the work plan developed under 3.1, the inclusion of WQ aspects in development projects will be supported.	6, 7, 8	1.3, 4.1	Strategy adopted by Cg/EC	2024	HCP, Secretariat		UNEP, UNESCO	INFCOM, SERCOM	Hydro SOS	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Development of concept paper for inclusion of WQ for HydroSOS	I.3.3	Based on I.3.2, a concept paper on how to enlarge the scope of HydroSOS by adding water quality information provided by Members will be developed	6, 7, 8	1.3, 4.1	Concept paper presented to Cg/EC	2025	SERCOM		UNEP, UNESCO	INFCOM, HCP	Hydro SOS	
	Country profile database collects basic information on water quality monitoring programmes	I.3.4	Optimized structure of information on water quality monitoring and assessment is used for evaluation of performance and needs for development and to support activities of WMO/UNEP/UNESCO partnership on water quality. Implementing basic supporting information to CPDB in coordination with GEMS/Water Capacity Development Centre.	8	1.3, 2.1, 4.1, 4.3	Water quality monitoring network and assessment report	2023	HCP, Secretariat		Member states	Community of practice, INFCOM, SERCOM		
Assumptions	Relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities, aiming for the same goals and providing the necessary resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.												
Risks	• The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit the development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic. • Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	• An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs and it might be difficult to approach them and to encourage them to contribute.												
I.4 Water quality aspects are included in country support activities/projects in the spirit of IWRM and in cooperation with other organizations	Partnership with UNEP, UNESCO, UNDP and WB on how to implement water quality aspects to develop projects	I.4.1	SDGs 3.9, 11.6, 12.4, 14.1, 14.2, 6.3, 6.5 are closely related to water quality. Their achievement demands on coordinating the efforts of all involved United Nations agencies to develop projects to establish a sustainable water quality monitoring and assessment system in countries where such a system does not exist. Defining how to best coordinate efforts with respect to this issue needs to be the first step.	8	1.3, 4.1, 4.2, 4.3	50% of country support projects in hydrology include the water quality aspect	2023	Secretariat, HCP		UNEP, UNESCO, WB, UNDP		HDOM	
	Definition of minimum requirements/checklist for water quality aspects to be included in country support activities based on I.4.1	I.4.2		8	1.3, 4.1, 4.2, 4.3	50% of country support projects in hydrology include the water quality aspect	2023	Secretariat, HCP		UNEP, UNESCO, WB, UNDP		HDOM	
Assumptions	Relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities, aiming for the same goals and providing the necessary resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.												

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
Risks	• The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit the development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic. • Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react. • An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs and it might be difficult to approach them and to encourage them to contribute.												
I.5 Partnership at the United Nations level delivers co-produced guidelines related to water quality	Establishing WMO-UNEP partnership/ mechanism on guidelines delivery and updating	I.5. 1	Responsibility for water quality at the United Nations level is shared between WMO and UNEP. Building on existing UNEP work (guidelines), a jointly coordinated effort needs to be established to compile guidelines and for operational hydrological services. The joint group should establish working procedures and develop a work plan.	8	1.3, 4.1, 4.2, 4.3	Joint group established and plan created for work to be done and deliverables (guidelines, etc.)	2023	INFCOM (JET/HYDM ON)		UNEP, (UNESCO-IHP for sediment transport)	SERCOM (SC-HYD) if water quality assessment issues are considered	CB, QMF-H	Likely to be part of activity 3.1 and connected to 2.5
	Development of technical regulation annex on water quality	I.5. 2	New structure of Technical Regulation Vol. III foreseen to develop annex on water quality. It shall be developed via mechanism of cooperation between WMO and UNEP and other partners as appropriate	8	1.3, 4.1, 4.2	Annex adopted by Cg	Based on 4.1	INFCOM (JET/HYDM ON)		UNEP, UNESCO-IHP	SERCOM (SC-HYD) if water quality assessment. Issues are considered	QMF-H	

