

Geneva
4–12 November
2008

Commission for Hydrology

Thirteenth session



**World
Meteorological
Organization**

WMO-No. 1033

Weather • Climate • Water

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Abridged final report with resolutions and recommendations

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This report contains the text as adopted by Plenary and has been issued without formal editing.

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (*agenda item 1*)

1.1 The president of the Commission for Hydrology (CHy), Mr B.J. Stewart (Australia), opened the thirteenth session of the Commission at 10.00 a.m. on Tuesday, 4 November 2008 at World Meteorological Organization (WMO) headquarters, in Geneva. In welcoming delegates and the representatives of other international organizations, Mr Stewart stressed that water remained at the forefront of issues of local, national, regional and international concern, and that water information was essential to improved management of the resource. He pointed out that droughts and floods remained key life-impacting events and improved knowledge about them and their forecasts would bring major benefits to society. He emphasized that as sessions of the Commission were held only every four years, it was therefore important that the precious time of all the participants was used in the most efficient manner. For that purpose, the documents presented were very focused and he hoped that they would generate good discussion. He mentioned that significant progress had been made by the Advisory Working Group (AWG) during the last intersessional period. He further expressed the hope that the discussion during the session would help enrich the programme proposed for the next four years.

1.2 The Secretary-General of WMO, Mr M. Jarraud, welcomed participants. In his address, he expressed his appreciation to the president of the Commission for his dedication to the work of CHy. He extended his gratitude to the members of the AWG and other experts from the open panels for their contributions to the work of the Commission. He mentioned that other WMO technical commissions would pay special attention to the way the session was conducted, including the pre-session discussions. He mentioned that there was an international consensus that the water problem was a management problem and that integrated water resources management and/or sustainable management of water resources had been promoted by experts around the world. He recalled that under the guidance of CHy, WMO was among the first international organizations which drew the attention of the world towards the fact that business as usual in the water sector was no more an option and that a paradigm shift in the way we managed our water resources around the world was called for. He expressed his hope that the present session would continue in that tradition in its fiftieth year and set up a work programme that would help solve water management issues around the world.

2. ORGANIZATION OF THE SESSION (*agenda item 2*)

2.0.1 The documents for the session were reproduced in all six working languages of WMO, namely Arabic, Chinese, English, French, Russian and Spanish. Simultaneous interpretation was provided for all meetings of the plenaries in all six working languages.

2.0.2 A total of 117 participants attended the session, representing 52 Members of WMO and 14 international organizations. The list of participants is given in the [appendix](#) to the present report.

2.1 CONSIDERATION OF THE REPORT ON CREDENTIALS (*agenda item 2.1*)

At the request of the president, the representative of the Secretary-General presented a list of the delegations present, including the capacities in which they were attending the session, whose credentials had been found to be in order. The list was accepted as the report on credentials.

2.2 ADOPTION OF THE AGENDA (*agenda item 2.2*)

The proposed annotated agenda was adopted without changes.

2.3 ESTABLISHMENT OF COMMITTEES (*agenda item 2.3*)

2.3.1 A Nomination Committee was established, consisting of the following delegates:

- RA I – Mr Ahmed Fawzy Tolba (Egypt)
- RA II – Mr Bi Baogui (China)
- RA III – Mr Antônio Cardoso (Brazil)
- RA IV – Mr Iván Jaramillo (Panama)
- RA V – Mr Ahmed Husaini-Sulaiman (Malaysia)
- RA VI – Mr Jan Kubát (Czech Republic)

Mr Antônio Cardoso (Brazil) was elected chairperson of the Nomination Committee.

2.3.2 The Commission, having reviewed and approved the working procedures for the Selection Committee drafted by the president at the request of the Advisory Working Group, also established such a committee to assist in the selection of experts and members of working groups, consisting of the following:

- RA I – Mr Mokake Mojakisane (Lesotho)
- RA II – Ms Chongkolnee Yusabye (Thailand)
- RA III – Ms Caroline Wittwer (France)
- RA IV – Mr Alain Pietroniro (Canada)
- RA V – Mr Bruce Stewart (Australia)
- RA VI – Mr Bogdan Ozga-Zielinski (Poland)

Mr Mokake Mojakisane (Lesotho) was elected chairperson of the Selection Committee.

2.3.3 The Commission carried out its work in plenaries. The General Plenary was chaired by the president and discussed agenda items 1, 2, 3, 5, 9, 12, 14, 15, 16, 17, 18, 19 and 20. Plenary A was chaired by the vice-president and discussed agenda items 4, 6, 7, 8, 10, 11, and 13.

2.3.4 A Coordination Committee was established, consisting of the president, vice-president and the representative of the Secretary-General.

2.3.5 Five working parties were established to consider in more detail the following topics:

1. WMO Quality Management Framework – Hydrology, chaired by Mr Paul Pilon (Canada)
2. WIGOS and WIS, chaired by Mr Julius Wellens-Mensah (Ghana)
3. Capacity-building in HWR, chaired by Mr Bruce Stewart (Australia)
4. WMO Strategic Plan 2012–1015, chaired by Mr Bruce Stewart (Australia)
5. Future programme of work for the Commission, chaired by Ms Ann Calver (United Kingdom of Great Britain and Northern Ireland)

2.4 ORGANIZATIONAL QUESTIONS (*agenda item 2.4*)

2.4.1 The working hours adopted were 9:30 to 12:30 and 14:30 to 17:30. Concerning the minutes of the session, the Commission agreed to not preparing them.

2.4.2 It was noted that, as a departure from previous sessions and for the sake of efficiency and reducing the session's costs, most of the factual information referring to past activities and not calling for decisions by the Commission was presented as information papers (INFs) and available in English and French.

2.4.3 The Commission also noted that, with an aim to increase the involvement in its decision process of those Members that had been unable to send a delegation to attend the session physically, a pre-session e-discussion facilitated by a virtual forum had been carried out for agenda items 6, 7, 8 and 9. A total of 78 experts had participated in the forum and provided their inputs. The outcomes of the pre-session e-discussion were presented to the Commission and are included in the present report under the relevant agenda items. The Commission considered that when important information was presented it should also be available in other languages.

3. REPORT ON THE HYDROLOGY AND WATER RESOURCES PROGRAMME (*agenda item 3*)

3.1 The Commission discussed the activities that had been included in the reports by the president and vice-president of CHy, the Advisory Group members and the Secretary-General, and also the report on regional aspects of the Hydrology and Water Resources Programme. All this information is included in the progress/activities reports presented at the thirteenth session of the Commission for Hydrology (Part II, available in English and French only).

3.2 As a result of the discussions on the report by the president of CHy and the reports of the AWG members, the session considered the issue of volunteerism in the work of the Commission. It was stressed that voluntary contributions from experts formed the mainstay of its success and encouraged Members to facilitate their participation in the activities of CHy. The Commission expressed its gratitude to the experts who had provided their valuable inputs in completing various activities during the intersessional period. The list of experts is given in the [annex](#) to the present report.

3.3 The representative of the International Association of Hydrological Sciences (IAHS) expressed pleasure that its long-standing cooperation with WMO continued to yield benefits to both parties. In particular, he thanked WMO for its contribution to IAHS activities and looked forward to similar cooperation in the future.

4. DECISIONS OF CONGRESS AND THE EXECUTIVE COUNCIL OF RELEVANCE TO THE HYDROLOGY AND WATER RESOURCES PROGRAMME (*agenda item 4*)

4.1 The Commission was pleased to note that Fifteenth Congress had recognized that the water sector constituted one of the major clients of WMO to fulfill its vision to contribute towards achieving the United Nations Millennium Development Goals and that it had expressed satisfaction at the direction given by the Commission to the Hydrology and Water Resources Programme (HWRP). The Commission also noted the recommendation of Congress of ensuring a wider representation from all the water management sectors while nominating members of CHy and the advice to the Permanent Representatives that they should appoint hydrological advisors who could coordinate with the various institutions involved in the water sector in their countries.

4.2 The Commission was informed that Fifteenth Congress had, as in the past, established a subcommittee on hydrology. The Commission was pleased to note that Congress had endorsed the CHy proposal to provide for the optional establishment of the subcommittee on hydrology based on the need and the agenda that required establishment of such a subcommittee, and had therefore decided, through Resolution 48 (Cg-XV) – Amendments to General Regulation 29 (b), to amend that General Regulation by replacing the verb “shall” by “may”. General Regulation 29 (b) therefore now reads as follows:

- (b) “At each session of Congress an open subcommittee on hydrology may be established, attended as a rule by those hydrological advisers of Permanent Representatives and/or those representatives of Hydrological Services included in the delegation of Members.”

4.3 The Commission agreed with Congress that the *Technical Regulations* (WMO-No. 49), Volume III – Hydrology, was an important document in the framework of the WMO Quality Management Framework. It also noted the decision by Fifteenth Congress that it shall be translated into all the WMO official languages in order to promote the use of a coherent set of technical regulations, in particular in transboundary basins. The Commission recommended issuing the *Technical Regulations* in all languages at the same time, as far as possible.

4.4 The Commission was informed that Fifteenth Congress had adopted Resolution 32 (Cg-XV) – WMO Quality Management Framework. Follow-up actions on the subject are reported under agenda item 6.

4.5 The Commission noted that Fifteenth Congress had adopted Resolution 21 (Cg-XV) – Strategy for the enhancement of cooperation between National Meteorological and National Hydrological Services for improved flood forecasting. Further action on the subject is discussed under agenda item 8.

4.6 The Commission was informed that Fifteenth Congress had adopted Resolution 30 (Cg-XV) – Towards enhanced integration between WMO Observing Systems, and requested the technical commissions to include that activity in their work programmes in order to fully accommodate the cross-programme nature of the integration initiative. Further actions on the WMO Integrated Global Observing Systems (WIGOS) and WMO Information System (WIS) are discussed under agenda item 11.

4.7 The Commission noted that Congress had kept in force Resolution 20 (Cg-XII) – World Hydrological Cycle Observing System (WHYCOS) and Resolution 21 (Cg-XII) – Global Runoff Data Centre (GRDC). In order to consolidate the significant results that had been achieved during the previous intersessional period in support of the New Partnership for Africa's Development and the African Minister's Council on Water, Congress had replaced Resolution 19 (Cg-XII) – Strategy and action plan for monitoring and assessing water resources of Africa by Resolution 22 (Cg-XV) – Support to the African initiatives on water.

4.8 The Commission noted that Congress had urged improved coordination between WMO HWRP and the International Hydrology Programme (IHP) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). At the same time, the Commission was informed that the Executive Council at its sixtieth session, having noted that a number of United Nations agencies were working on water-related issues, had stressed the need for WMO to involve itself in activities that were closely related to the WMO mandate and the WMO Strategic Plan.

4.9 The Commission was informed that Congress had adopted Resolution 25 (Cg-XV) – Natural Disaster Prevention and Mitigation Programme, and had requested the technical commissions to assist the Executive Council to prioritize and provide further guidance for the implementation of the Programme in line with the WMO Strategic Plan. It noted that Congress had also urged Members to strengthen collaboration of National Meteorological and Hydrological Services with the civil protection agencies and disaster risk management authorities.

4.10 The Commission was informed that Congress, through Resolution 8 (Cg-XV) – World Climate Programme and its coordination, had requested the technical commissions to accord high priority to the implementation of World Climate Programme activities that fell within the area of their competence and responsibility and support scientific capacity-building, most especially among developing countries and least developed countries.

4.11 The Commission noted with appreciation that, upon the recommendations adopted by the Commission at its twelfth session, the Executive Council at its fifty-seventh session had approved the amendments to the *Technical Regulations* (WMO-No. 49), Volume III – Hydrology; had approved the WMO Strategy on Education and Training in Hydrology and Water Resources; had revised the scope of the WMO Regional Meteorological Training Centres (RMTCs), thus they were now called WMO Regional Training Centres (WMO-RTCs); and had subsequently approved the criteria for the recognition of RTCs at its fifty-eighth session.

4.12 The Commission noted that the Executive Council at its sixtieth session had expressed satisfaction with the progress that had been made with the implementation of HYCOS projects in Africa, Asia, the Pacific and the Caribbean, and requested the Secretary-General to continue his efforts to mobilize extrabudgetary resources in order to extend the WHYCOS programme to other regions, such as the Nile basin, and the densely populated smaller basins of South-East Asia.

4.13 The Commission was informed that the Executive Council at its sixtieth session had supported efforts to identify options that might result in reduced costs of holding technical commission sessions. The Commission noted that the AWG proposal of providing partial financial support to participants from some developing countries and least developed countries, including

those from emerging economies, to attend the present Commission session had been considered by the Council at its sixtieth session. However, the Council had requested its Working Group on WMO Strategic and Operational Planning to look further into the issue.

4.14 The Commission was informed that the Executive Council at its sixtieth session had agreed in principle with the suggestions of the presidents of the Commissions for Basic Systems and Hydrology to award recognition to the experts who volunteered to devote their time to undertake the activities planned by technical commissions and regional associations, and the Council had urged the Secretary-General to propose a common scheme for awarding such recognition. It also noted that the Executive Council at its sixtieth session had also urged Permanent Representatives to facilitate the participation and voluntary contribution of experts, not only from the National Meteorological and Hydrological Services (NMHSs) but also from other national institutions, to the activities of WMO.

5. REVIEW OF ONGOING ACTIVITIES (*agenda item 5*)

5.1 The Commission was informed of the progress achieved during the intersessional period. It noted that a number of activities had been carried out through extrabudgetary resources, which complemented well with the programme of work and priorities of the Commission. It also expressed its satisfaction at the overall progress made within limited resources and offered its thanks to all the Open Panel of CHy Experts (OPACHE) members for their work.

WHYCOS

5.2 The Commission expressed satisfaction with the significant advances made in the establishment of new, and delivering of existing, HYCOS projects in the various regions and the impact on strengthening the capacities of National Hydrological Services (NHSs). The Commission noted that the approach adopted, which was focusing not only on the strengthening of the networks but on the needs of the basin or the region, combined with the overall capacity development of NHSs in various hydrological aspects, had played a major role in attracting financial partners. It noted also that WMO had to continue collaboration and cooperation with potential stakeholders and donors to develop new HYCOS projects and support the existing ones in order to contribute to the improvement of water resources assessment, hydrological forecasting, adaptation to climate variability and change, and water resources management capabilities in the various basins.

5.3 The Commission agreed that the WHYCOS International Advisory Group provided a useful platform to WHYCOS partners and should be used as an opportunity to bring together all potential stakeholders, donors, users, providers, scientists and researchers to exchange experience and information on the latest technology available and mobilize resources to support the programme.

INFOHYDRO

5.4 In view of the experience gained during recent years with the new format of the Hydrological Information Referral Service (INFOHYDRO) questionnaire, and in order to respond to doubts expressed thus far by NHSs when filling the questionnaire, the Commission urged the AWG and the Secretariat to add to it a set of definitions, clearly explaining which kinds of stations were meant to be reported under each section of the questionnaire.

5.5 The Commission urged Members to make special efforts to complete the information required in INFOHYDRO, as only the comparison of a reasonably wide spectrum of responses covering NHSs from all WMO Regions and at different levels of development would contribute to a correct assessment of the status of hydrological networks around the world. That in turn would help the Commission and the Secretariat to formulate a strategy and advocacy for strengthening the hydrological networks.

Cooperation with international organizations

5.6 The Commission noted with satisfaction the active role of WMO, among other international organizations, in promoting and advocating the importance of hydrological observations, water resources assessment and flood forecasting and management to various water-related issues. That role allowed WMO to establish fruitful collaboration and cooperation links with various United Nations agencies, intergovernmental organizations, non-governmental organizations and donors to support NMHSs on sustainable water resources management and yielded benefits to all parties. The Commission expressed its satisfaction at the synergetic leveraging that the HWRP had been able to generate by working with other agencies.

5.7 The Commission was pleased to note that WMO was continuing the long-standing cooperation with the International Association of Hydrological Sciences. It noted the advantage accrued from that collaboration based on the number of activities in which the two were involved. It noted that they would jointly organize a session on “Data for All” at the Fifth World Water Forum, to be held in Istanbul, Turkey, in March 2009. It also noted that WMO, jointly with the Japan Water Forum and the International Centre for Water Hazard and Risk Management (ICHARM), was co-coordinator of the Forum’s Global Changes and Risk Management theme.

5.8 The Commission also noted the close cooperation between WMO and the International Strategy for Disaster Reduction (ISDR). The ISDR representative expressed the importance of the HWRP activities in the field of flood management and hoped that the Associated Programme on Flood Management would actively participate in the second session of the Global Platform for Disaster Risk Reduction to be held in Geneva in June 2009. He noted it would provide a venue to share knowledge and wisdom in disaster risk reduction for policymaking at the global level and it was important to link with the wider disaster risk reduction community beyond the water sector.

5.9 The Commission was pleased to know of the WMO cooperation with the African Development Bank (AfDB) and the African Union Commission (AUC). The AfDB representative expressed appreciation for the WMO support to the Bank on organizing the First African Water Week, held in Tunis in March 2008, and for closely working with the AfDB in establishing the African Water Facility. He noted that the potential technical expertise in WMO provided an opportunity to AfDB to work together to develop adequate capacity in countries for prediction and management of disasters as well as adaptation to climate change. The AUC representative expressed appreciation to WMO and other partners for their support to the AUC on developing the “Climate Information for Development – ClimDev Africa” programme and requested WMO to continue its cooperation and collaboration with AUC to support its implementation. Given the important work being done by HWRP in flood management, the AUC representative also stressed the need for close collaboration with WMO on the African Union’s African Regional Strategy on Disaster Risk Reduction through the WMO Disaster Risk Reduction Programme.

