# APPENDIX XVII

# Report on Activities of Working Group on Hydrology (WGH) of TC in 2017

In 2017, Working Group on Hydrology (WGH) of Typhoon Committee (TC) conducted a series of activities very positively referring to the decision of 49th Session which was held in Yokohama, Japan from21to24 February 2017. This report was drafted mainly on the base of the outcomes of 6th WGH working meeting which was held in Seoul, the Republic of Korea from 25 to 28 September 2017, and the discussion of the parallel session of TC 12th Integrated Workshop (IWS) which was held in Jeju, the Republic of Korea from 30 October to 03 November2017.

The report highlighted the main progresses and achievements on hydrological component in Members in past year; briefly described the activities of WGH conducted in 2016, and summarized the status of implementation of WGH AOPs 2017. Based on the communication among Members and the discussion at TC 12th IWS, WGH proposed the implementation plan of AOPs for 2018 and beyond; and consequently requested the TCTF allocation for supporting WGH activities in the year of 2018.

1. **The Major Progresses on Hydrological Component in Members in 2017**
2. The WGH reviewed the hydrological activities conducted in Members in 2017 and noted the major progresses which may benefit other Members.
3. In China, a new system taking the impact-forecast and risk-warning into consideration is now being developed. In this system, not only the discharge and water level at specific section is predicted, but also the inundation area, depth and duration are calculated. In this connection, the impact and risk of flood to population, property, agriculture, industry and environment can also be evaluated, which can be used directly for DRR department.
4. In Malaysia, multi-flood disasters: especially monsoon flood and urban flash flood always occurs and the numbers increasing every year. Between January to October 2017, 278 flood events has been recorded compare to the 200 events as average annual flood. To date, the Department of Irrigation and Drainage (DID) has been developed 811 hydrological telemetry stations, 876 manual flood gauges, 103 flood warning boards and 472 automatic flood warning sirens in flood prone areas. Furthermore, six flood forecasting models have been deployed for selected river basins to provide flood forecast warning for the disaster’s agencies as well as to the public. Currently, there are several flood forecasting model being developed by the DID, namely the National Flood Forecasting and Warning System for Kelantan, Terengganu and Pahang river basin and expected to be completed by October 2018. Malaysia also committed to the programme carried out by ESCAP/WMO Typhoon Committee under Annual Operating Plan (AOP 4): The application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM). The preliminary field survey has been successfully conducted in August 2017 and the selection of the river basin for the case study has been finalized to be the Penang River during workshop held in Guangzhou (27 Nov - 1 Dis 2017).
5. In Philippines achieved on improvement of hydro-meteorological monitoring facilities and Radar data application (6 x-band Radars).
6. In the Republic of Korea made progresses on the development of flood forecasting system, TC WGH webpage, and flood information service system.
7. In Thailand, RID provided the effective flood information to public; established the Smart Water Operation Center (data bank), including sub-committee for monitoring and analyze water situation trends; public relations and warning (socio-media in dissemination of information and warding) and etc.
8. In Viet Nam, big disasters caused by flood and inundation; flash flood and landslide. National Center of Meteorological and Hydrological Forecasting (NCMHF) updated the early warning system (three levels); and made progress on forecasting technology; transmission and monitoring hydro-meteorological disasters.
9. The hydrological departments in the Members provided valuable service of flood forecasting and warning to the decision-making departments of the Governments and public.
10. **Review of the sixth WGH Working Meeting**
11. The 6th WGH working meeting which was held in Seoul, the Republic of Korea from 25 to 28 September 2017.
12. The meeting was hosted by the Han River Flood Control Office (HRFCO), Ministry of Land, Infrastructure and Transport (MOLIT) of the Republic of Korea (ROK) in cooperation with Korea Institute of Civil Engineering and Building Technology (KICT) with the generous offer of financial support, and co-chaired by WGH chairperson Mr. Tokunaga YOSHIO and the vice chairperson Dr. Hyo-Seob CHO.
13. The meeting was attended by about 20 participants from 8 Members, namely China, Japan, Laos, Philippines, the Republic of Korea, Thailand, USA and Vietnam. Dr. Jinping LIU, the hydrologist of TCS took part in the meeting.
14. The theme of the meeting was proposed as “Adaptive Capacity Building for Extreme Flood Preparedness” with the following purposes:

* to review the implementation status and progresses of WGH Annual Operating Plan (AOP) in 2017;
* to present new initiatives for WGH AOPs and discuss the implementation plans of WGH Annual Operating Plan (AOP) in 2018;
* to discuss the preparation for the 12th Integrated Workshop and 50th Annual Session;
* to coordinate and select Chairperson of WGH following the decision of 49th Session.