Output	Activity	ID	Description	LTA	SOP	Success criteria	Time frame	Responsibility	Resources	Partners	Linkages	MOA	Comments
	Development of guidelines according to 4.1.	I.5.3	Based on identification of joint work group, necessary guidelines supporting NHSs involvement in water quality monitoring and assessment will be developed.	8	1.3, 4.1, 4.2,	Guidelines published	Based on 4.1	INFCOM (JET/HYDMON)		UNEP, UNESCO-IHP	SERCOM (SC-HYD) if water quality assessment issues are considered	QMF-H	
Assumptions	The proposed activities and outputs are based on the basic assumption that relevant partners (UNEP, UNESCO, WHO, UNDP, WB) will join WMO in these activities, aiming for the same goals and providing the necessary resources. Additionally, there is the assumption that there will be an increased demand from Members for water quality related actions from WMO. In particular, Members with no systematic programmes for water quality monitoring and assessment will aim to develop and maintain these programmes as a priority and will contribute to the achievement of SDGs.												
Risks	• The global COVID-19 pandemic represents an imminent risk of failing to achieve all outputs. The post-pandemic economic situation might further limit the development of relatively expensive measures in water quality due to a decrease with respect to the resources available and a potential shift in priorities at the national and global level to recovery from the pandemic. • Limited resources might limit both the demand from Members, as well as the capacity of the United Nations system to react. • An additional risk would be the failure of Members to mobilize the expertise required for the WMO Expert Network to deliver on planned activities. Given the fact that water quality is not always the responsibility of NHSs, experts are often located outside of NMHSs and it might be difficult to approach them and to encourage them to contribute												

ANNEX II

MAPPING OF THE VISION AND STRATEGY FOR HYDROLOGY
ON TO THE WMO STRATEGIC PLAN

WMO Strategic Plan	Vision and Strategy for Hydrology
Vision	
By 2030, we see a world where all nations, especially the most vulnerable, are more resilient to the socioeconomic consequences of extreme weather, climate, water and other environmental events; and underpin their sustainable development through the best possible services, whether over land, at sea or in the air	By 2030, a cooperative global community is successfully addressing the growing challenges related to hydrological extremes, water availability and quality, and food security, by advancing operational hydrology, through enhanced science, infrastructure, capacity building and related services, in the context of sustainable development and enhanced resilience
Mission	
To facilitate worldwide cooperation on monitoring and predicting changes in weather, climate, water and other environmental conditions through the exchange of data, information and services, standardization, application, research and training	
Key Drivers/ High-level requirements	
Global agenda creating unprecedented demand for actionable, accessible and authoritative science-based information Increasing threats of extreme weather and climate urge action for resilience, mitigation and adaptation Growing capacity gap threatens global infrastructure and services Rapid advancements in science and technology and changing landscape of data and service delivery urge for innovative partnerships	Policy and decision-making that contribute to the achievement of Sustainable Development Goals related to water Real-time management of flood and drought events and integrated flood management and planning, including inundation mapping in support to MHEWS Integrated water resources management in national and transboundary catchments, including information on water quality, sediments and other elements Civil engineering for design and management of infrastructure (including dams and fluvial transport) Agriculture for decisions on agrotechnical practices, drainage and irrigation schemes and management Ecosystem management including wetlands

WMO Strategic Plan	Vision and Strategy for Hydrology
	Academic support for climate and hydrological regime studies, trend analysis, decision support systems
Overarching Priorities/Guiding principles	
Enhancing preparedness and reducing loss of life, critical infrastructure and livelihood from hydrometeorological extremes Supporting climate-smart decision-making to build or enhance adaptive capacity or resilience to climate risk Enhancing socioeconomic value of weather, climate, hydrological and related environmental services	Hydrological data and products are a global public good: Free and unrestricted access to public and private high-quality hydrological data and products for all Interoperability is key to improved services: Related disciplines, data, models, and risk management systems across all scales need to be interoperable and connected wherever it improves our analysis and optimization capabilities Capabilities are catalysed through digital revolution: Using the full potential of the digital revolution to improve science and operations Innovation and technology will improve established systems which will benefit from new sources of information Hydrological services are sustainable: Hydrological services are recognized as being of high priority and of public interest having clearly defined roles and responsibilities and sustainable financing. New actors are incorporated along the hydrological value chain from data to product/service Water quality and quantity issues must be addressed in an integrated, holistic way, following the principles of integrated water resources management (IWRM)
Long-term Goals/ Ambitions	
Goal 1: Better serve societal needs: delivering, authoritative, accessible, user-oriented and fit-for-purpose information and services	• No one is surprised by a flood • Everyone is prepared for drought • Hydroclimate and meteorological data support the food security agenda • Science provides a sound basis for operational hydrology • We have a thorough knowledge of the water resources of our world • Sustainable development is supported by hydrological information • Water quality is known