5.10 The Commission placed on record its gratitude to various financial partners, such as Governments of Japan, France, the Netherlands, the United States, Spain, Finland, Switzerland, Germany and Italy, for supporting various activities under the HWRP. It also expressed its appreciation to the European Union and the African Development Bank in providing financial support to the WHYCOS programme. It expressed the hope that the WMO Secretariat would continue to make efforts towards maintaining those relations and soliciting further support and extrabudgetary resources for various activities under the HWRP.

5.11 The representative of the International Association of Hydraulic Engineering and Research (IAHR) expressed the interest of the Association in continuing to contribute to the CHy project on the assessment of the performance of flow measurements instruments and techniques. The Commission took note of the offer of IAHR to cooperate with WMO in organizing short courses dedicated to engineers, hydrologists and staff to Hydrological Services about principles and methods of stream gauging. In such courses WMO references and documents would be presented with the objective to disseminate WMO QMF–Hydrology technical guidance documents (TGDs). Those TGDs would also be included in university curricula.

6. WMO QUALITY MANAGEMENT FRAMEWORK – HYDROLOGY (*agenda item 6*)

6.1 Following the decision of Fourteenth Congress to work towards a quality management framework (QMF) for NMHSs with a view to achieve their mission and strategic directions, the Advisory Working Group of the Commission had developed a framework proposal to ensure that the core activities undertaken by National Hydrological Services, such as hydrological data acquisition and delivery of services and products, were performed efficiently and effectively. The Commission was informed of the results of the pre-session discussion (PreSed) on that topic. Some of the contributions from PreSed were incorporated in the present report while other contributions were included elsewhere.

6.2 The Commission, through [Resolution 1 \(CHy-XIII\) – WMO Quality Management Framework – Hydrology](#), adopted the Quality Management Framework – Hydrology as contained in [Annex 1 to Resolution 1 \(CHy-XIII\)](#) and included the relevant activities required to be undertaken in its work programme ([Resolution 7 \(CHy-XIII\)](#)). It emphasized that the WMO QMF–Hydrology when formulating best technical practices should make use of approaches that had been developed by other organizations, including the International Organization for Standardization (ISO). To facilitate the development of technical guidance documents, WMO had signed an agreement with ISO, which included the subject of hydrometry, for the development of common standards. Furthermore, the Commission recommended that the Advisory Working Group consider the establishment of a policy for the systematic review of the technical guidance documents.

6.3 The Commission emphasized the responsibilities of the NHSs in the development of the national QMF, particularly in the case of a country with multiple hydrology-related organizations. It noted that in such a case, each hydrological service might develop and adopt its own quality management system (QMS) under the umbrella of the national QMF.

6.4 The Commission noted that a number of NHSs had undergone the ISO certification processes and urged the members to share their documentation for the establishment of best technical practices for advancing QMF and QMS development. It was envisaged that HOMS would be used to assist in the transfer of those technologies and practices.

6.5 The Commission expressed the desire that its members be periodically updated on the advances made in the relationship with ISO and the development of common best technical practices. The Commission also urged its members to become engaged with ISO national counterpart agencies for the development of standards of importance to NHSs. In addition, it desired that members also be periodically updated on the progress made in the development of QMF–Hydrology.

6.6 The Commission highlighted the need for a more complete mapping of the categories and sub-categories (processes and activities) to be covered in the QMF–Hydrology, an evaluation of the extent to which they were already covered through existing and planned technical guidance documents, and an outline of potential best technical practices that should be targeted for development. The Commission also expressed the need for the development of a workplan, including an overall scope of work and an assessment of the relative priority of each element within that workplan.

6.7 With the adoption of a QMF–Hydrology, the publications brought out under the technical guidance of the Commission should undergo a comprehensive peer review before being recommended for adoption as tools for the QMS. Therefore, the Commission adopted an updated peer review process for those publications as given in [Annex 2 to Resolution 1 \(CHy-XIII\)](#). It expressed the need for assigning one of its AWG members to deal with publications and to review the required standard reporting form and notes for reviewers in line with the new resolution.

6.8 According to [Resolution 26 \(Cg-XV\) – Publications Programme for the fifteenth financial period](#), the publications of the Organization generally fell into two broad categories: (a) mandatory publications, defined by the Convention of the World Meteorological Organization, the General Regulations or by specific decisions of Congress, for which funds were provided directly under the

Publications Programme; and (b) programme-supporting publications, such as WMO technical notes, World Weather Watch planning reports, operational hydrology reports, marine science affairs reports, special environmental reports and the WMO blue training series, for which funds were provided under the relevant scientific and technical programmes. The Commission deliberated on the issue in view of the WMO QMF and considered it necessary to review that classification, which had been made primarily on the basis of funding for the publication, and made recommendations accordingly.

6.9 The Commission considered the draft WMO Statement on the Scientific Basis for and Limitations of Hydrological Forecasting. It recognized the need for and importance of such a statement but recommended developing the statement further by focusing on limitations for streamflow and water-level forecasting. It decided that an expert group under the guidance of the new AWG would review the statement, outlining in a general but comprehensive manner limitations for streamflow and water-level forecasting. The Commission recommended that the members of the Commission be invited to provide their comments on the draft through e-mail. The Commission also directed the AWG to finalize and approve the statement on its behalf as expediently as possible. The Commission underlined the importance of continuing to address issues related to limitations in hydrological forecasting in the context of the QMF.

7. ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES (*agenda item 7*)

7.1 The Commission was pleased to learn of the progress achieved in the implementation of the workplan of the project for the assessment of the performance of flow measurement instruments and techniques.

7.2 The Commission expressed its support for the proposal presented in [Annex 1 to Resolution 2 \(CHy-XIII\)](#) and requested the AWG to consider extending the scope of the project to include assessments of: (a) the effects of different morphological and climatological conditions on instrument performance and (b) the stability and reliability of data resulting from instrumentation over long time periods. Several other interesting suggestions of a more general nature are reported under agenda item 6, Quality Management Framework – Hydrology. The Commission was also pleased to learn of the experiences of various countries that were undertaking the intercomparison and testing of flow instrumentation and techniques, and encouraged those countries to participate actively in the project in the future.

7.3 The Commission agreed with its AWG on the desirability of establishing a Steering Committee for the project, and decided to adopt the following governance scheme:

- The AWG would assume the role of Steering Committee of the project, to provide overall guidance;
- A Management Committee would be established with one representative each of CHy, the WMO Regional Working Groups on Hydrology, IAHR, IAHS, ISO and the Association of Hydro-Meteorological Equipment Industry, for day-to-day implementation.

The Commission tasked the AWG to finalize at its first meeting the terms of reference and responsibilities of the Steering Committee and the Management Committee, and encouraged the Secretariat to accelerate the actions needed for the establishment of the Management Committee.

7.4 As regards the recommendation of the AWG to task the Steering Committee to recommend to the Commission that it adopt the uncertainty analysis framework developed by the project, in view of the delay in the establishment of the Committee and taking into account new developments related to the involvement of other WMO technical commissions and the agreement with ISO recently signed by WMO, the Commission decided to empower the president of CHy and

the AWG to adopt the framework on its behalf and report on implementation progress to the members of the Commission.

7.5 The Commission noted that the pre-session discussion on that topic had taken place from 20 August to 8 October 2008. No specific changes had been suggested to the document under discussion, but some general conclusions could be derived from issues that were repeated in more than one intervention. For instance, several participants had stressed the need to have guidance material on the use of new technologies for developing countries, which were beginning to use them. The Commission asked the AWG to consider whether the new edition of the *Guide to Hydrological Practices* (WMO-No. 168) responded to that need, or whether new, additional material should be prepared in the next intersessional period. The majority of participants had insisted that WMO should assist in building the capacities of NHSs on the subject. Finally, the importance of working in a coordinated manner with other agencies in developing guidance material on estimating uncertainty had been stressed.

7.6 The Commission adopted [Resolution 2 \(CHy-XIII\) – Project for the assessment of the performance of flow measurement instruments and techniques](#).

8. HYDROLOGICAL FORECASTING AND FLOOD MANAGEMENT (*agenda item 8*)

8.1 The Commission welcomed the progress made under the WMO Flood Forecasting Initiative, and the development of the “Strategy and Action Plan for the Enhancement of Cooperation between National Meteorological and National Hydrological Services for Improved Flood Forecasting” (<http://www.wmo.int/pages/prog/hwrrp/documents/FFInitiativePlan.pdf>), which had been endorsed by Fifteenth Congress.

8.2 The Commission expressed its satisfaction at the efforts being made to improve collaboration between the meteorological Services and the hydrological Services, particularly in the area of flood forecasting as outlined in the report of the Secretary-General while reviewing the ongoing activities.

8.3 The Commission recognized the increasing responsibility that hydrological communities and meteorological communities shared to reduce the loss of life that took place due to flash floods around the world. It expressed satisfaction with the development of the Flash Flood Guidance System, in collaboration with the United States National Oceanic and Atmospheric Administration (NOAA) and the Hydrologic Research Centre, San Diego, United States, at the global level and the plans to implement the regional components. The Commission appreciated the financial support provided by NOAA and the United States Agency for International Development (USAID) for the flash flood conferences in Costa Rica and China, the support of the Government of Japan for the regional flash flood workshop in Tsukuba, and the support provided by the Government of Spain for the Ibero-American network on monitoring and forecasting of hydrometeorological phenomena (PROHIMET). The Commission further expressed the need to better integrate Quantitative Precipitation Estimation, Quantitative Precipitation Forecasting and probabilistic Quantitative Precipitation Forecasting into flood forecasting practices together with multimodel forecasting techniques and numerical weather prediction products that were available to Members.

8.4 The Commission recognized the important work being carried out by the Associated Programme on Flood Management in the form of providing flood management policy guidance and tools and welcomed the move to set up a HelpDesk for Integrated Flood Management. It noted that the HelpDesk would address only the policy and capacity-building issues and not emergency response. It appreciated the substantial support provided by the Governments of Japan, The Netherlands and Switzerland to the success of the Programme. It also expressed its appreciation to the Government of Spain for providing financial support for the training workshops in Cochabamba, Bolivia, and Lima, Peru, under the Programme.

8.5 The Commission noted that during the past intersessional period, as part of the drought activities, a low flow manual had been produced. The Commission expressed the need for

developing seasonal to annual hydrological predictions for monitoring droughts and establishing best practice guidelines for drought monitoring. It noted that the Commission for Agricultural Meteorology, which was charged with the activities of drought management and prediction, had established a group on drought management. The Commission saw merit in closely collaborating with that Commission and the Commission for Climatology to work towards developing tools and best practices guidance for hydrological drought monitoring and prediction.

8.6 The Commission adopted [Resolution 3 \(CHy-XIII\) – Hydrological forecasting and flood management](#).

9. WATER AND CLIMATE ISSUES (*agenda item 9*)

9.1 The Commission welcomed the formation of the new Climate and Water Department, noting that it would offer expanded and comprehensive opportunities to plan and implement climate-related activities in hydrology and water resources. In that respect, the Commission further appreciated the efforts undertaken thus far in the development of a WMO initiative to support adaptation to climate variability and change, to which it offered full support. It also noted the establishment of the Executive Council Working Group on Climate and Related Weather, Water and Environment Matters.

9.2 The Commission noted that many countries had started activities to develop national adaptation plans to cope with climate variability and change. Recognizing the vast amount of valuable information available in the water and climate communities, the Commission called upon its Members to provide tools, mechanisms, technologies and know-how related to hydrological impacts of climate variability and change, including extreme events, and share them among all Members through HOMS.

9.3 The Commission noted the valuable services provided by the Global Terrestrial Network – Hydrology (GTN-H) thus far in support of climate research and applications. The Commission further noted that strong observational networks covering climate sensitive variables were essential for climate- and water-related research and applications. In that regard, the Commission expressed its appreciation to governments of members that were sharing data from their networks and to those governments that provided the resources and infrastructure to host the global data centres and institutions that formed the core of GTN-H. In particular, the Commission expressed its gratitude to the Government of the Russian Federation for hosting the International Data Centre on the Hydrology of Lakes and Reservoirs (HYDROLARE) at the State Hydrological Institute in St Petersburg, on the basis of an agreement between ROSHYDROMET and WMO in June 2008.

9.4 The Commission recalled that water and climate issues reached beyond the traditional constituency of WMO and noted the United Nations-system wide coordination of climate activities. It therefore expressed its expectation that collaborative activities would be undertaken with other United Nations agencies, including UNESCO and governmental and non-governmental organizations at the national, regional and global levels.

9.5 While noting the progress that had been made in the organization of the World Climate Conference-3, although a separate water and climate session had been planned the Commission was concerned that water was not yet sufficiently reflected in the agenda of the conference and, in particular, that active involvement of hydrologists and water managers was required. The Commission further expressed its view that seasonal to annual timescales of climate variability should be the focus of hydrological contributions to the conference.

9.6 The Commission recognized the complementary nature of the water tasks of the Group on Earth Observations (GEO) to activities undertaken by the Commission and expressed its expectation that the Integrated Global Water Cycle Observations, co-hosted by WMO, acted as effective conduit of Commission inputs in support of the GEO water tasks.

9.7 The Commission subsequently adopted [Resolution 4 \(CHy-XIII\) – Water and climate issues](#).

10. CAPACITY-BUILDING IN HYDROLOGY AND WATER RESOURCES (*agenda item 10*)

10.1 The Commission noted that the implementation of the WMO Strategy on Education and Training in Hydrology and Water Resources, as had been adopted at its twelfth session and approved by the Executive Council at its fifty-seventh session, had been of great help in optimizing the available resources, by concentrating WMO support in those areas identified by the “WMO hydrological community” as requiring priority attention. It therefore revised the strategy for the next intersessional period, as indicated in [Annex 1 to Resolution 5 \(CHy-XIII\)](#).

10.2 The Commission recalled that the original concept of HOMS had been developed by Mr J. Nemeč and adopted by the Commission at its fifth session in 1976. The Commission confirmed that, while the concept was still valid, the system needed to be updated and therefore thanked the AWG that, in its capacity as the Steering Committee for the Hydrological Operational Multipurpose System (HOMS), had prepared a strategy for the future of HOMS, which took into account the technological, institutional and economical development affecting the work of NHSs in recent years. The Commission reviewed and revised the strategy and developed the alternative approaches to the future of HOMS as given in [Annex 2 to Resolution 5 \(CHy-XIII\)](#).

10.3 The decisions of the Commission regarding the two issues above are contained in [Resolution 5 \(CHy-XIII\) – Capacity-building in hydrology and water resources](#).

10.4 The Commission welcomed the offer by IAHR to cooperate with WMO in organizing short courses dedicated to engineers, hydrologists and staff of Hydrological Services about principles and methods of stream gauging. In such courses, WMO references and documents, such as the *Manual on Stream Gauging* (WMO-No. 519), would also be presented, with the objective to disseminate WMO guidance material on hydrometry in university curricula. Such courses would be organized with a common format and on a regional basis, with a particular attention to developing countries.

10.5 The Commission was pleased to learn that the HOMS National Reference Centre of Poland was planning to submit, in the near future, two new HOMS components.

10.6 The Commission noted that in the past, in addition to regulatory and guidance publications, the WMO Secretariat had issued training manuals for the benefit of NMSs, NHSs and RTCs. In particular, a nine-volume *Compendium of Meteorology for Use by Class I and Class II Meteorological Personnel* edited by Mr A. Wiin-Nielsen had been published. The Compendium included two volumes devoted respectively to general hydrology and to hydrometeorology. The Compendium had proved to be very useful in the past but was currently out of print. The Commission recommended that the AWG study the possibility of recovering and possibly updating and reprinting those volumes.

11. WMO INTEGRATED GLOBAL OBSERVING SYSTEMS AND WMO INFORMATION SYSTEM (*agenda item 11*)

11.1 In response to the request of Fifteenth Congress of including WIGOS activities in technical commission work programmes, and the subsequent request at the first meeting of the Executive Council Working Group on WIGOS and WIS, the Commission noted the proposal for implementing the HARON project in conjunction with GEO as a WIGOS pilot project. Following the guidance by Fifteenth Congress regarding the launching of five pilot projects, the Commission considered the request of the Executive Council Task Team on the Integration of the WMO Observing Systems to undertake the pilot project on initiation of a global network addressing a GCOS requirement. It decided to identify a package of approaches to address that requirement, and directed the AWG to develop components of such a package. The package would include a

clear articulation of scientific questions and purposes, to include other related initiatives such as the Prediction in Ungauged Basins (PUB) and the World Climate Research Programme/Global Energy and Water Experiment, and WHYCOS. In addition, it would include or explore other approaches such as geostatistical approaches to provide relevant data and information to address those scientific questions and purposes. The Commission stressed that data and information resulting from that package or activities should be shared with all interested parties.

11.2 The Commission viewed the proposed HARON project as one of the potential components of such a package and concluded that the HARON project needed further revision to include near-real-time hydrometric data quality assurance aspects under the project, plan for a network design, plan for sustaining stations, and the clear definition of the role of the AWG in its management. HARON should not proceed until the AWG adopted a scientific framework for the “package of approaches” and it had been specified how HARON fit within the overall framework and how it addressed the scientific questions and purposes.

11.3 The Commission recommended exploring the possibility of the Pacific-HYCOS project and other HYCOS projects being taken up as WIS pilot projects. The Commission further recommended that the data and information flows under the Flash Flood Guidance System be considered as part of a WIS pilot project.