1. The participants expressed their heartfelt appreciation to MOLIT, through HRFCO with cooperation of KICT, for kindly hosting the meeting and for all the excellent hospitality and logistic arrangement.
2. Japan expressed its willingness to host WGH 7th Working Meeting in Japan. The meeting is temporarily proposed 4 days, including one-day workshop for AOP1 led by Japan, namely Flash Flood Risk Information for Local Resilience. and one-day seminar to be funded by China on Decision Supporting to SOP for Coastal Multi-hazards Early Warning and Reduction.
3. **Progresses of WGH AOPs in 2017 and Implementation Plan for 2018**
4. The implementation status and the success indicators of WGH AOPs in 2017 were reviewed and discussed. The project leaders from China, Japan and Korea presented the progresses on AOPs achieved in 2017 and implementation plan for 2018. The WGH AOPs in 2017 and beyond was summarized in the table 1. The implementation status of WGH AOP 2017 is summarized in the Annex 1 and the success indicators of AOPs in 2018 are shown in Annex 2.

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| **Table 1 the Summary of WGH AOPs in 2017 and Beyond** | | | |
|  | **Projects** | **Driver** | **Duration** |
| AOP1 | Flash Flood Risk Information for Local Resilience | Japan | 2017~2019 |
| AOP2 | Extreme flood forecasting system | Korea | 2012~2017 |
| AOP3 | Guidelines for extreme flood risk management in TC region | Korea | 2013-2017 |
| AOP4 | Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members | China | 2014~2017 |
| AOP5 | Application of Hydrological Data Quality Control System in TC Members | Korea | 2018-2022 |
| AOP6 | Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique | Korea | 2018-2022 |
| AOP7 | Impact Assessment of Climate Change on Water Resource Variability in TC Members | China | 2018~2020 |

**AOP1: Flash Flood Risk Information for Local Resilience**

1. WGH reviewed the progresses of the project of Flash Flood Risk Information for Local Resilience in 2017 and the implementation plan in 2018 briefed as below:

* In 2017, MLIT of Japan and ICHARM put forward its outputs and activities for the whole period and analyzed the member countries’ disaster prevention policies by using questionnaire and exchanging information in WHG meetings and so on.
* In 2018, Japan will make an interim report on actual disaster experiences and cases of good practice in terms of disaster prevention policy, emergency response, restoration and reconstruction, and then systematically sort out the information.
* In 2018, Japan will promote collaboration between AOP1 and the “National Platform on Water and Disaster” project of the International Flood Initiatives. As the first step, Japan will introduce existing networks and their activities to the WGH Members and discuss potential sites in member countries.

1. ICHARM and MLIT will hold one-day workshop on AOP1 together with the 7th WGH meeting in Japan in September 2018 with partial funding support from TCTF for their operation.
2. The WGH members recognized the importance of the project in practice and expressed the willingness to be involved in the activities and apply the method in the flash flood risk reduction in their countries.

**AOP2: Extreme Flood Forecasting System (EFFS)**

1. WGH reviewed and summarized the activities and achievement of the project of Extreme Flood Forecasting System (EFFS) since 2012, which will be closed at TC 50th Annual Session.
2. The progresses of AOP2 in 2017 were summarized as following:

* The establishment of extreme flood forecast system almost has been completed as Level-1(stage method), Level-2(Rainfall-Runoff model), Level-3(Flood Forecasting using radar data) with PC-version, and Level-4(Establishment of Emergency Action Plan).
* The system file will be uploaded on TC WGH webpage after closing of 12 IWS.
* The technical report, including theoretical background and user manual, is published as one of TC Publications in 2017 and distributed at 12th IWS.
* The TC WGH webpage has been operated for sharing information among WGH members, and has been linked with TC Webpage (<http://www.typhooncommittee.org/wgh-web-page/>), will be operated continuously with support from TCS.

1. The programme of EFFS was installed in the laptops of participants and had demonstration. The representatives of three participating Members, namely Lao PDR, Philippines and Thailand presented the status of flood forecasting in their countries. All participants expressed their willingness to apply EFFS in practice so that to promote their capacity on real-time operational flood forecasting, and expect Korea-side continue improving and perfecting the System and keep the interested Members updated.
2. The HRFCO and KICT committed to continue developing and improving the functions of EFFS, and continue providing the technical support to Members in need.

**AOP3:** **Guidelines for Extreme Flood Risk Management**

1. WGH reviewed and summarized the activities and achievement of the project of Guidelines for Extreme Flood Risk Management since 2012, which will be closed at TC 50th Annual Session.
2. The implementation progresses of this project in 2017 were including:

* The 6th WGH working meeting was held in Seoul in conjunction with the workshop.
* The Guideline for Extreme Flood Risk Management in TC region is published and distributed in this meeting.
* The HRFCO and KICT expressed the appreciation to three pilot countries (Lao P.D.R, Philippines, Thailand) for contribution on drafting the guideline.

1. The Participants reviewed the final version of Guidelines with deep discussion. The participants expressed the appreciation to Dr. Chung-Soo KIM of KICT for his efforts on drafting the Guidelines with abundant information. The Guidelines was printed as one TC publication and distributed at 12th IWS to be held in Jeju, Korea from 30 October to 03 November 2017.