WMO Strategic Plan	Vision and Strategy for Hydrology
Goal 2: Enhance Earth system observations and predictions: Strengthening the technical foundation for the future	• No one is surprised by a flood • Everyone is prepared for drought • High-quality data supports science • We have a thorough knowledge of the water resources of our world • Sustainable development is supported by hydrological information • Water quality is known
Goal 3: Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services	• Science provides a sound basis for operational hydrology
Goal 4: Close the capacity gap on weather, climate, hydrological and related environmental services: Enhancing service delivery capacity of developing countries to ensure availability of essential information and services needed by governments, economic sectors and citizens	• No one is surprised by a flood • Everyone is prepared for drought • Hydroclimate and meteorological data support the food security agenda • High-quality data supports science • Science provides a sound basis for operational hydrology • We have a thorough knowledge of the water resources of our world • Sustainable development is supported by hydrological information • Water quality is known
Goal 5: Strategic realignment of WMO structure and programmes for effective policy- and decision-making and implementation	• No one is surprised by a flood • Everyone is prepared for drought • Science provides a sound basis for operational hydrology
Objectives/outputs	
Goal 1: Better serve societal needs: delivering, authoritative, accessible, user-oriented and fit-for-purpose information and services	
Objective 1.1 Strengthen national multi-hazard early warning/alert systems and extend reach to better enable effective response to the associated risks	Enhanced coordination, effectiveness and governance of all WMO activities in supporting Members in Flood Risk Assessment and Flood Forecasting and Warning Enhanced collaboration among NHSs, NMSs and other organizations (e.g. DRR authorities) at national level in developing and operating E2E MHEWS particularly including floods

WMO Strategic Plan	Vision and Strategy for Hydrology
	Increased Members' capacities to deliver and communicate to the public and to raise the awareness Increased capacities of Members through development projects in the area of drought monitoring, early warning, vulnerability and impact assessment, adaptation and mitigation, preparedness and response
Objective 1.2 Broaden the provision of policy- and decision-supporting climate information and services	The need of an effective national drought policy is understood by Members *Increased Members capabilities in drought vulnerability of and impact assessment on different sectors by meaningful drought indicators and indices used at all relevant scales*
Objective 1.3 Further develop services in support of sustainable water management	Increased Members' capacities to deliver and communicate to the public and to raise the awareness Increased Members' and regions' (basin authorities) application of Integrated flood risk management principles in flood prevention, preparedness and response The need of an effective national drought policy is understood by Members Increased Members capabilities in drought vulnerability of and impact assessment on different sectors by meaningful drought indicators and indices used at all relevant scales Increased cooperation (and co-production of services) among the hydrological, meteorological and climatological communities and international exchange of experiences (e.g. higher involvement of hydrologists in climate outlook forums, of meteorologists and climatologists in river basin commissions) Increased capacities of Members through development projects in the area of drought monitoring, early warning, vulnerability and impact assessment, adaptation and mitigation, preparedness and response Increased production and/or availability of agrometeorological and hydrological forecast from sub-seasonal to seasonal

WMO Strategic Plan	Vision and Strategy for Hydrology
	Effective dialogue between users and providers established Water-food-energy nexus and ecosystem services are better understood and inform water resources management There is a greater understanding of how the hydrological system responds to extreme conditions Current status/assessment of water resources is available at different spatial and temporal scales and covers a large range of products including e.g. snow, groundwater, lakes, and reservoirs The WMO community informs high-level policy discussions at global scale with (e.g. a global assessment or hot spot report) Increased NHSs involvement in co-production of water quality related data and products thanks to promotion of IWRM principles Partnership at UN level exists and promotes provision of water quality data from NHSs to existing information systems (such as WHOS, UNEP GEMS/water and UNESCO-IHP IIWQ and ISI) Increased presentation/communication and understanding of value proposition, benefits and risk analysis, and value of hydrological services to foster understanding by ministries and governments
Objective 1.4 Enhance the value and innovate the provision of decision-supporting weather information and services	Flood related data and products with global and regional coverage are available for use at national scale by Members Increased Members' capacities to deliver and communicate to the public and to raise the awareness