11.4 The Commission requested that hydrological requirements and perspectives be highlighted in sessions of the WIGOS and WIS working committees with the intent of making use of WIGOS/WIS mechanisms and infrastructure. In that respect, it decided that during the intersessional period, an AWG member should be made responsible for maintaining interaction with WIGOS/WIS activities in the hydrological context.

11.5 The Commission stressed the need to maintain awareness of Resolution 25 (Cg-XIII) – Exchange of hydrological data and products, within and beyond the WMO community. For that purpose, it should be regularly included as a discussion item in the meetings of regional association Working Groups on Hydrology. It also recognized that in some hydrology and water related fields there might not always be a need for general data exchange at the global level. Rather, exchange would be of specific datasets, targeted to a definite goal, such as data at the basin level for Integrated Water Resources Management and data at the global level to support regional downscaling of climatological products. The requirements of types of data and their format of exchange for different applications should be clearly identified and communicated. The Commission stressed in particular the need to ensure access to data for research needs.

11.6 The Commission adopted [Resolution 6 \(CHy-XIII\) – WMO Integrated Global Observing Systems and WMO Information System](#).

12. FUTURE PROGRAMME OF WORK OF THE COMMISSION (*agenda item 12*)

12.1 The Commission noted that the Advisory Working Group, during its last session, had invited the chairs of the Working Groups on Hydrology and the Working Groups on Hydrology and Water Resources of the regional associations with the main objective of planning for the current session of the Commission. Some of the chairs of the working groups had previously undertaken a consultation process in their respective regions. Based on that process, chairs of those working groups presented the regional needs, which were considered by the AWG while preparing the proposal for the CHy Workplan 2009–2012. The Commission noted that the AWG had also considered the ongoing activities that needed to be completed and the new proposed activities that were considered by the Commission under previous agenda items. Based on those AWG recommendations and the resolutions it had previously adopted during the current session, the Commission adopted the programme of work for its next intersessional period, as given in [Annex 1 to Resolution 7 \(CHy-XIII\)](#).

12.2 The Commission proposed that the activities, in principle, be categorized by the AWG as: (a) mission critical, which should be accomplished, where practical, within the intersessional

period and funded mainly from the core budget; (b) strategic and desirable, which were not critical to achieve during the intersessional period and for which resources could be available from the core budget or could be arranged from extrabudgetary resources; and (c) discretionary, which were beneficial tasks to the Commission but not necessarily of strategic value and did not require completion during the intersessional period and that should be funded essentially through extrabudgetary resources. The Commission recommended that the AWG attempt to complete all the activities within the intersessional period and those other activities for which resources were available.

12.3 Appreciating the increased interaction between the Working Groups on Hydrology and the Commission, the members expressed the need to draw from the activities of the regional working groups while implementing the Commission's programme of activities. Members of the Commission also expressed the need for maintaining regular communication (approximately quarterly) between the AWG and the members of the Commission and the Regional Working Groups on Hydrology. For that purpose, they suggested making use of newly available tools.

Structure of CHy and nomination of Advisory Working Group members

12.4 CHy discussed its current structure (an AWG and five OPACHES), and decided to continue that structure with slight changes, as shown in [Annex 2 to Resolution 7 \(CHy-XIII\)](#). To carry out its programme of work during the next intersessional period, the Commission, therefore, established an AWG composed of nine members and relevant OPACHES covering the four thematic areas. It also agreed to explore the increased utilization of existing and appropriately referenced guidance material from non-WMO sources in undertaking its activities. The Commission urged the members of AWG responsible for a particular theme area to make special efforts to carry out their activities with the active support from the relevant OPACHES, while at the same time keeping in mind the cross-cutting nature of their activities and the need to involve experts from outside their OPACHES as required. The Commission decided that the mechanism of OPACHES, though not perfect, was a reasonable way to involve those experts willing to work in the activities of CHy and as such decided to continue with the OPACHES established during its twelfth session, with slight modifications. The Commission appealed to members to facilitate the participation of experts in its activities and expressed that participation by a greater number of volunteers, for example, through the OPACHES, was necessary in the future to enhance the accomplishment of CHy results.

12.5 The composition of the AWG and terms of references of each one of its members is given in [Annex 2 to Resolution 7 \(CHy-XIII\)](#). The members were designated during the session and their names are listed in [Resolution 7 \(CHy-XIII\) – Work programme and structure of the Commission for Hydrology](#). The president was authorized to designate substitutes should any of those members become unable to serve during the next intersessional period and recommended that the AWG at its first meeting identify potential substitutes and keep them informed of the progress with activities.

13. WMO STRATEGIC PLAN 2012–2015 AND MONITORING AND EVALUATION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME (agenda item 14)

13.1 The Commission noted that WMO had adopted the results-based management approach and that Strategic Planning, the WMO Operating Plan as well as Monitoring and Evaluation were an integral part thereof. It further noted that the Executive Council at its sixtieth session had endorsed the schedule for delivering the draft WMO Strategic Plan for the period 2012–2015 by the end of 2008. Taking advantage of the opportunity offered by the holding of its session in time for submitting its contribution to the elaboration of such a document, the Commission discussed the future thrust of its activities and recommended that the formulation of the Strategic Planning should be used as an opportunity to further clarify the WMO role in hydrology and other water-related issues, especially with respect to other United Nations agencies, international and regional institutions, and international initiatives such as the Millennium Development Goals. It noted that in view of the fragmentation of the water sector, there was a

need to place particular emphasis on building partnership with other water sector agencies at the local, national and regional levels, and promoting the role of National Hydrological Services.

13.2 Some of the key areas of future work identified by the Commission included water resources assessment, hydrological forecasting, measurement methods and instruments, data assimilation, environmental aspects of hydrology and water quality and groundwater monitoring for integrated catchment management. Assessment of hydrological impacts of urban development and of changes in land use and climate, as well as increasing awareness and educating stakeholders and users about those impacts, were also important elements of the future work of the Commission.

13.3 The Commission also noted that the Executive Council at its sixtieth session had recommended optimizing the number of expected results and associating them with well-formulated key performances indicators. In that regard, the Commission was informed of the first draft of the reviewed strategic thrusts and expected results and of the proposal for identifying for each expected result some key outputs to which key performance indicators would be attached. Noting that there was an almost perfect one-to-one correspondence between the top-level objectives and the strategic thrusts, the latter describing the means by which the former were attained, the Commission considered that, for the sake of simplification, it might be appropriate to merge those two strategic planning levels into one.

13.4 The Commission debated whether maintaining a specific and separate expected result addressing hydrological data, information, forecasts and assessments, or merging it to create a single weather, climate and water expected result, was most appropriate. One approach represented integrated research and application development while the other allowed for the different approaches and practices in each field. The Commission, however, was of the opinion that the proposal to have specific key outputs as the level below expected results might provide a solution to its concerns. The key outputs should be carefully formulated to cover all hydrology and water-related issues of concern to the Commission and could be inferred from the theme areas in the future programme of work. While the Commission saw merits in both approaches, there were concerns that to merge the expected results would result in a downgrading of hydrology within WMO and thereby not meet the requirements and needs of the hydrological community. On balance, therefore, the Commission proposed that existing expected result 3, Enhanced capabilities of members to provide better hydrological forecasts and assessments, be maintained.

13.5 The Commission expressed the concern that, in the case of merging that specific hydrological expected result into a broader one, it might follow that the future structure of technical commissions and regional associations might not have dedicated bodies for hydrological and water-related issues. The Commission members considered WMO hydrological constituent bodies as essential platforms for the hydrological community in WMO.

13.6 The Commission suggested that present expected results 4 (Integration of WMO observing systems) and 5 (Development and implementation of the new WMO Information System) could readily be combined into an integrated observations and data expected result. However, it agreed that, in changing the expected results, care needed to be taken in regards to the implications for budget allocations and perceived priorities.

13.7 The Commission recognized that WMO activities in the field of hydrology and water resources had more often the function of catalysts for triggering and promoting further activities developed and carried out by NHTs and other bodies working in the water sector, including international organizations and aid agencies. Furthermore, contrary to the meteorological domain, several other United Nations agencies, in parallel with a number of international non-governmental organizations, operated in the water sector in fields close or partially overlapping with those of HWRP. It also noted that the budget spent by WMO on water-related activities was relatively insignificant as compared with the financial resources invested by various hydrological services in the countries and other international organizations. In consideration of that, it might not be realistic to expect that direct impacts of activities carried out in the framework of HWRP be reflected in the activities and outputs of NHTs, in a tangible manner clearly discernible from other contributions.

Therefore, the Commission, having taken note of the decision of the Executive Council at its sixtieth session concerning the monitoring and evaluation process, in particular the definition of key performance indicators, recommended that the monitoring and evaluation of HWRP results be made on the basis of the outcomes of the activities and not on the basis of the evaluation of their impacts, since the latter would require a complex assessment process (involving agencies external to WMO) and extensive use of human and financial resources. The Commission adopted [Recommendation 1 – WMO strategic plan 2012–2015 and monitoring and evaluation of the Hydrology and Water Resources Programme](#).

13.8 However, some Commission members expressed their concern with that approach on the basis that it was the net impact of the activities of the NHSs that was important, rather than their outcomes. Noting that impacts were indeed harder to evaluate and measure, the Commission recommended that if the key performance indicators continued to focus on outputs, then direct linkages between outputs and impacts be established and referred to in the relevant documentation.

14. SCIENTIFIC LECTURES (*agenda item 15*)

The Commission devoted two afternoons to a series of scientific lectures on the following subjects:

- HYDROMET Technology Transfer and Development Center – The Vision by Mr C. Barrett from the United States, on Thursday, 6 November 2008, pm
- The potential of integrated modelling and the OpenMI by Mr R. Moore from the United Kingdom on Thursday, 6 November 2008, pm
- Assessment of Uncertainties in Hydrological Measurements by Mr P. Pilon, from Canada on Monday, 10 November 2008, pm
- Moving from Climate Outlooks to Hydrologic Outlooks by Mr C. Pearson from New Zealand, on Monday, 10 November 2008, pm
- Local Ownership of Flood Forecasts through IFNet/GFAS by Mr K. Takeuchi from Japan, on Monday, 10 November 2008, pm
- Collaboration between National Hydrological Services and National Meteorological Services in Hydrological Forecasting: Experiences from Latin America by Mr A.L. Aldana from Spain, on Monday, 10 November 2008, pm

The Commission expressed its appreciation to those experts who had delivered the lectures.

15. ELECTION OF OFFICERS (*agenda item 16*)

The Commission for Hydrology unanimously re-elected Mr Bruce Stewart (Australia) president and Mr Julius Wellens-Mensah (Ghana) vice-president for the next intersessional period.

16. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT EXECUTIVE COUNCIL RESOLUTIONS (*agenda item 17*)

The Commission examined the resolutions and recommendations adopted at its twelfth session, as well as the Executive Council resolution relating to Commission activities that were still in force, namely Resolution 4 (EC-LVII). The decisions of the Commission in that regard are incorporated in [Resolution 8 \(CHy-XIII\) – Review of previous resolutions and recommendations of the Commission for Hydrology](#) and [Recommendation 2 \(CHy-XIII\) – Review of the resolution of the Executive Council based on previous recommendations of the Commission for Hydrology](#).

17. OTHER MATTERS (*agenda item 18*)

There were no other matters raised.

18. DATE AND PLACE OF THE FOURTEENTH SESSION (*agenda item 19*)

The Commission agreed that its fourteenth session should be held preferably in 2012.

19. CLOSURE OF THE SESSION (*agenda item 20*)

19.1 At the close of the session the president thanked all participants for their active contribution to the deliberations.

19.2 The thirteenth session of the Commission for Hydrology closed at 3.20 p.m. on Wednesday, 12 November 2008.

RESOLUTIONS ADOPTED BY THE SESSION

Resolution 1 (CHy-XIII)

WMO QUALITY MANAGEMENT FRAMEWORK – HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Recalling:

- (1) Resolution 27 (Cg-XIV) – Quality management, to set up a Quality Management Framework,
- (2) Resolution 32 (Cg-XV) – WMO Quality Management Framework,

Considering:

- (1) The recommendations of the CHy Advisory Working Group at its third session, held in Geneva in February 2008,
- (2) The recommendations of the Inter-Commission Task Team on Quality Management Framework (ICTT QMF), held in Geneva, from 15 to 17 January 2007,
- (3) That the Secretary-General signed a working arrangement with the International Organization for Standardization (ISO) on 16 September 2008 to improve the cooperation between ISO and WMO,
- (4) The experience gained during the last eight years in the implementation of the review procedure for the technical reports requested by the Commission as laid down at its eleventh session,

Noting that:

- (1) The adoption of quality management principles, approaches and practices facilitates the efficient and effective management and operation of a service and the implementation of quality management systems is likely to assist NHSs in adopting good management practices and enhance confidence in the quality of their data, products and services,
- (2) There are uncertainties associated with the hydrological processes and the impossibility to completely eliminate these uncertainties involved in the data and products,
- (3) It is useful to make the users aware of these uncertainties,
- (4) An enhanced peer review process for publications of the Commission would be required before they are admitted for their use as recommended hydrologic practices under QMF–Hydrology,

Noting further that the Commission will be requested to contribute to the preparation of Volume IV of the Technical Regulations on the administrative aspects of quality management systems, which would be coordinated by the Inter-commission Task Team on Quality Management Framework,

Taking into account Resolution 26 (Cg-XV) – Publications Programme for the fifteenth financial period,

Decides:

- (1) To adopt a Quality Management Framework – Hydrology providing an overall strategy, advice, guidance and tools for National Hydrological Services to attain efficiency, quality and effectiveness in their functioning as given in Annex 1 to this resolution;
- (2) To adopt the peer review process for the technical guidance documents brought out by the Commission as included in Annex 2 to this resolution;
- (3) To work closely with ISO within the framework of the WMO–ISO working arrangement;
- (4) To collaborate with the ICTT QMF in furthering this approach of peer reviews as an example of effective implementation of the WMO-wide QMF;

Recommends:

- (1) That the Executive Council review the concept of mandatory publications in the light of the WMO QMF and the recent technological advances in publication and encourage each technical commission to define the required mandatory publications under this revised process;
- (2) That the Executive Council, probably through the ICTT QMF, adopt a revised glossary on terminology related to the QMF including the usage of the term “standard”;

Encourages:

- (1) Members to support the development and implementation of the Quality Management Framework – Hydrology by providing the necessary support to their experts in the relevant OPACHE (Open Panel of CHy Experts) to develop and update the necessary technical guidance documents;
- (2) The Secretariat to make all efforts to prepare the technical guidance documents in all the relevant official WMO languages and the Members to support the Secretariat in this effort;
- (3) National Meteorological and Hydrological Services to design and implement quality management systems, based on the WMO Quality Management Framework and the principles of ISO or any relevant quality management standards, as appropriate to their
- (4) National Meteorological and Hydrological Services to participate in ISO activities through their appropriate national channels and to assist WMO in the development of common standards with ISO.

Annex 1 to Resolution 1 (CHy-XIII)**WMO QUALITY MANAGEMENT FRAMEWORK – HYDROLOGY****Why Quality Management Framework – Hydrology?**

Reliable hydrological data and information are key inputs to the sound and wise management of water resources. Particularly under the changing paradigm of integrated water resources management, where decisions are increasingly being made through a consensual approach, including relevant stakeholders, it is imperative that reliable data and information be accessible in a timely manner to facilitate informed decision-making. The value of such data and information increases when they are provided through organization(s) that value and adhere to quality management principles.

Decisions in various sectors of the economy are becoming increasingly dependent on hydrological information. Depending on a particular country's circumstances it is possible that various agencies may be involved in hydrological data collection within a basin. Lack of standard procedures of obtaining measurements, storage of data, data manipulations, and protocols for data and metadata exchange, as well as acceptable analytical methodologies for transferring data into information, may often result in the generation of conflicting information, data and products being made available among various sectors, administrative regions and diverse users. Such a situation can lead to disagreements, generate reluctance to cooperate and can undermine the importance and credibility of the work of the National Hydrological Service (NHS). In transboundary basins, the equation evolves into another level of complexity requiring assurance among riparian countries and compatibility of the quality of data and products.

Given the uncertainties associated with the hydrological processes and the impossibility to completely eliminate them in data and information production, it is useful to make the clients aware of these uncertainties. Further, research on the global water cycle and impacts of increasing climate variability and potential climate change on the availability of water resources requires the sharing and use of data from many countries. It is important that in such analyses the data be compatible, comparable and of known assured quality.

Quality Management Framework and National Hydrological Services

With a view to achieving their mission and strategic directions, the NHSs have to ensure that their core activities of hydrological data acquisition and delivery of services and products are working efficiently and effectively. It is also beneficial at the same time to have in place quality management approaches so that assurances can be given that the stated quality of the data is being attained. Implementation of quality management systems will assist NHSs in the provision of good management practices and ultimately will enhance confidence in the quality of their data, products and services (ICTT QMF, 2007).¹ This may build confidence in the NHS with its clients, users and stakeholders, possibly resulting in the additional benefit of raising awareness on the need for financial and human resources to manage and operate the NHS.

It is worth noting that quality management is useful to an NHS even if there is no intention by the Service to enter into a formal certification process, as the adoption of quality management principles, approaches and practices facilitates the efficient and effective management and operation of a Service. Therefore, NHSs from developing or developed countries that may not have sufficient funds needed for third-party certification would still greatly benefit by adopting quality management principles.

What is the WMO Quality Management Framework (WMO QMF)?

The essence of the WMO QMF is to provide an overall strategy, advice, guidance and tools for a Member's National Meteorological and Hydrological Service to attain quality, efficiency and effectiveness in its functioning. The WMO QMF would enable the provision of continuing relevant advice to WMO Members on developing their individual quality management systems (QMSs), thereby providing a mechanism for their further improvement. It is meant to complement and assist with the implementation of national QMSs developed or to be developed by National Meteorological and Hydrological Services (NMHSs). The role of the WMO QMF is, therefore, to enable and support a process of continuous quality improvement in Member countries. It would include the following distinct though related elements:

- WMO policy statement;
- WMO technical standards, including Volume IV of the WMO Technical Regulations;
- Catalogue of technical publications/standards as potential contributions to QMSs;
- Guide on quality management to assist NMHSs in the design and implementation of QMSs;
- Training of quality managers, practitioners and NMHS decision-makers.

QMF–Hydrology, within the overall WMO QMF, would mainly address the hydrological needs of the Members. It would, however, adopt the elements of weather and climatic observations from the WMO QMF.

National quality management framework

In the case of hydrology it is common to have multiple organizations perform similar activities with different objectives or at different geographical scales. At the same time, overall responsibility for maintaining and improving the quality of hydrological observations, products and services may rest with a central authority, typically referred to as the NHS within the country. Such a central authority should strive to establish and support the quality-related structures and processes to be adopted by the Hydrological Services operating at various geographical and administrative levels within the country, including in the private sector, if it is possible to do so.

To this end it is expected that the NHS and each entity involved in the provision of hydrological data, products and services in a country or a basin would establish a QMS, to support continuous improvement process aimed at all activities related to the provision of hydrological data, products

¹ Inter-Commission Task Team on Quality Management Framework (ICTT QMF), Report of its second session, WMO, Geneva, 15–17 January 2007.

and services, including the quality system itself. An authorized organization, normally the NHS, should be able to guide such a process by defining the national QMF. In other words, in the case of a country with multiple hydrology-related organizations, the NHS would be responsible for the national QMF, with each Hydrological Service developing and adopting its own QMS under the umbrella of the national QMF.

The national QMF has to be underpinned by an agreed upon statement articulating the objectives, policy and values of the NHS concerning the maintenance and improvement of the quality of hydrological information that it provides. It is important to ensure that policies and objectives are relevant to the stated policy of the NHS, and in consonance with the circumstances and environment of the country.

Typically, the compilation and documentation of the quality system is undertaken through a quality manual, which forms an important part of the process of building, consolidating and clarifying the quality management framework. Describing the framework in a single document helps reflect a coherent and integrated overall quality management strategy. The manual, in addition to the details of the specific elements of the quality system, should describe the broader content of the quality management system, including policy, objectives, organization, quality improvement and service standards. This manual may also show linkages to the WMO QMF and WMO publications. This document could also summarize what actions have been taken to satisfy the requirements of a QMS based on ISO 9000 requirements or a similar system.

What is a quality management system?

“A quality management system is a management tool consisting of a set of rules to direct and control an organization with regard to quality, which is intended to assist in establishing policy and objectives and in achieving those objectives. It is a dynamic process that brings resources, activities and behaviour together to focus on the achievement of success.”

(WMO, 2006, p. 36)²

A QMS should exist in the context of the policy and structures of its QMF. The country-specific QMS would reflect the current political, administrative, legal and socio-economic environment within which the Hydrological Service(s) operate(s).

To support a complex professional service like a Hydrological Service, QMS must incorporate specific operational elements of quality assurance through establishing the acceptable practices and exercising control checks on these practices, which together constitutes a QMS. Such a QMS operates to control the quality and standards throughout the business process and supports the staff engaged in various activities in achieving the objectives of quality policy. To achieve this, it is necessary to define clearly the responsibility, authority and interrelation of all staff who undertake work that affects the quality of data, products and services, as well as the approaches and verifications that are established within the system.

The quality management system guides the entire process leading to the quality of the final data, products and services. It should also be extended to include the other activities undertaken by the NHS such as accounting practices, performance appraisals and other non-technical matters. The QMS would ensure the ability of the NHS to accurately and reliably inform “clients that its data, products and services meet the standards of quality that have been defined for them” (WMO, 2006, p. 36).³

The key principles of any quality management system should include the following:

- Quality is built into the data/observation and information production process rather than relying on post-production audits or checks;

² WMO, *Guidelines on the Role, Operation and Management of National Hydrological Services*, Operational Hydrology Report No. 49, WMO-No. 1003, Geneva, 2006.

³ WMO, *Guidelines on the Role, Operation and Management of National Hydrological Services*, Operational Hydrology Report No. 49, WMO-No. 1003, Geneva, 2006.

- Responsibilities for each player in the process are clearly defined and properly communicated;
- Existence of an efficient results-focused control process (too many controls results in no control);
- Stakeholders involvement in performance assessment;
- Participation of the practitioners in the continuous evolution of the quality management system.

Continuous improvement activities form part of every quality management system. There are many possible mechanisms for quality improvement and each Hydrological Service will need to develop approaches best suited to its own circumstances. A continuous improvement process typically contains six activities that operate in an interactive manner. They are:

- Formal documentation of standards and accepted practices;
- Development of activities that build staff awareness of standard procedures and expectations;
- Assessment of product or process quality against set indicators;
- Studies to propose improvements in practices;
- Development of an inventory of improvement initiatives;
- Identification and documentation of lessons learned.

Role of the Commission for Hydrology within the WMO Quality Management Framework

The technical Commission for Hydrology is expected to contribute to the overall WMO Quality Management Framework that is specific to NHSs, particularly with respect to further development of Volume IV on Quality Management within the Technical Regulations. These contributions would help address processes and procedures that are inherent to hydrological data/observations, products and services. These contributions would provide documentation (regulations, guides and manuals on technical standards), advice and guidance to NHSs that would be of utility in the formation of their QMS within their country.

The Commission for Hydrology will develop guidance material to assist NHSs in the development of their QMS. This material would provide an organized system to ensure national consistency in the progressively more common cases of decentralization, partial or complete privatization and outsourcing of functions related to the acquisition of hydrological data, products and services. An initial effort would be made to further develop and document quality assurance and quality control procedures common to various NHSs. Efforts would be made to develop training materials in close cooperation with the regional associations' working groups on hydrology.

How would the WMO QMF–Hydrology be established?

There would be three broad categories of potential focus of CHy with respect to QMF, plus one cross-cutting aspect related to training. These would include:

- Documentation on approaches to QMS and guidance on its adoption and implementation, including guidance on documenting procedures used by a NHS and documentation of the attributes of the products that the NHS produces including its level of quality;
- Documentation and guidance on management of NHSs, for example, Guidelines on the Role, Operation and Management of National Hydrological Services (WMO Operational Hydrology Report No. 49, WMO-No, 1003);
- Documentation on technical approaches for the provision of hydrological data, products and services;
- Development of training modules and materials.

CHy, with its long and successful history of developing and promoting various technical guidance documents, would undertake to develop the required guidance documents. Such technical guidance documents could form the building blocks of the QMSs of NHSs. These documents would be categorized as:

- *Technical Regulations,*
- *Guide to Hydrological Practices,*
- *Manuals,*
- *Guidance material: guidelines,*
- *Technical documents.*

Information on some of the relevant technical guidance documents, currently under revision, is given in Table 1. In the formulation of guidance for NHSs on approaching QMF and documentation of technical approaches within the QMF, the CHy would make use of the existing best technical practices and approaches that have been developed by other organizations and take advantage of the ISO standards. The working agreement⁴ with the International Organization for Standardization, which includes the subject of hydrology, would be used for the preparation of joint standards as outlined in the agreement. CHy would keep the options open for the possibility of working jointly with other organizations that promote the development of standards in hydrology.

CHy would advance the use of definitions adopted by ICTT QMF when considering activities and processes within the provision of hydrological data, products and services. The ICTT QMF defines a process as a set of interrelated activities, which transforms inputs into outputs. Each of the processes could in turn consist of sub-processes and activities or steps that are necessary to arrive at the observation. The technical guidance document for the specific process would inherently consider and possibly articulate various approaches to sub-processes and their interactions in arriving at an “observation.”

For example, hydrological observations such as, but not limited to, the following components and processes could consist of:

- Hydrometry: Measurements of:
 - Stage
 - Velocity
 - Water temperature
 - Suspended sediment concentration and bed load
 - Water quality (surface water and groundwater: diverse variables)
 - Soil moisture
 - Groundwater level
 - Evaporation and evapotranspiration
 - Rate and volume of groundwater abstraction
- Climatological observations for hydrological purposes:
 - Precipitation (diverse variables)
 - Snow cover (diverse variables)
 - Snow water equivalence
 - Air temperature
 - Wind speed and direction
 - Solar radiation

Apart from observations, some hydrological processes are usually considered by practitioners to be derived using observations combined, at times, with the use of models and judgment. Some examples of these would include, but are not limited to, aspects such as the estimation of actual evaporation, rates and volumes of groundwater recharge and stream flow (discharge). The derivation of discharge data includes aspects such as data processing and storage (including the derivation of rating curves and their adjustments, and the conversion of stage into discharge).

The provision of hydrological forecasts, which includes in general stream flow forecasting and specifically flash flood forecasting, flood forecasting, low flow forecasting and flow forecasting, could be considered as hydrological products. Other commonly developed hydrological products

⁴ See the agreement in the background material.

result from “secondary data processing.” Examples of these include low and flood flow frequency analyses, and the estimation of probable maximum precipitation and probable maximum flood. These, at times, form important aspects of hydrological products and services provided by NHSs. It would be beneficial if products of this nature were included in the quality management system of an NHS.

Table 1. Examples of WMO technical guidance documentation and current status

<i>Title</i>	<i>Latest edition</i>	<i>Form of availability</i>	<i>Web link, if available</i>	<i>Target date for update, if possible</i>	<i>Group overseeing updating of the document</i>	<i>Whether it contains standard procedures, standard practices</i>
<i>Technical Regulations, Volume III – Hydrology</i> WMO-No. 49	2006	Printed and electronic	N/A	–	CHy Advisory Working Group	Yes
<i>Guide to Hydrological Practices</i> WMO-No. 168	1994	Printed and electronic	ftp://ftp.wmo.int/Documents/MediaPublic/Publications/Guide_to_Hydrological_Practices/	Nov. 2008	CHy Advisory Working Group	Yes
<i>Manual on Stream Gauging</i> WMO-No. 519	1980	Printed	N/A	June 2009	OPACHE on Basic Systems	Yes

Annex 2 to Resolution 1 (CHy-XIII)

TECHNICAL GUIDANCE DOCUMENTS FOR WMO QUALITY MANAGEMENT FRAMEWORK – HYDROLOGY

Peer Review Process

1. Introduction

With the adoption of a Quality Management Framework for Hydrology, the publications brought out under the technical guidance of the Commission for Hydrology form an essential tool for meeting the objectives of a quality management system (QMS). As such, the publications brought out by CHy should undergo a comprehensive peer review before they are recommended for adoption as tools for the QMS. The Commission at its thirteenth session adopted the following peer review process. The review process derives from the experience gained during the years since the eleventh session of the Commission when a formal peer review process was defined for the first time and has been strengthened.

2. The peer review process

The president of CHy shall appoint a member of the advisory working group (AWG), or a similarly named management group, as responsible to oversee the peer review process during an intersessional period (hereafter referred to as the “responsible member”). Technical material related to the scope of CHy activities can be submitted to be published as a CHy publication by:

- A member of the AWG,
- One or more of the OPACHE members,

- A member of CHy,
- Chairperson of the WGH of regional associations,
- Director of HWRP.

In this regard, the WMO Secretariat should ensure that the technical material is complete, is in a form ready for review, and has been assigned to a category of technical guidance document. If required, the member of the AWG dealing with the subject closest to the subject matter of the technical material shall be consulted. If the report is not considered ready, the Secretariat shall advise the author(s) as to how it might be amended so as to make it suitable for the review process. This could be organized through the relevant AWG member in conjunction with the author(s).

Once the technical material is ready for review it should be sent to the responsible member for peer review. The peer review process shall comprise of the following steps:

- (a) Selection of reviewers;
- (b) Assessment of the report by the reviewers;
- (c) Evaluation of the comments from the reviewers;
- (d) Publication of the report.

2.1 Selection of reviewers

The responsible member shall determine whether a particular report is ready for review. For the purpose, if applicable, he or she should consult the AWG member responsible for the subject matter of the draft publication. The responsible member, in consultation with the president of CHy and the Secretariat, should choose three reviewers who are experts in the subject matter.

2.2 Assessment of a report by the reviewers

The responsible member will forward to the reviewers the draft report and a copy of the “notes for reviewers” together with a peer review document pro-forma for reviewers of reports. An agreement with the reviewers should be reached on the time period required for review. The reviewers should be informed that they have the right to remain anonymous, if they so wish.

Reviewers should consider the report from a scientific, technical and editorial point of view and provide their advice using a standard reporting form, including their views on the suitability of the pre-assigned category of the document.

2.3 Evaluation of the comments from the reviewers

The member of the AWG responsible for CHy publications will evaluate the comments from the reviewers and if needed may forward proposed revisions prepared by the reviewers to the author of the technical material. If appropriate, the author(s) should be requested to elaborate on and comply with the comments of the reviewers. If one or more reviewers wish to see the revised draft, it should be sent to those in question. If, as a result of the review process, the report is considered suitable for publication within the Commission for Hydrology publication series, the responsible member will recommend its publication to the president of CHy.

2.4 Publication of the report

The president of the Commission will consider the recommendation when making his or her decision and, when approved, will coordinate the publication of the report with the WMO Secretariat.

3. Classification of publications

Publications prepared as part of different activities of CHy should be classified into one of the

following categories:

- Technical Regulations;
- *Guide to Hydrological Practices*;
- Manuals on hydrology and water resources;
- Guidance material: guidelines in hydrology and water resources;
- Technical documents.

3.1 Technical Regulations

The Technical Regulations lay down the hydrological practices and procedures to be followed by WMO Member. They set out what National Hydrological Services should do. The Technical Regulations comprise standard/recommended practices and procedures. They are designed:

- (a) To facilitate cooperation in meteorology and hydrology between Members;
- (b) To meet, in the most effective manner, specific needs of the various fields of application of meteorology and hydrology in the international sphere;
- (c) To ensure adequate uniformity and standardization in the practices and procedures employed in achieving (a) and (b) above.

Congress in accordance with Article 8 (d) of the Convention determines the Technical Regulations of the World Meteorological Organization. The Commission for Hydrology makes recommendations to Congress on the contents of the *Technical Regulations* (WMO-No. 49), Volume III – Hydrology.

3.2 Guide to Hydrological Practices

The Technical Regulations are supplemented, wherever required, by the *Guide to Hydrological Practices* (WMO-No 168) and manuals, which describe in more detail the practices, procedures and specifications that Members are invited to follow or implement in establishing and conducting their arrangements for compliance with the Technical Regulations and in developing and operating Hydrological Services and carrying out other activities in the field of water resources in their respective countries. The *Guide to Hydrological Practices* provides general practices across the full range of hydrological activities. It forms an essential tool for implementing the QMS.

3.3 Manuals

The manuals provide more detailed guidance on practices and procedures of relevance to a specific field of hydrology and water resources. Manuals can form an important tool for the QMS.

3.4 Guidance material: guidelines

Guidance material or guidelines are those publications that provide important information and state-of-the-art summary on a particular topic. These reports can be the results of inter-comparisons of techniques, a state-of-the-art summary of current activities or newly proven innovative scientific technology, or the current state of progress in significant developments. Guidelines provide “guidance” on the acceptable (possible best practices) use of techniques, technology or scientific practice.

3.5 Technical documents

Publications on technologies and procedures that are of general interest but do not fall into one of the categories described in 3.1 to 3.4 above (for example, because they are only of regional relevance, they express the personal opinion of an expert, or they describe technologies or emerging innovative scientific practices which are not yet operational) should be issued as technical documents. The technical documents do not need to undergo the same review process as described above, but will require the approval of the president of CHy as in 2.4 above. The proceedings of workshops and conferences can also be brought out as technical documents.

Background material, which may prove useful in the preparation of future publications under the above-listed categories, is also included in this category. Such material would not be widely distributed.

Resolution 2 (CHy-XIII)

PROJECT FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

THE COMMISSION FOR HYDROLOGY,

Recalling that through Resolution 1 (CHy-XII) – Structure and programme of work of the Commission for Hydrology, the Commission had decided, as one of the activities under its theme area on basic systems (hydrometry and hydraulics), to “develop a proposal and implement a project to assess the performance of flow measurement instruments and techniques against WMO standards”,

Noting:

- (1) That a comprehensive proposal had been developed (Annex 1 to this resolution) and progress had been made in several tasks foreseen in the proposed workplan,
- (2) The report of the Advisory Working Group member leading activities associated with the basic systems (hydrometry and hydraulics) theme of the Commission,
- (3) The project workplan (Annex 2 to this resolution),

Noting further the approach taken of involving other technical commissions, such as CIMO, and external organizations, such as the International Association of Hydraulic Engineering and Research, International Association of Hydrological Sciences, International Organization for Standardization and Association of Hydro-Meteorological Equipment Industry, in the project,

Decides to continue with the implementation of the project during the next intersessional period;

Endorses the workplan for the remainder of the project as contained in Annex 2 to this resolution, authorizing the Steering Committee to modify the workplan as necessary based on the consideration of events that unfold during the intersessional period;

Requests:

- (1) The Advisory Working Group to consider, at some stage in the future and subject to successful implementation of the first stages of the project, the possibility of extending the scope of the project to cover other hydrological measurements beyond those related to discharge;
- (2) The Secretariat to provide the necessary support to this important activity, in particular, by ensuring efficient linkages with the other participating organizations;

Urges Members to participate actively in this project, in particular by responding to the online Survey on Field Discharge Measurement Instrumentation and Techniques used operationally by National Hydrological Services, and by contributing their national guidance material, instrument comparison reports and laboratory test of instrument reports to the project databases;

Encourages the participating organizations to continue with their active involvement in the project, in particular by supporting their representatives in the management committee and promoting the initiative among their network of affiliates.