WMO Strategic Plan	Vision and Strategy for Hydrology
Goal 2: Enhance Earth system observations and predictions: Strengthening the technical foundation for the future	
Objective 2.1 Optimize the acquisition of Earth system observation data through the WMO Integrated Global Observing System (WIGOS)	Drought-related data and products with global and regional coverage are available for use at national scale by Members Methods for standard assessment of data quality developed Quality assured hydrometeorological data by NHSs are generated through increased compliance to the culture of Quality Management Framework – hydrology (QMF-H) Improved guidance for development and maintenance of technical platforms to support data exchange for research and science Improved data policies, financing schemes, and enhanced political arrangements to collect hydrologic data and derived products Increased joint water quantity and water quality assessment (monitoring and modelling) for operational management and for planning Sustainable projects help build capacities of NHSs Effective and efficient, low-cost methods for hydrological observations are broadly available *Increased availability and international exchange of hydrometeorological data for operational flood forecasting and early warning and enhanced international cooperation in flood management especially for transboundary basins on a free and unrestricted basis.*
Objective 2.2 Improve and increase access to, exchange and management of current and past Earth system observation data and derived products through the WMO Information System	Improved guidance for development and maintenance of technical platforms to support data exchange for research and science Improved coordination on observing networks to fit research purposes Basic tools to assist members are created, including an archive of relevant information, tools for transforming data to information, and maintenance of essential

WMO Strategic Plan	Vision and Strategy for Hydrology
	"treasury/heritage" variable to support sustainable development Increased NHSs involvement in co-production of water quality related data and products thanks to promotion of IWRM principles *Increased availability and international exchange of hydrometeorological data for operational flood forecasting and early warning and enhanced international cooperation in flood management especially for transboundary basins on a free and unrestricted basis*
Objective 2.3 Enable access and use of numerical analysis and Earth system prediction products at all temporal and spatial scales from the WMO seamless Global Data Processing and Forecasting System	Flood related data and products with global and regional coverage are available for use at national scale by Members Drought-related data and products with global and regional coverage are available for use at national scale by Members Data, products and model results, at adequate spatial and temporal resolutions, are available for actionable planning and operations at the local scale (High resolution data and modelled information are available for actionable planning and operations at the local scale)
Goal 3: Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services	
Objective 3.1 Advance scientific knowledge of the Earth system	Enhanced culture of research and development to operation projects co-design (by operational hydrology and academia) – (Demonstration) projects are developed with beneficiaries being National Meteorological and Hydrological Services Improved Earth system models outputs and its availability at high resolution for local and regional applications
Objective 3.2 Enhance the science-for service value chain ensuring scientific and technological advances improve predictive capabilities	Enhanced culture of research and development to operation projects co-design (by operational hydrology and academia) – (Demonstration) projects are developed with beneficiaries being National Meteorological and Hydrological Services

WMO Strategic Plan	Vision and Strategy for Hydrology
	Inventory of the compiled data and products from Earth systems science projects for hydrological applications Effective and efficient, low-cost methods for hydrological observations are broadly available Enhanced collaboration between hydrology and meteorology communities of practice, including academia
Objective 3.3 Advance policy-relevant science	Intensified national, basin, transboundary and international cooperation and activities to meet the SDGs The end users of hydrological information/data have a clear understanding of what the data means and it's relative (un)certainty
Goal 4: Close the capacity gap on weather, climate, hydrological and related environmental services: Enhancing service delivery capacity of developing countries to ensure availability of essential information and services needed by governments, economic sectors and citizens	
Objective 4.1 Address the needs of developing countries to enable them to provide and utilize essential weather, climate, hydrological and related environmental services	A framework is developed for the evaluation of gaps and needs of national flood forecasting and early warning systems Increased exchange of knowledge and technical expertise in flood forecasting among Members Enhanced coordination, effectiveness and governance of all WMO activities in supporting Members in Integrated Drought Management Gaps in Members' capabilities in drought assessment, monitoring, modelling and prediction are known The need of an effective national drought policy is understood by Members Training to increase capacities of Members in drought management (monitoring, modelling, early warning & drought vulnerability and impact assessment & drought adaptation and mitigation, preparedness and response) Basic tools to assist members are created, including an archive of relevant information, tools for transforming data to information, and maintenance of essential