Annex 1 to Resolution 2 (CHy-XIII)

PROPOSAL FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES¹

Abstract

1. Several new hydrometric instruments and measurement techniques have been developed over the last few decades, but National Hydrological Services², who have a responsibility to measure surface water characteristics, have not witnessed an equal growth in knowledge and practices pertaining to the procedural manuals and standards for the use of the newer instruments and techniques nor for establishing the uncertainty associated with the estimate of the measurement. The World Meteorological Organization (WMO) Commission for Hydrology (CHy), in recognizing this deficiency, identified at its twelfth session in 2004 the need “to develop a proposal and to implement a project to assess the performance of flow measurement instruments and techniques”. The proposed project and its implementation are expected to improve the understanding of the accuracy of various types of hydrometric instruments, thereby contributing to the management of water resources. This document provides the substance of the proposal and its implementation plan, and experts are invited to come forward to contribute to this worthwhile initiative.

Background

2. Existing WMO guidance pertaining to flow measurements include: the *Technical Regulations* (WMO-No. 49), Volume III – Hydrology (WMO, 2006); the *Guide to Hydrological Practices* (WMO-No. 168) (WMO, 1994), Chapters 10, 11, 12, and 13; and the *Manual on Stream Gauging* (WMO-No. 519) (WMO, 1980). These documents are intended to provide information ranging from general guidance to more specific details on stream gauging practices. They are not intended to provide detailed results of testing of flow measurement technology and measurement techniques.

3. The existing documents address the proper use of propeller type water-velocity meters, flumes, weirs and dye dilution methods to measure discharge and the use of floats and bubbler (mercury manometer pressure measurement) systems to continuously measure water level. Automated data recording systems described in the documents were either paper chart recorders or paper punch tape, and the publications largely predate the use of strain-gauge type pressure systems for water-level measurements. These earlier publications also introduced newer methods for discharge estimation including the moving boat, ultrasonic and electromagnetic. However, since their initial publication, there have been significant advances in the “newer” technologies such as hydrometric acoustic and radar instrumentation, as well as remote-sensing systems.

4. New instrumentation technologies for discharge measurements include acoustic Doppler current profilers (ADCPs), point acoustic velocity meters, surface-velocity radar and large-scale particle image velocimetry (LSPIV). For water-level measurements, the new technologies include

¹ This version has been adapted from the version dated 6 June 2007 to make it compatible for presentation to CHy-XIII. The text of the original proposal can be found at: http://www.wmo.int/pages/prog/hwrrp/documents/Proposal_20070606.pdf

² For the sake of conciseness, the term National Hydrological Services is used throughout this document to indicate those organizations that deal operationally with flow measurement and/or with flow measurement instrument calibration, recognizing that in the case of many countries this will encompass several organizations of different affiliation.

strain-type pressure sensor (submersible sensor and bubbler system), acoustic, radar and laser systems. For data recording, paper systems have been almost entirely replaced by largely automated electronic logging, analysis and data transmission systems.

5. The new instrumentation and methodologies may offer more and better quality data at a lower cost while being easier and safer to use. Acoustic velocity technologies can offer vector components of water velocity that allow improved measurement accuracy in situations of bi-directional flow. Surface velocity radar can make non-contact or non-intrusive measurements of water velocity during conditions that are too hazardous for instruments that need to be submerged in the water (Cheng and others, 2001). Some of the newer instrumentation for water-level measurement also requires less installation effort than the older instrumentation.

6. However, the methodology used by surface velocity radar and ADCP instrumentation does not duplicate the methodology used by the older propeller and electromagnetic current meters. The newer water-level instrumentation may be more sensitive to data aliasing due to sampling intervals. None of the existing WMO guidance and standards, or, for that matter, those of other international organizations, such as the International Organization for Standardization (ISO), sufficiently address the newer instrumentation and methodologies for arriving at discharge measurements and their associated uncertainties. Information on the appropriate use and accuracy of these newer instruments and methodologies is needed.

7. Analyses of uncertainty of data measured with the older and newer instrumentation and methodologies are also needed to quantify the uncertainty in hydrological measurements. Some uncertainty analyses, such as ISO 1983 and 1993, are available. However, few if any uncertainty analyses are available for the newer instrumentation and methodologies. These analyses are of fundamental importance to the application of risk management procedures and sustainable water resources management, by ensuring that the methodology and instrumentation selected for a task will deliver the accuracy that is needed. These analyses would also enable investments in hydrological instrumentation in the most cost-effective manner. Guidance on uncertainty analysis is available from several sources including the United States National Institute of Standards and Technology (NIST), the United Kingdom Accreditation Service, the International Organization for Standardization and the American Institute of Aeronautics and Astronautics (AIAA). Existing WMO guidance and standards documents do not sufficiently address the computation of the uncertainty of these newer hydrological measurements.

8. A new edition of the *Guide to Hydrological Practices* is currently in the final stages of preparation and should be published in 2008. Even if it will contain sections addressing new instrumentation technologies, those sections will likely reflect the experiences of a small group of experts and currently available literature. A concerted effort by the international community as reflected in this proposal could greatly advance our current state of practice.

Objectives and approach

9. The main objective of this project is to help make information and standardized test results on hydrometric instrumentation and measurement methodologies generally available to National Hydrological Services (NHSs) by providing a website as a forum for the exchange of instrumentation and measurement methodology test results and information. A secondary objective of this project is to encourage and solicit the testing of the newer hydrometric instrumentation and methodologies.

10. Many NHSs test the performance of hydrological instrumentation and are developing or testing new flow measurement methodologies. Some NHSs are also involved in field studies comparing the newer methodologies with the older methodologies. Mueller (2003) provides an example of an existing report on field testing of new flow measurement methodology for boat-mounted acoustic Doppler instruments used to measure streamflow. Sharing such test results would be advantageous for the NHSs as the large number of new instruments and testing costs limit the number of instruments and methodologies that any one NHS laboratory can test.

11. Typically instrumentation test results, especially for commercially available instruments, are internally circulated within an NHS. This existing source for instrumentation test results could be made available to the project. For example, the United States Geological Survey routinely writes internal reports on the testing of commercially available hydrometric instrumentation and could be a source of testing information. NHSs would be encouraged to submit their instrument test results in a standardized test format (containing, if possible, detailed descriptions of testing methodologies and technologies used and a list of potential sources of uncertainties) that would facilitate comparisons between similar instruments. The NHSs would also be encouraged to use a standard uncertainty analysis when reporting test results for various instrumentations. Test results would be made available to NHSs on a website maintained by the project.

12. Flow measurement methodology test results are frequently published by NHSs in technical journals or conference proceedings as well as in internal documents. NHSs would be encouraged to make such documents available on the website maintained by the project. The NHSs would also be encouraged to investigate the uncertainty of the methodology using a standard uncertainty analysis for experiments (see, for example, Coleman and Steele, 1999) and to make such analyses available on the website. Examples of uncertainty analysis for acoustic Doppler current profiler discharge measurements are provided by Dongsu and others (2005) and Muste and others (2006).

13. The project would compile a list of existing information on the newer and older instrumentation, the existing and new methodologies for flow measurement and of NHS standards for hydrometric measurements with the help of staff from contributing NHSs. The compilation would be used to help revise and update WMO guidance manuals and measurement standards and to identify WMO testing requirements.

14. The project would encourage and solicit testing by contributing NHSs of the newer instrumentation and methodologies. The project would solicit loans of instrumentation and/or funding from instrumentation manufacturers and contributions from NHSs of personnel, equipment and test facilities in order to test newer instrumentation and methodologies identified by the contributing NHSs. Contributing NHSs would participate in writing and reviewing test plans, and contributing manufacturers would participate in reviews of test plans. In special cases, WMO may consider providing supplemental funding for testing by an NHS of new methodologies for discharge measurement. Contributing NHSs would provide their written test results. Manufacturers and NHSs would contribute to an independent-peer review of results. Test results, including uncertainty analyses, would be disseminated on the project website and would be used to help develop WMO measurement standards for existing and newer technologies and methodologies.

Expected outputs

15. Six outputs are expected from the project:
- (a) A summary of field discharge measurement instrumentation and techniques, where “techniques” includes methodologies and procedures for field measurements. This would include, for example, site selection, vertical velocity distribution models and algorithms for the determination of discharge. This includes instruments and techniques used or for potential use by NHSs;
 - (b) Collection of international and national standards and guidelines regarding field discharge measurement instrumentation and techniques identified using the structure under (a) above;
 - (c) Framework for the assessment of uncertainty in discharge measurement and guidelines for its implementation, including:
 - Standardized approaches to uncertainty analysis;
 - Uncertainty analysis implementation examples;
 - Guidance in the form of decision-aid tools;

- Uncertainty analysis database (information on uncertainties acquired with the standardized approach);
- Uncertainty analysis outcomes/inferences (recommendations for optimization of instrument configuration, operation and algorithms);

Note that the last three items would initially be limited to two examples of velocity instruments (profilers and point current meters) to help facilitate the overall design of the framework and to illustrate its utility;

- (d) Guidelines for conducting and reporting results of instrument calibration and performance tests on instruments and techniques;
- (e) Collection of test reports on the performance of instruments and techniques, including:
- Manufacturer specifications;
 - Multiple instrument comparisons;
 - Reports of tests performed under laboratory conditions;
 - Reports by NHSs;
 - Contact details of institutions where testing is conducted;
 - Methodology of measurement;
 - Site conditions and characteristics, including presence of sediments and other relevant aspects;
 - Other relevant information;
- (f) Overall website design to disseminate all of the above for promoting the exchange of information and fostering the use of common standards in testing and presentation of results.

16. A summary of the field discharge measurement techniques and instrumentation would describe selected techniques and instrumentation and include verification results. It would also estimate and compare the effort and costs associated with use of each technique/instrument. The uncertainty of the data collected with the technique/instrument would also be included when possible. Standard techniques for computing and reporting the uncertainty of measurements have been adopted by various organizations such as the American Society of Mechanical Engineers (ASME), AIAA, NIST and ISO. The intent would be to develop or adopt standard techniques for use by all NHSs.

17. A summary of current instrumentation standards (and policy) of WMO and those used by member NHSs would be compiled. The summary could be used by instrumentation manufacturers as guidance for instrumentation development, as well as by NHSs as guidance material for quality assurance and quality management systems. The compilation would be helpful for reviewing and revising WMO standards. NHSs could use the compilation to help develop or revise their instrumentation standards, flow measurement techniques or as guidance in developing instrumentation test plans. Entries in the compilation, for example, could include reference material on test facilities such as tow tanks to help ensure credibility of test results.

18. Guidance would be developed on verification testing to manufacturer specifications and NHS/WMO standards and manuals. An early output of this project would be the development and adoption of a prototypical test report format and recommendations on the technique used to develop and compute uncertainties of the collected test data. The test report format would allow easy comparisons among tested instrumentation and techniques.

19. A central website for the distribution of NHSs laboratories tests of hydrological instrumentation would be developed. The website would facilitate communication of instrumentation testing among NHSs.

Expected results

20. The proposed project is expected to improve planning and management of water resources by: (a) improving the understanding and knowledge of the accuracy of various types of hydrometric instruments; (b) encouraging the development of instrumentation that meets the measurement needs for water planning and management; (c) encouraging the standardization of hydrometric measurements and the computation of estimates of measurement uncertainty, leading to improved quality of data and their comparability; and (d) improving cooperation amongst NHSs.

Specific activities

21. Several specific activities for the project are needed to accomplish the proposed outputs. The identified specific activities include reviews of: (a) flow measurement standards and manuals of NHSs, (b) existing instrumentation and techniques used for flow measurement, and (c) existing NHS testing facilities and measurement standards; other identified specific activities are (d) guidance for testing instrumentation and techniques to a known standard, (e) development of a reporting format for documenting instrument and technique test results, (f) adoption of a technique to use for estimating the uncertainty of hydrological measurements, and (g) the development of a central website for sharing hydrometric instrumentation information.

Potential linkages

22. The proposed project has potential linkages with several international and national hydrological organizations. For example, the American Society of Civil Engineers/Environmental and Water Resources Institute (ASCE/EWRI) has a workgroup, which is part of the Committee on Hydraulic Measurements and Experimentation that is investigating uncertainty analyses for hydraulic measurements. Such a group would be an excellent resource for contributing to the development of the uncertainty methodology. The WMO Commission for Instruments and Methods of Observation (CIMO) has experience with a website that presents information on meteorological instrumentation that could be useful to the project (see <http://www.wmo.int/pages/prog/www/IMOP/WebPortal-AWS/Index.html>).

A few of the potential linkages are listed below:

- WMO Commission for Instruments and Methods of Observation
- WMO regional associations Working Groups on Hydrology
- UNESCO International Hydrological Programme (IHP)
- International Association of Hydraulic Engineering and Research (IAHR)
- International Association of Hydrological Sciences (IAHS)
- American Society of Civil Engineers/Environmental and Water Resources Institute
- International Organization for Standardization (ISO)
- The Association of Hydro-Meteorological Equipment Industry (HMEI)

Other potential contributions

23. The WMO Commission for Hydrology is seeking additional participation of experts from national laboratory testing facilities, National Hydrological Services, international organizations and associations, manufacturers, industry and academia that would be willing to contribute to this international initiative.

Conclusions

24. Estimating uncertainty and developing standards associated with newer hydrometric instruments and measurement techniques is quite challenging. Enhancing our understanding of uncertainty and making its estimation available to practitioners by water monitoring organizations would be a significant contribution to the state-of-the-practice and would result in significant benefits to society. In order to achieve this, a concerted collaborative effort is required at both the national and international levels to address this limitation. This document provides a path forward to achieving this. Working together offers the greatest potential for success.

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Annex 2 to Resolution 2 (CHy-XIII)

PROJECT FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

Workplan¹

1. At the meeting of experts (WMO, 2007), a workplan for the Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques was established for each of the outputs of the project with the roles of specific experts and the estimated amount of time to complete certain tasks. The material provided below is adapted from the output of the meeting of experts.

2. The tables provided below list the specific tasks that need to be accomplished, with overall efforts being prioritized. It is recognized that ongoing or planned activities of partners in the project and some other institutions may be leveraged to help achieve the overall results. For example, there are currently ongoing efforts to update the *Manual on Stream Gauging* (WMO-No. 519), while the *Technical Regulations* (WMO-No. 49), Volume III – Hydrology and the *Guide to Hydrological Practices* (WMO-No. 168) undergo a continuous revision process. At the same time, the Organization for Standardization (ISO) has projects geared to developing and issuing standards on, for example, acoustic Doppler current profilers (ADCPs) and other new technologies. All of these efforts require the documentation of modern technologies and measurement techniques, which may prove a valuable source of material for input to task I(a), and these efforts would potentially benefit from the implementation of this proposal.

3. During the meeting of experts (WMO, 2007), it was also noted that the authorship of the publications and documents associated with this project that are made available on the website or are published in any other form by WMO should be acknowledged, given the importance of recognition by contributors.

4. Where appropriate, each major project output has an associated table where the tasks needed for each output have been identified along with the responsible expert(s); the estimated time required for each aspect; and a tentative completion date for each aspect.

(I) Summary of field discharge measurement instrumentation and techniques

Task	Experts	Estimated time (months)	Tentative completion date
(a) Prepare structure of summary form and populate it	J. Fulford	2	Completed
(b) Upload form on Web and request contributions to fill gaps	WMO Secretariat	2	Completed on 11/06/08
(c) Notify NHSs by circular letter	WMO Secretariat	2	Completed on 11/06/08
(d) Synthesis of results	J. Fulford, Z. Buzas	2	31/03/09 (depends on receipt of responses)

¹ As it is common in the implementation of any project, since the original conception of the Project Document in April 2007, slight amendments had to be made to the original workplan. This version is the most up to date as of November 2008. It reflects slight changes in the scope and expected deadline of individual tasks, agreed by the core groups of experts in the process of implementing the project. It is anticipated that further modifications will be made as the project evolves.

(II) Collection of international and national standards and guidelines regarding field discharge **measurement** instrumentation and techniques identified using the structure under I). *(Requested documents could be in “pdf format”, link to websites or hardcopy (identifying the source, issuing authority, and copyright restrictions). Documents would be limited to those in one or more of the six official languages of WMO.)*

Task	Experts	Estimated time (months)	Tentative completion date
(a) In circular letter under output I(b), include a request for standards and guidelines.	WMO Secretariat	See I(c)	Completed on 11/06/08
(b) Upload collection on the website and request additional contributions	WMO Secretariat	See I(d)	31/12/08

(III) Framework for the assessment of uncertainty in discharge measurement and guidelines for its implementation.

Task	Experts	Estimated time (months)	Tentative completion date
(a) Literature review of existing uncertainty analysis framework approaches	M. Muste, J. Fulford	8	30/09/08
(b) Synthesis of recommended standardized approach to uncertainty analysis for discharge measurements (draft for review on web)	M. Muste, J. Fulford	8	30/09/08
(c) Developing implementation examples of the uncertainty analysis (draft for review on web)	M. Muste, J. Fulford	8	30/09/08
(d) Development of decision-aid tool prototype and associate uncertainty analysis database for proof of concept and demonstration purposes of point and profiling velocity instruments and multiple techniques (draft for review on the web)	M. Muste, J. Fulford, J. Le Coz	20	31/12/09
(e) Development of examples of the utility of prototype for improvement of measurement approaches and processes (draft for review on the web)	M. Muste, J. Fulford	20	31/12/09

(IV) Guidelines for conducting and reporting results of instrument calibration and performance test on instruments and techniques.

Task	Experts	Estimated time (months)	Tentative completion date
(a) Establishment of protocols/specifications for instrument calibration and testing and verification of performance characteristics of instruments and techniques (draft for review on the web)	P. McCurry, J. Fulford, J. Le Coz	20	31/12/08
(b) Develop sample format for reporting testing and verification results (draft for review on the web)	P. McCurry, J. Fulford	8	31/12/08

(V) Collection of test reports on the performance of instruments and techniques

Task	Experts	Estimated time (months)	Tentative completion date
Request instrument comparison reports as part of the letter in I	WMO Secretariat	See output 1	See output 1
Request reports and specifications from manufacturers	HMEI	See output 1	See output 1
Request reports of laboratory tests of instruments	WMO Secretariat, IAHR	See output 1	See output 1
Add new reports developed using guidelines under IV (draft for review on the web)	WMO Secretariat	18	After 31/12/08

(VI) Overall website design to disseminate all of the above. The contents of the website should include:

- Output of Tasks I to V
- Forum/chat-room facility
- Search engines
- News feature
- Guidance on targeting community involvement

5. The WMO Secretariat would be responsible for the web design. The working website was launched in test mode in May 2008, and linked to the WMO Website in August 2008.

Resolution 3 (CHy-XIII)

HYDROLOGICAL FORECASTING AND FLOOD MANAGEMENT

THE COMMISSION FOR HYDROLOGY,

Noting:

- (1) The request of Fifteenth Congress for the Commission to implement the activities under the Strategy and Action Plan on the Flood Forecasting Initiative (FFI),
- (2) The request of Fifteenth Congress encouraging the continued advocacy of WMO for a widespread adoption of an Integrated Flood Management approach at the basin, national and international levels,

Considering:

- (1) The potential benefits from the Flash Flood Guidance System (FFGS), the Ibero-American network on monitoring and forecasting of hydrometeorological phenomena (PROHIMET) and the Global Flood Alert System (GFAS) in furthering the objectives of FFI,
- (2) That Fifteenth Congress welcomed the plans to establish HelpDesk Services as a mechanism for providing support on flood management policy issues in collaboration with other partners,

- (3) That the technical and financial support made available by the Governments of Japan, the Netherlands, Switzerland and Spain, for Associated Programme on Flood Management activities, has allowed WMO to create capacities for flood management policy advice and guidance for the benefit of its Members,

Recognizing:

- (1) That the implementation of the Flood Forecasting Initiative forms a central part of the workplan of the Commission,
- (2) That the Flood Forecasting Initiative and the Associated Programme on Flood Management contribute substantially to the International Flood Initiative,
- (3) That hydrological aspects of drought are an important component of hydrological forecasting and prediction services provided by National Hydrological Services,

Decides:

- (1) To supplement the Strategy and Action Plan on the Flood Forecasting Initiative with a detailed activity plan that will assist Members in establishing flood forecasting systems;
- (2) To explore the possibility of establishing an Inter-Commission Task Team comprised of representatives of the Commission for Hydrology, Commission for Basic Systems, Commission for Climatology and the Commission for Instruments and Methods of Observation for the implementation of FFI;
- (3) To continue promoting the activities of PROHIMET, including the development of demonstration projects in the Ibero-American region;
- (4) To support operationalization of GFAS by testing and validating global precipitation products and information, suitable for various geographical regions;
- (5) To direct the Advisory Working Group to establish an adequate monitoring and evaluation mechanism to keep track of the implementation of the Strategy and Action Plan on the Flood Forecasting Initiative;
- (6) To assist setting up a HelpDesk for Integrated Flood Management for the benefit of Members in the areas of flood management policy and strategy, and capacity-building in support thereof;
- (7) To develop, in collaboration with the Commission for Agricultural Meteorology and the Commission for Climatology, activities to support hydrological drought prediction capabilities of National Hydrological Services;

Invites Members to cooperate in developing regional components of FFGS, with consideration of other similar initiatives in the regions;

Requests the Secretary-General:

- (1) To further undertake all necessary actions to implement the FFGS through regional projects while keeping abreast of other forecast-based approaches and methods to address floods, particularly flash flood issues;
 - (2) To set up a Flash Flood Guidance System management structure as appropriate;
 - (3) To continue to promote the Associated Programme on Flood Management to attract more extrabudgetary resources for its activities.
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Resolution 4 (CHy-XIII)**WATER AND CLIMATE ISSUES**

THE COMMISSION FOR HYDROLOGY,

Noting:

- (1) The establishment of the Executive Council Working Group on Climate and Related Weather, Water and Environment Issues,
- (2) That the Executive Council at its sixtieth session had endorsed the concept of a WMO initiative to provide climate information in support of adaptation to climate change and climate variability,
- (3) The United Nations-wide coordination of climate activities, where WMO and the United Nations Educational, Scientific and Cultural Organization (UNESCO) have been assigned as the conveners of monitoring, assessment and early warning, jointly termed as the knowledge base,
- (4) That the World Climate Conference-3 will be organized by WMO from 31 August to 4 September 2009 on the theme "Climate predictions and information for decision-making",
- (5) The various climate initiatives, including the African Union Climate Information for Development in Africa (ClimDev–Africa) Programme and the establishment of a joint Secretariat on Climate Change comprising the African Union Commission, the African Development Bank and the United Nations Economic Commission for Africa,

Further noting:

- (1) That the Secretariat has established a new Department on Climate and Water comprised of the Climate Prediction and Adaptation Branch and the Hydrology and Water Resources Branch,
- (2) The current lead role assigned to WMO and UNESCO to jointly provide the knowledge base for adaptation in accordance with the United Nations system-wide coordination of climate activities,

Recognizing:

- (1) That climate variability and change have an impact on water availability and hydrological extremes, which needs to be understood,
- (2) That the National Hydrological Services have a crucial role to play in providing hydrological data and in understanding and evaluating hydrological impacts of climate variability and change in support of decision making and planning in water management,
- (3) That the objective of World Climate Conference-3 is to work towards a mechanism to share climate information for the benefit of the end-users,
- (4) That the World Climate Programme – Water (WCP–Water) has played a significant role in linking water and climate issues on a science-based approach in cooperation with the Intergovernmental Panel on Climate Change and other relevant bodies and organizations,
- (5) That WMO and UNESCO are likely to set up a mechanism to convene the "knowledge base" activities at the United Nations system-wide level,

Recommends:

- (1) The establishment of a task team comprising, inter alia, representatives of the Commission for Climatology and the Commission for Hydrology as a new coordinating mechanism replacing WCP–Water to guide common and joint water- and climate-related activities, inviting UNESCO to join;
- (2) Active involvement of water managers, including members of the Commission for Hydrology, in the World Climate Conference-3;
- (3) To further strengthen activities undertaken by the Global Terrestrial Network – Hydrology and other relevant Commission initiatives in support of the adequate provision of climate-relevant hydrologic data and information for climate research and applications, and in support of adaptation to climate variability and change in the water sector;
- (4) That Members maintain and strengthen the hydrological networks and observational capabilities that are a prerequisite for the development of adaptation strategies and related activities;

Decides:

- (1) That the Commission shall actively participate in the development of the WMO initiative to encourage provision and dissemination of climate and hydrological information in support of hydrology and climate research, adaptation to climate change and climate variability, and in providing feedback from the water community;
- (2) That the collaboration between the Commission and the water tasks of the Group on Earth Observations should be largely facilitated through the Integrated Global Water Cycle Observations.

Resolution 5 (CHy-XIII)**CAPACITY-BUILDING IN HYDROLOGY AND WATER RESOURCES**

THE COMMISSION FOR HYDROLOGY,

Considering:

- (1) The growing importance that education and training issues are assuming in a rapidly changing environment, especially in the fields of hydrology and water resources management,
- (2) That, although the Hydrological Operational Multipurpose System (HOMS) as a concept remains useful, as a system its effectiveness needs to be upgraded,
- (3) That in the context of the proposed adoption of a Quality Management Framework (QMF) – Hydrology, a vehicle for dissemination of recommended practices would still be of considerable value,

Noting:

- (1) That the WMO Strategy on Education and Training in Hydrology and Water Resources, adopted by the Commission at its twelfth session and approved by the Executive Council at

its fifty-seventh session, had started yielding positive results, in particular by reorienting the education and training activities of WMO towards the real needs of the National Hydrological Services,

- (2) That continuing efforts were needed to mobilize additional resources to meet the expanding needs of education and training, as only some of these needs can be met with the available resources,
- (3) The results of the surveys of regional training requirements in hydrology and water resources conducted by the six Working Groups on Hydrology of the regional associations,
- (4) The review of the status of HOMS and the strategy for its future presented by the Advisory Working Group,

Decides:

- (1) That the revised WMO Strategy on Education and Training in Hydrology and Water Resources, contained in Annex 1 to this resolution, should guide the activities of the Organization in education and training on hydrology and water resources for the period 2009–2012;
- (2) To ask the Advisory Working Group to develop, by December 2009, a Course of Action, with timelines, for the proposed changes to HOMS, taking into consideration the alternative approaches to the future of HOMS included in Annex 2 to this resolution;

Requests the Advisory Working Group to prepare a position paper on distance and blended learning techniques applied to Hydrology and Water Resources that would draw on the experience gained thus far in the Hydrology and Water Resources Programme to propose a future course of action in this area;

Encourages Members to support the implementation of the Strategy by offering courses in the priority areas; providing fellowships and instructors for the international courses organized or co-organized by WMO; providing operationally proven technologies in hydrology and water resources management to the WMO hydrometeorological community through HOMS; and any other action they consider appropriate to further the capacities of National Meteorological and Hydrological Services in the fields of hydrology and water resources management.

Annex 1 to Resolution 5 (CHy-XIII)

WMO STRATEGY ON EDUCATION AND TRAINING IN HYDROLOGY AND WATER RESOURCES FOR THE PERIOD 2009–2012

General concepts and principles

Introduction

The purpose of this document is to lay down the guiding principles on which the education and training activities of WMO in the field of hydrology and water resources should be based in the future (after 2008).

The document has been prepared taking into account:

- The experience accumulated during several years of conducting business, mainly in what could be defined a “reactive” way, that is, considering requests for support of education and

training activities on a case-by-case basis, without defining an overall conceptual framework;

- The fact that during recent WMO financial periods the financial resources available for Hydrology and Water Resources (HWR) in general (and for education and training activities in HWR in particular) in WMO have remained practically constant, while the demand from Members has increased proportionally to the rise of the “water” issue to the top of the international political agenda;
- The recognition that there is a need to optimize the available resources, by concentrating WMO support, be it direct to organizers of education and training activities or through fellowships, to those courses which address areas identified by the “WMO hydrological community” as requiring priority attention, where WMO has the possibility of influencing in the development of curricula, that represent an adequate geographical balance, and are proven to be cost-effective;
- The need for a greater involvement of the Commission for Hydrology in the design, implementation, monitoring and update of the strategy;
- The fact that, within the WMO Secretariat, the Education and Training Office is the key unit for the coordination of Education and Training activities and the assignment of fellowships is under the responsibility of the Fellowship Committee;
- The relative success of the concept of Regional Training Centres in the WMO community;
- The wish expressed by the Advisory Working Group to move to a more integrated, focused and proactive approach in education and training in HWR;
- The principles contained in the *Guidelines for the Education and Training of Personnel in Operational Hydrology* (WMO-No. 258), Volume II: Hydrology;
- The education and training activities in HWR promoted by other agencies of the United Nations system, in particular UNESCO, and by other intergovernmental and non-governmental organizations, and the fact that the ten-year period beginning on 1 January 2005 has been proclaimed the United Nations Decade of Education for Sustainable Development (United Nations General Assembly resolution A/RES/57/254).

On the basis of the above, the following mission, vision, main objectives, identification of clients and mechanisms to establish priority areas and implementation means of the HWRP Subprogramme “Capacity-building in Hydrology and Water Resources” were defined.

Mission

To support Members in assessing their education and training needs in HWR, and play a catalytic role in satisfying those needs, by providing both financial and technical assistance.

Vision

NHSs contributing effectively to the integrated water resources management in their countries, by generating, organizing and disseminating adequate information on the state of the water resources.

Objectives

- Assist Members in assessing their own education and training needs in HWR;
- Provide adequate education and training to personnel of the NHSs;

- Assist Members in developing/updating national curricula in HWR;
- Optimize the use of available resources and mobilize extrabudgetary resources.

Identification of target groups

The primary target group is the technical and professional staff of the Hydrological and Hydrometeorological Services of Members of WMO, including managers, scientists, engineers, technologists and technicians. The secondary group is those academic and government agencies involved in hydrology and water resources. While it is fashionable to include at a high level of priority the local communities, and civil society in general, it has to be recognized that they generally will be outside the scope of this strategy, in view of the specialized nature of WMO. Particular attention will be given to the needs of NMHSs from developing countries, as they are the ones likely to benefit the most from WMO assistance.

Prioritization of subjects

Education and training activities supported by WMO should in principle be demand-driven. The requirements will be determined on the basis of inputs from the Members, regional associations Working Groups on Hydrology, CHy and its subsidiary bodies, and surveys undertaken by the WMO Secretariat. The results will be analyzed and prioritized by CHy at its regular sessions, and presented to the following Executive Council session for its endorsement. It will thus be valid for a four-year period. Permanent Representatives with WMO, their Hydrological Advisers, members of CHy and training centres that have maintained relationships with WMO will be informed of the priority areas selected for each period. This means that support given to course organizers as well as the approval of fellowships will be focused on those areas determined as indicated above. There would still be room to support requests on a case-to-case basis, but it should be limited.

Types of Education and Training activities

In order to maximize the extent of the “Capacity-building in Hydrology and Water Resources” subprogramme, emphasis will be put on activities of a short duration, low cost and great potential impact with regard to number of beneficiaries, without compromising their quality. Given their proven value, activities such as training of trainers and roving seminars will be pursued principally, resorting to regional courses only when it is proven to be the most practical solution. Certification awards will be issued, recognizing the results, level of the course and hours of lecture.

Conferences/seminars/workshops/ on specific issues that are not covered by existing training centres will be organized, preferably through co-sponsorship arrangements.

Particular attention will be paid to distance learning and blended learning techniques, and application of latest available information technologies, such as Internet-based presentation software and knowledge management systems, in view of the evident advantages of their successful application. To this end, existing, pioneering experiences already supported by WMO will be evaluated in order to decide if, when and where they are the alternative to be preferred.

Another important field of action will be in promoting among Members the use of the *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology* (WMO-No. 258), Volume II: Hydrology, since these Guidelines will contribute to the development of national curricula and syllabi under an international framework, both at the professional and at the technician level.

Although they are recognized as having a great importance, this strategy does not consider public awareness or community training activities, as it is more convenient to separate these areas from those dedicated to the education and training of the NMHS staff.

Means of supporting the activities

The support provided by WMO to education and training activities in HWR can take one of the following forms:

ETRP

- *Support to training events under HWRP:* In view of the available resources, only a handful of international courses will receive support under this modality. Important criteria to decide whether a course qualifies for direct support are: (a) WMO should have the possibility of influencing in the development of curricula; (b) adequate geographical balance, even if only at the regional level, should be ensured; and (c) cost-effectiveness.
- *Fellowships:* They have to be requested through the Permanent Representative of the candidate's country to WMO. Preference should be given to those courses on priority subject areas and where a review by WMO of the content and level of the programme of study, to verify its concordance with the WMO Strategy on Education and Training in HWR, has been undertaken.

HWRP

- *Enabling support (partial):* Under this modality, course organizers request support from WMO in a range of ways, from the simple use of the WMO logo to a limited (normally less than US\$ 5 000) financial contribution. Decisions, to be made on a case-by-case basis should be based on the priority of the subject areas treated, the tradition of cooperation of the organizers with WMO, the reputation of the organizing institution, the number and geographical representation of international participants, and the number of participants from developing countries.
- *Support as part of regular activities of the HWRP:* Various components of the regular HWRP of WMO, such as WHYCOS, HOMS and the Associated Programme on Flood Management, regularly organize training activities on subjects related to their work. These training activities are funded from the regular budget assigned to each programme, and will continue in the future to be organized according to the guiding principles contained in this strategy.

In the first two cases above, from a budgetary aspect, the financial resources are under the ETR Programme of WMO. The difference between the two is that, while the support to training events under HWRP is earmarked as such, the support to fellowships is part of the total budget of WMO for fellowships. As an indication, in the decade 1990–1999, approximately 11 per cent of all WMO fellowships were awarded in the field of HWR. The third modality is usually financed through budget assigned to the HWRP, and the requests far normally exceed the available resources.

Promoting partnerships

In addition to the above, particular emphasis will be placed on developing partnerships with academic institutions active in the areas of interest of WMO in HWR, for instance promoting exchanges of professoriate staff, co-sponsorship by institutions of the developed world of specific international courses organized by developing countries' institutions, technical assistance in the preparation of syllabi and course programmes.

Particular attention will be dedicated to the cooperation with UNESCO in general and with the UNESCO-IHE Institute for Water Education in particular, in order to take advantage of its high academic level and excellent facilities, and of the fact that it is situated under the umbrella of the traditional partner of WMO in HWR education and training activities.