WMO Strategic Plan	Vision and Strategy for Hydrology
	"treasury/heritage" variable to support sustainable development Water quality aspects are included in country support activities/ projects in the spirit of IWRM and in cooperation with other organizations Partnership at UN level exists and promotes provision of water quality data from NHSs to existing information systems (such as WHOS, UNEP GEMS/water and UNESCO-IHP IIWQ and ISI) Increased presentation/communication and understanding of value proposition, benefits and risk analysis, and value of hydrological services to foster understanding by ministries and governments Increased management skills of NHSs management (including middle and lower management) supports effectiveness and development of NHSs Enhanced customer orientation and better marketing skills generates better services and products with higher added value Institutional development plans and monitoring network development programmes are in place and implemented taking into account the catalogue of products and services
Objective 4.2 Develop and sustain core competencies and expertise	Increased Members' and regions' (basin authorities) application of Integrated flood risk management principles in flood prevention, preparedness and response Training to increase capacities of Members in drought management (monitoring, modelling, early warning & drought vulnerability and impact assessment & drought adaptation and mitigation, preparedness and response) Strengthened capacity of NMHSs personnel in user driven products and services design and delivery (in the field of support of food production and security) Increased national capacities to collect water-related data and transform them to useful/relevant products through capacity building

WMO Strategic Plan	Vision and Strategy for Hydrology
	(The staff of NMHSs understands the societal impacts of water and water resources management plans and decisions, the importance of water resources assessments for various stakeholders, and is well informed on the technologies available for them to best carry out their tasks and are expert in those that best suit their key applications) Water quality aspects are included in country support activities/ projects in the spirit of IWRM and in cooperation with other organizations Increased management skills of NHSs management (including middle and lower management) supports effectiveness and development of NHSs Enhanced customer orientation and better marketing skills generates better services and products with higher added value. Institutional development plans and monitoring network development programmes are in place and implemented taking into account the catalogue of products and services
Objective 4.3 Scale-up effective partnerships for investment in sustainable and cost-efficient infrastructure and service delivery	Partnership at UN level delivers co-produced guidelines related to water quality Enhanced resource mobilization (expertise, financial, partnership) for capacity building, technical assistance, training of personnel and sustainability of E2E MHEWS, and flood, drought and water resources management Increased involvement and enhanced cooperation with private sector support Members' flood, drought and water resources management Sustainable projects help build capacities of NHSs

WMO Strategic Plan	Vision and Strategy for Hydrology
Goal 5: Strategic realignment of WMO structure and programmes for effective policy- and decision-making and implementation	
Objective 5.1 Optimize WMO constituent body structure for more effective decision-making	Increased presentation/ communication and understanding of value proposition, benefits and risk analysis, and value of hydrological services to foster understanding by ministries and governments Enhanced regional cooperation, planning and implementation of NMHSs led activities The operational hydrology community at national scale knows how to access the global and regional products, services, tools, and actively participates in the activities and community of WMO
Objective 5.2 Streamline WMO programmes	Enhanced coordination, effectiveness and governance of all WMO activities in supporting Members in Integrated Drought Management The operational hydrology community at national scale knows how to access the global and regional products, services, tools, and actively participates in the activities and community of WMO Enhanced collaboration between hydrology and meteorology communities of practice, including academia
Objective 5.3 Advance equal, effective and inclusive participation in governance, scientific cooperation and decision-making	The operational hydrology community at national scale knows how to access the global and regional products, services, tools, and actively participates in the activities and community of WMO

Note: the detailed mapping of activities vs the WMO Strategic and Operating plan is available

ANNEX III

BACKGROUND INFORMATION

Formation of the WMO Hydrological Assembly (from Resolution 24 Cg-18, Annex 2 - Terms of Reference of the Open Committee of Congress Entitled the WMO Hydrological Assembly)

1. Building on the long history and work of the WMO Commission for Hydrology, the Eighteenth World Meteorological Congress (Cg-18) convened an open committee to create a new WMO Hydrological Assembly, as part of the larger reform of WMO constituent bodies. Among its findings, the Assembly found that WMO should take a more proactive coordination and leadership role in global water issues, focusing on its mandate in Operational Hydrology.

2. The Assembly is structured as an open Committee of Congress to make recommendations to Congress and relevant constituent bodies on matters related to hydrology including but not limited to Article 2(e) of the WMO Convention, namely, to promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services. The activities of the Hydrological Assembly are guided by the WMO Strategic Plan and the agenda of Congress and focus on: (a) Contributing to the integration of hydrology in working programmes of WMO; (b) Mobilizing the operational hydrological community to participate in WMO governing bodies at all levels; (c) Advising the heads of Congress delegations on emerging hydrological issues as well as on their consideration within the governing structures of WMO; (d) Motivating Governments to improve the integration of weather, water and climate topics on national and regional levels.