Mechanism of Implementation

Given that ETRP has the leading role in coordinating Education and Training activities in the areas of interest of WMO, and that this programme has already well-established mechanisms and procedures, it would seem to be convenient to design and work through similar mechanisms and procedures. In view of the decision of the Executive Council taken at its fifty-eighth session to widen the scope of WMO Regional Training Centres to include other areas of interest of WMO, particular attention should be given to expedite the establishment of new WMO RTCs with a special focus in hydrology and water resources.

Evaluation procedures for all courses in HWR supported by WMO will continue, using the customary mechanisms designed for this purpose by the ETRP, and implementing additional ones if needed.

Priority areas for 2009–2012

The Commission noted the following priority areas, among others, for education and training in HWR, identified by the Working Groups on Hydrology and Water Resources of the regional associations (RAWGsH), and recommended that, in addition, training activities should be undertaken at the global level on the utilization of the Guides and Manuals issued under the QMF-Hydrology:

RA I: 1. Hydrological instruments and methods of observation
2. Data processing and quality control
3. Management of Hydrological Services

RA II: 1. Remote sensing in hydrology
2. Flood management
3. Integrated water resources management

RA III: 1. Operation and maintenance of automatic stations
2. Integrated water resources management
3. Hydrological instruments and methods of observation

RA IV: 1. Operation and maintenance of automatic stations
2. Extreme event analysis
3. Flood forecasting

RA V: 1. Water resources information systems
2. Remote sensing in hydrology
3. Integrated water resources management

RA VI: 1. Data processing and quality control
2. Flood forecasting
3. Hydrological modelling

As and when new surveys on training needs are conducted at the next sessions of the RAWGsH, the above regional priorities will be revised accordingly.

Annex 2 to Resolution 5 (CHy-XIII)

ALTERNATIVE APPROACHES TO THE FUTURE OF THE HYDROLOGICAL OPERATIONAL MULTIPURPOSE SYSTEM

Introduction

The Hydrological Operational Multipurpose System (HOMS), the WMO international system for technology transfer in operational hydrology and water resources, was launched in 1981 and underwent a major review starting from 1999 to 2002, with the updating of the online version of the HOMS Reference Manual (HRM), its translation into French, Russian and Spanish and the preparation of promotional materials. During this process, the Implementation Plan for HOMS in the XXI century (HOMS Plan) was adopted, containing the current procedures for inclusion of new components in the system. During its 27 years of existence, HOMS has developed a network of 120 HOMS National Reference Centres (HNRCs) and 8 Regional Focal Points.

The Mission and Objectives of HOMS as presented in the HOMS Plan are still valid and relevant. However, there are concerns about the utility of HOMS in view of the lack of updating of existing components and the minimal incorporation of new components during the last decade. The main reasons for this situation appear to be:

- (a) The majority of NHSs who in the past were major contributors of HOMS components have suffered reductions in their staff dedicated to technical cooperation activities, as their organizations have moved towards either outsourcing, regionalization or increased cost recovery;
- (b) The boom in the use of Internet has made it simpler to disseminate pieces of technology on individual organizations' websites, as opposed to using an international network with common agreed formats;
- (c) The widespread access to Internet has also meant that it is now easier than ever for many potential users of HOMS to find technological information that previously would have been available only in the HRM.

Guiding principles

The above aspects have been taken into account in preparing this Strategy, in particular by recognizing the existence of the above trends while trying to take advantage of the main positive aspects of HOMS, which are:

- a) The fact that HOMS components have proven their operational value, as demonstrated by the provider NHS, gives them an aura of reliability that is often missing in material found on the Internet;
- b) The network of national and regional focal points mentioned above.

Proposed actions

The following complementary actions are proposed to be undertaken:

The name of HOMS should be changed, as with time it has lost its significance and has become confusing to the professional unaware of its history. The new title or name should reflect the main purpose of HOMS, which is Technology Transfer in Hydrology and Water Resources.

The present online version of the HRM in four languages should be maintained and mechanisms explored to continue to receive more components. For instance, rankings of popularity of components based on Web visits could be displayed, providers of popular components could be officially acknowledged, reminders to all HNRCs could be regularly issued, and greater assistance could be provided from the Secretariat to prepare/update the components' descriptions for inclusion in the HRM.

A repository of HOMS components should be created and held in the Secretariat to ensure that components that are no longer supported by the providers are not lost entirely to the hydrological community. Furthermore, different categories of components could be introduced:

- * The traditional components that meet the current, stringent requirements to become a HOMS component and for which technical support is assured by the provider;
- * Software, procedures etc., that are used in universities, research centres, global centres (for example, Global Runoff Data Centres) that are freely available as "UTILITIES" tools;
- * Components contributed by consultants, experts and individuals who are prepared to share their products, tools, etc. freely (possibly with some mechanism for review by an expert or group of experts in that particular area).

Several users from developing countries have pointed out that even if the components in the last two categories could not be technically supported, they would still be worth having in the System. The submission of components, regardless of their category, should be the responsibility of the respective HNRC. The possibility of establishing a continuous evaluation system by the users should be explored.

A better use should be made of Internet facilities and, whenever possible, users should be directed to links where components could be easily downloaded.

A continuous effort should be made to continue to publicize and promote the use of HOMS, particularly targeting young upcoming hydrologists and students in universities and polytechnical institutes.

In line with the new structure of the HWRP, HOMS (or its new name) should become an integral part of a broader capacity-building framework. This would mean in particular that both the active request of development of new components and the support to training activities should be principally oriented towards those areas that have been identified as priority for a particular Region. In addition, greater links to existing WMO activities with a strong capacity-building component, such as WHYCOS, Associated Programme on Flood Management (HelpDesk) and the Flood Forecasting Initiative, should be established.

Perhaps even more importantly, the infrastructure of HOMS could be used as the dissemination mechanism of the new regulatory material developed by the HWRP in the framework of the QMF–Hydrology. Under this alternative, parallel with the issuing of the new edition of the *Guide to Hydrological Practices* (WMO-No. 168) and other manuals foreseen in the QMF–Hydrology, training activities supported by the HWRP would be focused on the use of these materials through the network of HNRCs. Eventually the network of HOMS focal points could become a network of experts enabled to provide technical assistance in the correct utilization of the guidance material in the QMF–Hydrology, both at the national and regional levels, with the Secretariat playing a coordination and clearing house role. In addition, WMO Regional Training Centres (RTCs) could also be enabled or encouraged to provide technical assistance in the correct utilization and application of HOMS components.

The transformation in the role of the HNRCs described above, as well as the involvement of RTCs in supporting the utilization of HOMS components, would be announced previously by a circular letter from the Secretariat and the president of the Commission for Hydrology, allowing Members and RTCs to show their interest in participating in this new course of action and/or adapt their national HOMS focal point and Centres to it. For instance, as it is becoming more and more difficult for NHSs to commit their regular staff time to such efforts, they could envisage engaging retired persons who may be interested in sharing their time and experience with young upcoming hydrologists.

Resolution 6 (CHy-XIII)

WMO INTEGRATED GLOBAL OBSERVING SYSTEMS AND WMO INFORMATION SYSTEM

THE COMMISSION FOR HYDROLOGY,

Recalling:

- (1) Resolution 30 (Cg-XV) – Towards Enhanced Integration between WMO Observing Systems,
- (2) Decisions and guidance from Fifteenth Congress towards the implementation of the WMO Information System (WIS),
- (3) Resolution 3 (EC-LIX) – Executive Council Working Group on the WMO Integrated Global Observing Systems and the WMO Information System,
- (4) The WMO Strategic Plan 2008–2011,

Noting:

- (1) Recommendations of the third session of its Advisory Working Group,
- (2) Report of the first session of the Executive Council Working Group on the WMO Integrated Global Observing Systems and the WMO Information System,
- (3) Report on Implementation of the WIGOS concept to the Executive Council at its sixtieth session,
- (4) The report on a draft metadata profile prepared by the Global Runoff Data Centre at the request of WMO,

Considering:

- (1) That an enhanced integration between the WMO observing systems could have the potential to lead to important benefits for Members and their National Meteorological and Hydrological Services and the Organization as a whole,
- (2) That the WMO Information System is to be used for the collection and sharing of information for all WMO Programmes and, therefore, information exchange within the WMO Hydrology and Water Resources Programme is a component of WIS; however, most of the metadata required for ensuring discovery, access to and use of this information was not yet available,
- (3) That the WIGOS and WIS could bring potential benefits to the hydrological community,
- (4) International data exchange formats and the resulting need for the development of a standard metadata profile is important,

Encourages Members to regularly exchange data at the regional and global levels to support of regional and global research, under conditions such as those specified by Resolution 25 (Cg-XIII) – Exchange of hydrological data and products;

Recommends:

- (1) That the Advisory Working Group in close collaboration with the Global Climate Observing System review the data exchange requirements at the regional and global levels;
- (2) That the Global Runoff Data Centre should undertake the development of the metadata profile, in collaboration with interested parties, under the overall guidance of WIS/WIGOS to form part of the WMO Core Profile of the ISO Metadata Standard;

Decides:

- (1) To determine the requirements and arrangements for taking benefit from WIS for the information flows and outputs, including associated metadata, of WHYCOS, and develop a WIS pilot project with the Pacific-HYCOS project and/or any other HYCOS projects as may be determined by the WHYCOS International Advisory Group;
- (2) To take advantage of WIS for the information flows and associated metadata under the Flash Flood Guidance System;
- (3) To form a small ad hoc work team to prepare, by February 2009, a guidance document for the development of a framework for a “package of approaches”, that will be submitted to the Advisory Working Group for further development;
- (4) That based on this guidance the Advisory Working Group will develop a framework for a “package of approaches” within the domain of the Commission for Hydrology.

Resolution 7 (CHy-XIII)**WORK PROGRAMME AND STRUCTURE OF THE
COMMISSION FOR HYDROLOGY**

THE COMMISSION FOR HYDROLOGY,

Noting:

- (1) Resolution 20 (Cg-XV) – Hydrology and Water Resources Programme,
- (2) The report of the president of the Commission for Hydrology (CHy),
- (3) The reports of the members of the Advisory Working Group (AWG), which the Commission established at its twelfth session,
- (4) The report of the Secretary-General regarding the activities of the Commission during its previous intersessional period,
- (5) The Annex – Volunteerism in the work of technical commissions and regional associations – to Resolution 4 (EC-LX) – Role and terms of reference of the Meetings of Presidents of Technical Commissions,
- (6) The other resolutions adopted by the Commission during the present session,

Considering the valuable role that can be played by the experts of national agencies in implementing the activities of the Commission,

Decides:

- (1) To adopt the four thematic areas contained in Annex 1 to this resolution as a priority for the work of the Commission in the next intersessional period, together with the corresponding sets of activities and expected outputs and outcomes contained therein;
- (2) To re-establish the Advisory Working Group of the Commission for Hydrology, acting also as the Steering Committee for the Hydrological Operational Multipurpose System (HOMS), with the terms of reference given in Annex 2 to this resolution;
- (3) To continue the existing Open Panels of CHy Experts (OPACHE) and update them to cover the areas listed in Annex 2 to this resolution, which can be further divided into sub-themes or otherwise as meets the needs;
- (4) To establish the following general terms of reference applicable to the Advisory Working Group and other experts:
 - (a) Members of the Advisory Working Group to ensure that the sections of the *Technical Regulations* (WMO-No. 49), the *Guide to Hydrological Practices* (WMO-No. 168), the manuals on hydrology and water resources and other guidance material relevant to their particular areas of responsibility are reviewed and appropriate proposals for revisions and/or additions are included in future editions of these publications;
 - (b) Members of the Advisory Working Group advise and assist the president of CHy, and the WMO Secretariat, as appropriate, in the development of HOMS components within the general subject area related to their terms of reference;
 - (c) Members of the Advisory Working Group and experts are to take account of relevant international agreements and conventions and of the activities of other international organizations working in fields related to theirs when fulfilling the tasks specified in their individual terms of reference;
- (5) To invite the following experts to serve as the members of the Advisory Working Group in the capacities indicated therein:
 - Mr Bruce Stewart (Australia) – President of CHy
 - Mr Julius Wellens-Mensah (Ghana) – Vice-president of CHy
 - Mr Harry Lins (United States) – Quality Management Framework – Hydrology
 - Ms Zsuzsanna Buzás (Hungary) – Quality Management Framework – Hydrology
 - Ms Jeanne Balonishnikova (Russian Federation) – Water Resources Assessment
 - Mr Zhiyu Liu (China) – Hydrological Forecasting and Prediction
 - Mr Guido Van Langenhove (Namibia) – Hydrological Forecasting and Prediction
 - Ms Ann Calver (United Kingdom) – Water, Climate and Risk Management
 - Mr Antônio Cardoso (Brazil) – WIGOS and WIS

Urges Members to nominate additional experts to OPACHes and to facilitate the voluntary contribution of all members of the OPACHes to the activities of the Commission.

Annex 1 to Resolution 7 (CHy-XIII)

COMMISSION FOR HYDROLOGY DRAFT PROGRAMME OF WORK 2009–2012

Theme Areas

The Programme of Work of the Commission for Hydrology will focus on the following four theme areas that fall under the mandate of WMO:

1. Quality Management Framework – Hydrology (QMF–Hydrology)
2. Water Resources Assessment
3. Hydrological Forecasting and Prediction
4. Water, Climate and Risk Management

The activities under each of the Theme Areas are listed below in the order of priority. While developing these activities the cross-cutting issues mentioned at the end of this annex shall be taken into account. Contribution of the outcomes within each theme area to the WMO expected results is also identified.

Theme Area 1: Quality Management Framework – Hydrology (QMF–Hydrology)

List of activities

- (a) Finalize the preparation of the manual on water quality monitoring (ensuring that guidance on relevant data transmission technology is included);
- (b) Preparation and publication of guidance material on the definition and implementation of a Quality Management System (QMS) for NHSs;
- (c) Review of material for the *Technical Regulations* (WMO-No. 49);
- (d) Undertake a project to assess the performance of flow measurement instruments and techniques against WMO standards based on the project proposal developed during the previous intersessional period;
- (e) Develop standards, formats and protocols for data transfer;
- (f) Monitoring advances and assist in the development of new technologies for Hydrometric Monitoring;
- (g) Prepare a Manual on design flood estimation;
- (h) Prepare guidance material on the effect of weed growth and ice effects on flow measurement and rating curves;
- (i) Prepare a Manual on monitoring of glacier and snowfields;
- (j) Preparations for an International Conference on Hydrometry.

Expected outputs/outcomes – Contribution to expected results 3 and 4

- (a) An agreed QMS for NHSs;
- (b) CHy *Technical Regulations* that are up to date and relevant to the roles and responsibilities of NHSs;
- (c) Improved understanding of the quality and performance of flow measurement instruments and techniques;
- (d) Additional guidance material for NHSs in the areas of water quality monitoring, discharge measurement and design flood estimation;
- (e) Identification (hardware) and development (software) of technology to support the required needs of NHSs in hydrometry, including discharge measurement and estimation;
- (f) Standards, formats and protocols for the transfer of hydrological data and information.

Theme Area 2: Water Resources Assessment

List of activities

- (a) Finalize the preparation of the manual on water resources assessment (ensuring that it addresses the groundwater/surface water interface, use of remote sensing and modelling, application to protected areas, other available relevant material and is cross-referenced to the UNESCO/WMO Manual) (a contribution to the QMF–Hydrology);
- (b) Provide input to the development of improved aeral estimation of evaporation and evapotranspiration (in cooperation with the Commission for Climatology) and soil moisture;
- (c) Prepare guidance material on the current status of network design and optimization, including the use of modelling;
- (d) Prepare an information note on ecological flow requirements and ecological assessment, taking into account the activities of other groups;
- (e) Prepare guidance material on the current status of estimation of snow water equivalent.

Expected outputs/outcomes – Contribution to expected result 3

- (a) Provision of NMHSs with tools and techniques for the assessment of their water resources (both surface and groundwater) in support of sustainable management of the resource;
- (b) A manual on water resources assessment;
- (c) Increased effectiveness of CHy activities through appropriate cooperation and coordination of activities with other relevant groups and agencies;
- (d) Improved estimates of evaporation and evapotranspiration, soil moisture and snow water content;
- (e) Improved guidance for network design.

Theme Area 3: Hydrological Forecasting and Prediction

List of activities

- (a) Finalize the preparation of the manual on flood forecasting (a contribution to the QMF–Hydrology);
- (b) Promote capacity-building in the use of manual on low flows
- (c) Provide advice and support to the projects related to the Flash Flood Guidance System (FFGS) and PROHIMET taking account of other initiatives in the area;
- (d) Provide advice on and monitor the development and application of the Global Flood Alert System;
- (e) Assess the use of advanced numerical weather prediction (NWP) to improve flood forecasting, for example, through case studies;
- (f) Prepare guidance material on seasonal flow forecasting – including quantifying uncertainties (in association with the Water, Climate and Risk Management theme);
- (g) Review the current status of and provide guidance material on Quantitative Precipitation Estimation (QPE), Quantitative Precipitation Forecasting (QPF) and probabilistic Quantitative Precipitation Forecasting (pQPF);
- (h) Prepare guidance to undertake an intercomparison related to the use of operational flood forecasting models (taking account of previous exercises);
- (i) Provide advice and guidance on relevant hydrological risk management issues;

Expected outputs/outcomes – Contribution to expected results 3 and 6

- (a) Improved flood forecasting and low flow forecasting capabilities for NMHSs through new techniques and better assimilation of available data into hydrological models;
- (b) A coordinated and cooperative effort amongst modellers (in NMSs and NHSs) to work together in the interests of developing an effective and technologically sound and robust flood forecasting methodology (incorporating QPE and QPF);
- (c) Assistance to, and guidance in, disaster mitigation and risk management in support of the role and responsibilities of NMHSs;
- (d) Increased effectiveness of CHy activities through appropriate cooperation and coordination of activities with other relevant groups and agencies.

Theme Area 4: Water, Climate and Risk Management**List of activities**

- (a) Complete the identification of climate sensitive stations and analysis of their data (including obtaining the data (with the assistance of the GRDC) and undertaking the trend detection studies);
- (b) Prepare guidance material on the potential use of the current capabilities in regional climate modelling (RCM) for water resources assessment and management;
- (c) Promote data rescue activities;
- (d) Contribute to the guidance material on seasonal flow forecasting (liaise with hydrological forecasting and prediction theme) – including quantifying uncertainties;
- (e) Prepare guidance material on the climate information requirements of water resources managers for operations, long-term planning and design;
- (f) Prepare guidance material on drought forecasting and indices – including quantifying uncertainties;
- (g) Prepare guidance material for factoring transient climates, non-stationary nature of data sets and uncertainty analysis in the estimation of design floods.

Expected outputs/outcomes: Contribution to expected result 7

- (a) An agreed international network of climate sensitive river basins;
- (b) Statistically sound and relevant studies of trends in hydroclimatological data for input to decision-making activities associated with sustainable water resources management and disaster mitigation;
- (c) Improvements in the guidance available to both the climatological and hydrological communities in regard to both the potential capabilities of climate modelling (seasonal and decadal) and the hydrological requirements for climatological information;
- (d) Improved guidance material and inputs to drought monitoring and management;
- (e) Increased effectiveness of CHy activities through appropriate cooperation and coordination of activities with other relevant groups and agencies.

Cross-cutting Issues

While developing the Programme of Work, a number of cross-cutting issues will be taken into account. While implementing the programme activities these cross-cutting issues would have to be kept in view:

(a) Transboundary river basins/aquifers

Transboundary river basins and/aquifers were identified as a key applications area for many of the activities proposed. For example, water resources assessment methodologies must be able to address the groundwater/surface water interface, monitoring systems must be designed with transboundary issues in mind and flood forecasting systems must be able to operate in transboundary river basins.

(b) Methods for data-sparse areas

Methodologies that will be applicable in data-sparse area must be identified and included under many of the theme areas, for example water resources assessment, flood forecasting, seasonal flow forecasting etc.

(c) WHYCOS

WHYCOS addresses cross-cutting topics as all HYCOS projects cover activities related to data collection and transmission, development of information systems that provide specific services/products and knowledge on water resources assessment, hydrological forecasting, flood management and integrated water resources management. Activities under each of the theme areas assist in general in the development of material in support of the WHYCOS projects. They form the main vehicle for both human and infrastructure capacity development in NHSSs.

(d) Capacity-building

Capacity-building is a key expected result of all activities in the CHy Programme of Work and as such all activities would contribute to capacity-building initiatives across all theme areas.

(e) Socio-economic and ecological benefits of Hydrological Services

Each of the theme areas will have different economic benefits and members should look for opportunities to contribute to the identification of relevant material for valuation of the economic benefits of the hydrological services in these areas.

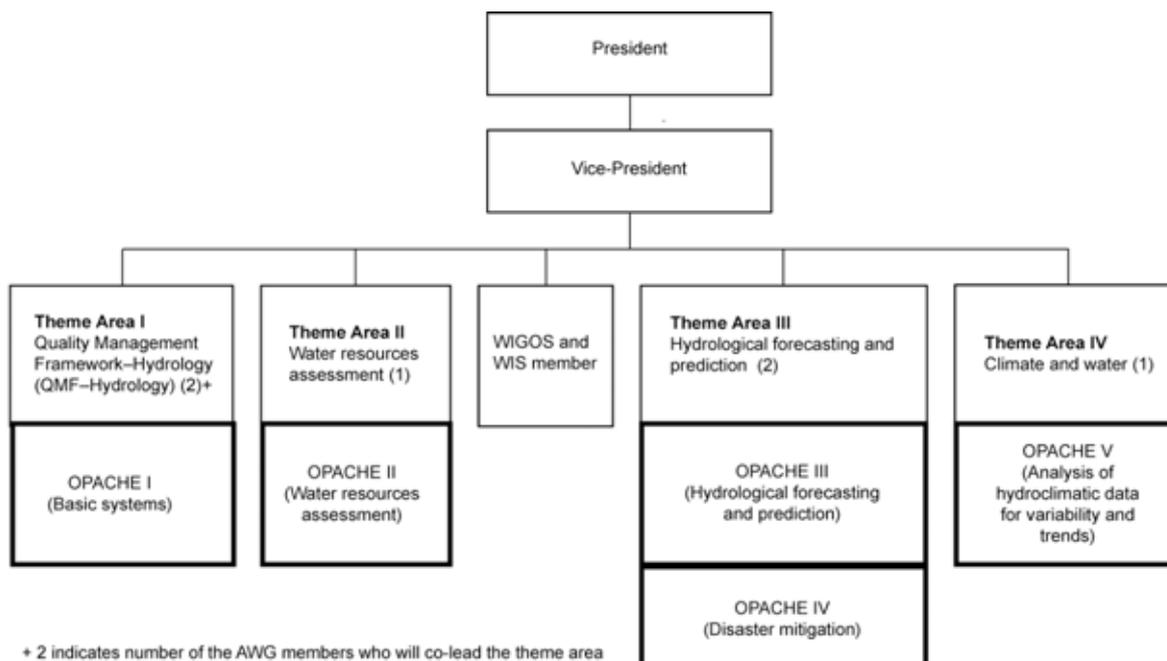
Annex 2 to Resolution 7 (CHy-XIII)

PROPOSED STRUCTURE OF THE COMMISSION FOR HYDROLOGY AND TERMS OF REFERENCE OF THE ADVISORY WORKING GROUP MEMBERS

The Advisory Working Group (AWG) will consist of the following:

1. President (Mr Bruce Stewart)
2. Vice-president (Mr Julius Wellens-Mensah)
- 3–4. Theme Area 1: 2 members (Mr Harry Lins and Ms Zsuzsanna Buzás)
5. Theme Area 2: 1 member (Ms Jeanne Balonishnikova)
- 6–7. Theme Area 3: 2 members (Mr Zhiyu Liu and Mr Guido Van Langenhove)
8. Theme Area 4: 1 member (Ms Ann Calver)
9. WIGOS and WIS: 1 member (Mr Antônio Cardoso)

The members of the AWG responsible for a particular Theme Area would carry out their activities with support from the relevant Open Panel of CHy Experts (OPACHEs). The OPACHEs established by the Commission at its twelfth session would continue to provide support to the members. It is proposed the OPACHEs on Hydrologic Forecasting and Prediction and the OPACHE on Disaster Mitigation – Floods and Droughts will serve Theme Area 3 as shown in the organigramme below.



TERMS OF REFERENCE

While developing the activities it should be ensured that the cross-cutting issues, that is, transboundary river basins/aquifers issues, methods for data-sparse areas, need and outreach of WHYCOS, capacity-building needs and economic benefits of hydrological services, will be taken into account.

1. President of the Commission for Hydrology (Mr Bruce Stewart)

Terms of reference

- To undertake the duties required of a president of a WMO technical commission in accordance with WMO General Regulation 185;
- To chair meetings, as required, within the above duties, including, for example, the CHy AWG, the WHYCOS International Advisory Group.;
- To represent CHy in the WMO system, in cooperation with other United Nations agencies, especially UNESCO, and at a range of other meetings, workshops and conferences;
- To promote the recognition of, and increase awareness about, the role of WMO in hydrology and water resources;
- To ensure that the activities of regional associations, and, in particular, the regional association Working Groups on Hydrology (RAWGHs) are coordinated within overall Commission activities and that there is effective communication between the Commission and the RAWGHs;
- To monitor changes in the operation and management of NMHSs, including product delivery and public awareness in hydrology and water resources.

2. Vice-president of the Commission for Hydrology (Mr Julius Wellens-Mensah)

Terms of reference

- To assist the president of the Commission, as and when required;

- (b) To assist the AWG in fulfilling its duties as outlined in the Implementation Plan for HOMS or, as appropriate, its replacement;
- (c) To coordinate the editing and production of publications prepared on behalf of CHy;
- (d) To identify and lead actions with regard to the education and training requirements of Commission activities under the adopted Strategy on Education and Training for HWR and the QMF–Hydrology;
- (e) To monitor and report on the updating of INFOHYDRO;
- (f) To promote data rescue and protection and develop project proposal(s) in the light of the requirements report from the previous intersessional period;
- (g) To support the development and promotion of guidance material on the estimation of the economic benefits of hydrological services.

3. Members (2) (Mr Harry Lins and Ms Zsuzsanna Buzás) leading activities associated with Theme Area 1: Quality Management Framework – Hydrology (QMF–Hydrology)

Terms of reference

- (a) To co-lead, monitor, report and provide advice on the activities of the relevant Theme Area, as indicated in the Draft Programme of Work (Annex 1 to Resolution 7 (CHy-XIII));
- (b) To liaise, as necessary, with relevant areas of WMO (for example, the Commission for Instruments and Methods of Observation), the International Organization for Standardization (ISO) and other United Nations agencies with regard to quality management;
- (c) To develop and implement capacity-building initiatives based on the activities undertaken within the relevant Theme Area;
- (d) To report on activities at each AWG meeting and as requested by the president of CHy.

NOTE: While developing the activities it should be ensured that the cross-cutting issues are taken into account.

4. Member (1) (Ms Jeanne Balonishnikova) leading activities associated with Theme Area 2: Water Resources Assessment

Terms of reference

- (a) To lead, monitor, report and provide advice on the activities of the relevant Theme Area, as indicated in the Draft Programme of Work (Annex 1 to Resolution 7 (CHy-XIII));
- (b) To liaise, as necessary, with relevant areas of WMO, United Nations agencies and other relevant groups with regard to water resources assessment activities;
- (c) To develop and implement capacity-building initiatives based on the activities undertaken within the relevant Theme Area;
- (d) To report on activities at each AWG meeting and as requested by the president of CHy.

NOTE: While developing the activities it should be ensured that the cross-cutting issues are taken into account.

5. Members (2) (Mr Zhiyu Liu and Mr Guido Van Langenhove) leading activities associated with Theme Area 3: Hydrological Forecasting and Prediction

Terms of reference

- (a) To co-lead, monitor, report and provide advice on the activities of the relevant Theme Area, as indicated in the Draft Programme of Work (Annex 1 to Resolution 7 (CHy-XIII)), and to undertake the following activities:

- (b) To liaise, as necessary, with relevant areas of WMO (in particular Disaster Risk Reduction, the Commission for Atmospheric Sciences and the Commission for Basic Systems with regard to the WMO Flood Initiative) and other organizations (for example UNESCO IHP, IFI, ICHARM) with regard to hydrological forecasting and prediction and disaster risk reduction activities;
- (c) To develop and implement capacity-building initiatives based on the activities undertaken within the relevant Theme Area;
- (d) To report on activities at each AWG meeting and as requested by the president of CHy.

NOTE: While developing the activities it should be ensured that the cross-cutting issues are taken into account.

6. Member (1) (Ms Ann Calver) leading activities associated with Theme Area 4: Water, Climate and Risk Management

Terms of reference

- (a) To lead, monitor, report and provide advice on the activities of the relevant Theme Area, as indicated in the Draft Programme of Work (Annex 1 to Resolution 7 (CHy-XIII)), and to undertake the following activities;
- (b) To liaise, as necessary, with relevant areas of WMO (for example, the Commission for Climatology) and other organizations (UNESCO-IHP, UNEP, IAHR and IAHS) with regard to climate and water activities;
- (c) To develop and implement capacity-building initiatives based on the activities undertaken within the relevant theme area;
- (d) To report on activities at each AWG meeting and as requested by the president of CHy.

NOTE: While developing the activities it should be ensured that the cross-cutting issues are taken into account.

7. Member (1) (Mr Antônio Cardoso) leading activities associated with WIGOS and WIS

Terms of reference

- (a) To act as the Commission for Hydrology focal point for the activities associated with WIGOS and WIS;
- (b) To promote, monitor, report and provide advice on the application of Resolution 25 (Cg-XIII) – Exchange of hydrological data and products, by Members and in particular in HYCOS projects, as and when necessary;
- (c) To design and coordinate a project that will develop hydrological data transfer standards protocols and formats in support of WIGOS and WIS;
- (d) To explore and develop opportunities for expanding the use of Hydrological Information Systems (HISs) and associated free-ware, model interface platforms, Web services for hydrological applications, etc.;
- (e) To monitor, report and provide advice on the activities of the international data centres such as GRDC, the Global Precipitation Climatology Centre (GPCC) and IGRAC and address the international data requirements, including hydrological components of large-scale initiatives such as GEWEX and GTN-H, GCOS, GTOS and GEO;
- (f) To report on activities at each AWG meeting and as requested by the president of CHy.

NOTE: While developing the activities it should be ensured that the cross-cutting issues are taken into account.

Resolution 8 (CHy-XIII)

**REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE
COMMISSION FOR HYDROLOGY**

THE COMMISSION FOR HYDROLOGY,

Considering:

- (1) That the resolutions adopted prior to its twelfth session are no longer in force,
- (2) That Resolution 1 (CHy-XII) – Structure and programme of work of the Commission for Hydrology and Resolution 2 (CHy-XII) – Review of previous resolutions and recommendations of the Commission for Hydrology, are now obsolete,

Noting the action taken on the recommendations adopted prior to its thirteenth session,

Decides:

- (1) Not to keep in force any of the resolutions of its prior sessions;
 - (2) To note with satisfaction the action taken by the competent bodies on the recommendations of its prior sessions, and to keep in force Recommendation 2 (CHy-IX) – Support to global data centres, Recommendation 1 (CHy-X) – Hydrological networks, Recommendation 2 (CHy-X) – Participation of women in the work of the Commission (except the text under REQUESTS) and Recommendation 1 (CHy-XI) – Establishment of an International Groundwater Resources Assessment Centre (IGRAC), all other recommendations now being redundant.
-

RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation 1 (CHy-XIII)

WMO STRATEGIC PLAN 2012–2015 AND MONITORING AND EVALUATION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME

THE COMMISSION FOR HYDROLOGY,

Noting:

- (1) Resolution 20 (Cg-XV) — Hydrology and Water Resources Programme,
- (2) Resolution 27 (Cg-XV) — WMO Strategic Plan,
- (3) Resolution 28 (Cg-XV) — Preparation of the WMO Strategic Plan for 2012–2015,

Noting further:

- (1) The report of the president of the Commission for Hydrology,
- (2) The reports of the members of the Advisory Working Group, which the Commission established at its twelfth session,
- (3) The report of the Secretary-General regarding the activities of the Secretariat during its previous intersessional period,
- (4) The recommendation of the Executive Council concerning the formulation of the Strategic Plan for 2012–2015,
- (5) The recommendation of the Executive Council concerning the monitoring and evaluation process,

Considering:

- (1) The need to further improve the Strategic Plan and its formulation process in order to better take account of and reflect the requirements and expectations of the Members, especially developing country Members, as well as the specificity of the Hydrology and Water Resources Programme,
- (2) The need to develop appropriate, reliable and easily implementable metrics for assessing the performance of the Programme,

Recommends:

- (1) The continuing involvement of its representatives, especially the Advisory Working Group, in all stages of development of the Strategic Plan including the identification of key performance indicators and the monitoring and evaluation process for the period 2012–2015;
- (2) That the regional associations incorporate the point of view of the regional WMO hydrological communities, including the participation of the Regional Hydrological Advisers foreseen in the WMO General Regulations) in their proposals for the development of the Strategic Plan for the period 2012–2015;

Encourages the WMO hydrological community to take every opportunity to provide prioritized proposals and suggestions to the formulation of the Strategic Plan for the period 2012–2015, for example, through the deliberations of other WMO bodies such as Regional Working Groups on Hydrology and regional associations.

Recommendation 2 (CHy-XIII)

REVIEW OF THE RESOLUTION OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Noting with satisfaction the action taken by the Executive Council on the previous recommendations of the Commission for Hydrology, addressed to it,

Considering that some of these recommendations still bear significance for future activities, while other had become redundant,

Recommends:

- (1) That Resolution 4 (EC-LVII) – Report of the Twelfth Session of the Commission for Hydrology, be no longer considered necessary;
 - (2) That Resolution 5 (EC-LVII) – Participation of WMO in the International Flood Initiative, be kept in force.
-

ANNEX

ANNEX

Annex to [paragraph 3.2](#) of the general summary

ACKNOWLEDGEMENT OF VOLUNTARY CONTRIBUTORS

The Commission for Hydrology acknowledged the voluntary contribution made by the following experts in the accomplishment of its work during the intersessional period 2004–2008.

A. BASIC SYSTEMS (HYDROMETRY AND HYDRAULICS)

1. International Glossary of Hydrology

Standing Committee on Terminology: Javier Samper (Spain), Kim Losev (Russian Federation), Pierre Hubert (France) and Philip Holland (United Kingdom).

2. Guide to Hydrological Practices

Review committee: Karl Hofius (Germany), Suresh Chandra (India), Denis Hughes (South Africa), Fred Kyosingira (Uganda), Paul Pilon (Canada) and Marco Polo Rivero (Venezuela).

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3. Methods for the quantification of evaporation from lakes

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C. HYDROLOGICAL FORECASTING AND PREDICTION

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D. DISASTER MITIGATION: FLOODS AND DROUGHTS

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E. CAPACITY-BUILDING AND TECHNOLOGY TRANSFER

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