WMO Hydrological Coordination Panel (from Resolution 5 (EC-71) - Hydrological Coordination Panel)

3. Following Cg-18, the seventy-first session of the Executive Council (EC-71) established the WMO Hydrological Coordination Panel (HCP) as "the WMO think tank on hydrology". The HCP supports and advises on an integrated delivery of WMO water-related activities and undertakes preparatory work for the Hydrological Assembly, in relation to current and emerging scientific and technical water-related global challenges. The Panel integrates the hydrological work of WMO into the wider global water agenda and supports and advises the WMO Executive Council's Technical Coordination Committee (EC/TCC). The Panel works in accordance with the purposes of the Organization related to hydrology including but not limited to Article 2(e) of the Convention: To promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services.

4. HCP supports the efforts of EC and TCC to identify service and related science and technology gaps associated with each element of the seamless end-to-end operational prediction process whose elements include data, data services, modelling, forecasting, warnings, dissemination, decision support, training and outreach. Once identified and prioritized, information regarding these gaps can be used to inform investment decisions made by Members to build operational capacity.

Mandate for the Vision and Strategy for Hydrology and associated Plan of Action (from Resolution 24 (Cg-18) - Vision, Strategy and Organizational Arrangements for Hydrology and Water Resources in WMO and Resolution 25 (Cg-18) - Major Hydrological Initiatives, Resolution 5 (EC-71) Annex 1 - Terms of Reference of the Hydrological Coordination Panel)

5. Cg-18 requested the Executive Council to develop, with the support of HCP, a Plan of Action for consideration of an extraordinary session of Congress in 2021 taking into consideration, the reinforcement of the importance of operational hydrology in addressing global water challenges, opportunities in the future in the broader WMO Earth system approach and interdisciplinary context and the recommendation of the Hydrological Assembly, and to explore mechanisms that improve effective engagement and enable a stronger presence of the hydrological community in WMO activities.

6. Cg-18 also determined that eight ongoing hydrological activities and systems are fundamental pillars that support the WMO Strategic Plan and its further development. The eight initiatives include:

Quality Management Framework – Hydrology and its further implementation:

7. With the aim of promoting a stronger culture of compliance and quality assurance, the Commission for Hydrology (CHy) decided to engage in an in-depth review, to be completed by 2021, of its technical and regulatory material, ensuring alignment with other WMO regulatory material and its consistency with other sources of standardization such as ISO. This work started from the *Basic Documents No. 2, Technical Regulations Volume III: Hydrology* (WMO-No. 49) and will also include the review of existing material and guidance and the development of new material, responding to Members' requirements including innovative technologies and citizen science.

Assessment of the performance of flow measurement instruments and techniques:

8. The development of software to assist NHSs in the assessment of the uncertainty of river discharge measurements is nearing completion and will be widely distributed to WMO Members under the coordination of the Management Committee of Project X; the project will continue to provide support and advice to members on flow measurement techniques, including innovative approaches.

The Global Hydrometry Support Facility (HydroHub)

9. The implementation of Hydrological Cycle Observing System (HYCOS) components according to Members' priorities, under the new World Hydrological Cycle Observing System (WHYCOS) framework and integrating innovative monitoring approaches, is being revamped. Innovation in hydrometry is being harmonized into the hydromet development activities that are financed by the international donor community. A community of practice is being built to support hydrometric requirements of NHSs and an information system developed for stakeholders. The Meteorological, Climatological and Hydrological (MCH) Database Management System will, in coordination with climate data management systems continue to be developed and implemented according to hydrological and climatological needs and the existing MCH community of practice will be extended to other languages in addition to English.

Hydrological data operations and management

10 The implementation of the WHOS Phase II, in accordance with its Implementation Plan endorsed by EC-71, with its governance and architecture compliant with WIGOS, WIS and the Global Data-processing and Forecasting System (GDPFS), will be extended to other regions, on the basis of the successful experiences in the Plata and Sava river basins, as well as in the Arctic; the contributions of global data centres (GRDC, GPCC, IGRAC, HYDROLARE, federated under GTN-H) are relevant for the Global Climate Observing System (GCOS) Implementation Plan and their role, especially in the implementation of WHOS, will be reviewed in order to enhance it.

The WMO Flood Forecasting Initiative and hydrological contributions to disaster risk management, including flood (APFM) and drought (IDMP) management:

11. Assessment guidelines for end-to-end Early Warning Systems for flood forecasting and to assist Members in the assessment of their flood forecasting capabilities are being finalized and are being implemented through extra-budgetary resources in Burkina Faso and Dominican Republic, with additional donor interest being expressed for their implementation in Ecuador and other RA III/IV countries. Phase III of the project for the advancement and sustainability of a flash flood guidance system with global coverage project started in March 2019. It will allow additional benefits to be accrued to Members including further development and implementation of the Flash Flood Guidance System (FFGS), with advanced features such as landslide susceptibility, urban flash flood forecasting, riverine flood forecasting, and seasonal prediction. Cooperation with the Global Water Partnership (GWP) in the implementation of APFM and IDMP continues and is being reaffirmed through an MoU.

WMO Global Hydrological Status and Outlook System (HydroSOS)

12. HydroSOS, launched in 2018, will continue to be implemented building on the existing efforts from a number of Members to produce regular analyses of the current national hydrological condition complemented by forward looking assessments of how the water situation may change over sub-seasonal to seasonal timescales, and taking into consideration the need to link this initiative closely with other related WMO activities such as WIGOS (in particular by making use of the opportunities provided by WHOS) and the GDPFS. Pilot projects have been initiated in the Lake Victoria and Ganges-Brahmaputra basins to test the concept, with the ultimate objective of reaching global coverage; this activity can be supported by the Dynamic Water Resources Assessment Tool (DWAT) which allows the assessment of the impacts of land-use changes within the basin over time on water availability. DWAT can be used to assess a wide variety of scenarios as well as the interactions between climate, water and landscape on the availability of water resources.

Capacity building in hydrology and water resources management

13. The WMO strategy for capacity building in hydrology and water resources management agreed by CHy and endorsed by EC, will continue guiding the activities. Current developments consist of the distance learning course on hydrometry for field hydrologists, developed for the Pacific small islands and later adapted for African countries, being further adapted for other regions. A distance learning course on hydrological data sharing using the WHOS Phase II approach will be developed and the first edition delivered in early 2022.

***The World Water Data Initiative (WWDI*)**

14. Together with the World Bank and the Australian Government among other key partners, will promote modern national strategies, including an open data policy, to improve water information and contribute to reinforce the capabilities of countries and other data providers in building and operating hydrometeorological monitoring networks as well as successful water data management. Together with the HydroHub, identify barriers to effective monitoring and propose approaches for overcoming them, including innovative solutions and modernization of standardization processes.

15. Following Cg-18, EC-71 concluded the terms of reference for the HCP, which include direction to the HCP to "develop the Vision and Strategy for Hydrology and its associated Plan of Action, which support the achievement of water-related WMO Strategic Plan goals to be reviewed by EC-72 in 2020 and submitted for consideration of the extraordinary session of Congress in 2021". The WMO Vision and Strategy will be continuously updated for regular sessions of the Hydrologic Assembly.

Definition of Operational Hydrology (from Cg-18, Resolution 24, Annex 1)

16. Operational Hydrology is the real time and regular measurement, collection, processing, archiving and distribution of hydrological, hydrometeorological and cryospheric data, and the generation of analyses, models, forecasts and warnings which inform water resources management and support water-related decisions, across a spectrum of temporal and spatial scales. Operational hydrology requires capacity building and scientific and technical advancement and innovation in the areas of observation, data standards and services, modelling, prediction, hydro-informatics and decision support, communications, training, and outreach.

Annotation

17. These data include, but are not limited to, precipitation; air temperature and humidity; water level of streams, lakes, deltas and estuaries; streamflow; snow and ice cover, depth and water equivalent; river and lake ice; glacier mass balance; reservoir storage; soil moisture; groundwater and ground frost; evaporation and evapotranspiration; water temperature; sediment dynamics; water and sediment quality and other related variables, including within the context of global change. Global change is expressed through different aspects, such as land-use changes, socioeconomic dynamics, climate variability and climate change.

Relationship to the WMO Strategic Plan

18. The Strategic Plan adopted by the Eighteenth World Meteorological Congress, in June 2019, sets the directions and priorities to guide the activities of the WMO during 2020–2023 and up to 2030 to enable all Members to improve their information, products and services.

19. It also sets three overarching priorities: (i) enhancing preparedness for hydrometeorological extremes, (ii) supporting climate-smart decisions, and (iii) enhancing socioeconomic benefits of related services – with a view to contributing to the societal needs reflected in the global agenda to realize sustainable development.

20. The Plan recognizes the demand for actionable, accessible and authoritative science-based information to address the increasing threats of extreme weather and the urgency of climate action for resilience, mitigation and adaptation, as well as the need to reduce the growing capacity gap in infrastructure and services by making use of rapid advancements in science and technology and innovative partnerships.

21. To address these ambitious aspirations, the Strategic Plan pursues five long-term goals and associated objectives:

1. Better serve societal needs: Delivering, authoritative, accessible, user-oriented and fit-for-purpose information and services;

2. Enhance Earth system observations and predictions: Strengthening the technical foundation for the future;

3. Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services;

4. Close the capacity gap on weather, climate, hydrological and related environmental services: Enhancing service delivery capacity of developing countries to ensure availability of essential information and services needed by governments, economic sectors and citizens;

5. Strategic realignment of WMO structure and programmes for effective policy- and decision-making and implementation.

22. The WMO Strategic Plan provides a reference framework for the HCP plan of action and forms the basis to set the priorities for its implementation, establishing also the clear contribution of WMO Members to major international agreements.

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APPENDIX

LIST OF ACRONYMS

APFM: Associated Programme on Flood Management

AMCOW: African Ministers' Council on Water

CAP: Common Alerting Protocol

CB: Capacity building

CHy: Commission for Hydrology

Cg: Congress

CIFI: Coastal Inundation Forecasting Initiative

DRR: Disaster Risk Reduction

DWAT: Dynamic Water Resources Assessment Tool

EC: Executive Council

E2E MHEWS: End-to-End Multi-Hazard Early Warning Systems

ENSO: El Niño-Southern Oscillation

EWS: Early Warning System

FAO: Food and Agriculture Organization

FFI: Flood Forecasting Initiative

FFGS: Flash Flood Guidance System

GBON: Global Basic Observing Network

GCOS: Global Climate Observing System

GCW: Global Cryosphere Watch

GDPFS: Global Data-processing and Forecasting System

GEMS: Global Environmental Monitoring System

GEO: Group on Earth Observations

GHSF: Global Hydrometry Support Facility (HydroHub)

GMAS: Global Multi-hazard Alert System

GRDC: Global Runoff Data Centre

GTN-H: Global Terrestrial Network – Hydrology

GWP: Global Water Partnership

HCP: Hydrological Coordination Panel

HDOM: Hydrological Data Operations and Management

HydroSOS: Global Hydrological Status and Outlook System

IAHR: International Association for Hydro-Environment Engineering and Research

IAHS: International Association of Hydrological Sciences

IDI: International Drought Initiative

IDMP: Integrated Drought Management Programme

IFAD: International Fund for Agricultural Development

IFI: International Flood Initiative

IFM: Integrated Flood Management

IGRAC: International Groundwater Resources Assessment Centre

IIWQ: International Initiative on Water Quality

INFCOM: Commission for Observation, Infrastructures and Information Systems

IPCC: Intergovernmental Panel on Climate Change

ISI: International Sediment Initiative

IWRM: Integrated Water Resources Management

LTA: Long-term ambition

MCH: Meteorological, Climatological and Hydrological

MHEWS: Multi-Hazard Early Warning Systems

NGO: Non-governmental Organization

NHSs: National Hydrological Services

NMHSs: National Meteorological and Hydrological Services

NMS(s) – National Meteorological or Hydrometeorological Service(s)

NWP: Numerical Weather Prediction

QMF-H: Quality Management Framework – Hydrology

QPE: Quantitative Precipitation Estimation

QPF: Quantitative Precipitation Forecast

RCOFs: Regional Climate Outlook Forums

SERCOM: Commission for Weather, Climate, Water and Related Environmental Services and Applications

SOFF: Systematic Observations Financing Facility

SDG: Sustainable Development Goal

SOP: Strategic and operation plan

SWFP: Severe Weather Forecasting Programme

UNDP: United Nations Development Programme

UNDRR: United Nations Office for Disaster Risk Reduction

UNECE: United Nations Economic Commission for Europe

UNESCO-IHP: United Nations Educational, Scientific and Cultural Organization – Intergovernmental Hydrological Programme

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

WB: World Bank

WFP: World Food Programme

WHOS: WMO Hydrological Observing System

WIGOS: WMO Integrated Global Observing System

WIS: WMO Information System

WMO: World Meteorological Organization

WWDI: World Water Data Initiative

WWQA: World Water Quality Alliance

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