**AOP4: Development Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for Selected TC Members**

1. WGH reviewed the implementation progresses of OSUFFIM in 2017. The main activities conducted for OSUFFIM in 2017 were briefed as:

* Application in Dong Guan City of China;
* DID Malaysia visiting SYS University with fund support from SYS University from 19 to 21 April 2018;
* Software updating and perfecting for Pilot City of Thailand;
* Survey Mission in Malaysia from 24 to 31 August 2017;
* RID experts visiting SYS University from 20 to 22 October 2017 for discussion the structure of OSUFFIM to be applied in Thailand.
* Survey Mission in Vietnam from 13 to 19 November 2017;
* OSUFFIM workshop was held in SYS University Guangzhou, China from 27 to 30 December 2017, with participants from China, Myanmar, Malaysia, Philippines, Thailand and Vietnam as well as TCS;
* Organized the planed Workshop on 28-30 November 2017 in Guangzhou, China.
* The Participants include the heads of divisions or senior experts from TC Members: Thailand (2), Philippines (2), Malaysia (1), Viet Nam (1) and Lao PDR(1), and PTC Members: Myanmar(1); and the hydrologist of TCS, Dr. Jinping LIU;
* For the participants from TC Members, TCTF funded international transportation and partial DSA; SYS University funded accommodation; and for the participants from PTC Members, SYS funded all expenses.
* TCS distributed the Nomination Form right after 6th WGH working meeting.
* Prof. CHEN Yangbo of SYS University and TCS Hydrologist Mr. LIU Jinping visited Ho Chi Ming, Hue and Hanoi of Vietnam from 13 to18 November 2017 for selecting the pilot city from 2-3 surveyed cities. The National Center for Hydro-Meteorological Forecasting (NCHMF), National Hydro-Meteorological Service (NHMS) of Viet Nam provided very strong support to the survey mission. The focal point of Viet Nam Ms. DANG Thanh Mai coordinated this event.
* SYS University expert visiting Hat Yai of Thailand for Data collection from 29 January to 3 February 2018.

1. Considering there are many things not yet fulfilled on OSUFFIM and some Members expressed their willingness to apply OSUFFIM, SYS University planned to conduct Phase-II for OSUFFIM as one of WGH AOPs from 2018 to 2020. The pilot cities will be selected from above-mentioned Members. The roadmap of OSUFFIM-II was proposed as below:

* 2018: updating operation system for Hat Yai of Thailand; study the urban flood pattern in TC Members; system development preparatory for selected new pilot cities in 2 or 3 interested Members; and technical publication.
* 2019: modeling system construction and development, and trial operation
* 2020: continual trial operation; summarize the project.

1. The implementation plan was discussed for 2018:

* to end of March: decide 2 or 3 new pilot cities.
* to September (13th IWS): maintain the operation system in Hat Yai city of Thailand and Dong Guang city of China; field survey, data collection and study urbanization pattern in selected new pilot cities;
* to end of December: conduct kick-off meeting for discussing work plan; summarize the operation in Thailand and China.

1. **New Proposals for 2018 and Beyond**
2. Following the decision made at TC 49th Session, Korea proposed two new AOPs, and China proposed one new AOP for 2018 and beyond.

**New Proposal 1: Application of Hydrological Data Quality Control System in TC Members**

1. Acquirement of the high quality hydrological data is the most basic work in flood forecasting. But, there is no hydrological data quality control system in TC member countries. The project will be support and provide the guideline and system to upgrade the quality of hydrological data in TC regions.
2. The project will be drove by HRFCO of Korea with support of KICT and last 5 years from 2018 to 2022, with objects of:

* enhancement of TC Member’s capacity for managing & monitoring of hydrological data (Rainfall, Water Level, Discharge);
* reducing the uncertainty of input data for flood forecasting;
* suggesting the procedure of producing hydrological data; and
* establishment of the hydrological data quality control system linkage to EFFS

1. The basic methodology of data processing and quality control to be applied in the project can be briefed as:

* Rainfall : arithmetic mean, RDS weighted average, Kriging method, etc.
* Water Level : arithmetic mean, relationship with upper-down stream station, Neural Network, etc.
* Discharge : calculation of uncertainty in measuring the discharge, assessment of stage-discharge relationship equation, etc.

1. The roadmap of the project are described as:

* 2018: Analysis of the status for Monitoring Hydrological Data in TC regions
* 2019: Suggestion of the Establishment Direction & Techniques
* 2020: Development of Hydrological Data Quality Control System (1)
* 2021: Development of Hydrological Data Quality Control System (2)
* 2022: Distribution of the System & Publication, Training

1. The implementation plan for 2018 was proposed as below:

* Analyze the status of hydrological data monitoring and management in TC members
* Exchange & confirm the results of analysis
* Survey the Hydrological Data Quality Control System in Republic of Korea

1. Some participants expressed their interests to join this project and will provide further commitment for this AOP, such as HFC of China, DID Malaysia and etc.

**New Proposal 2: Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique**

1. It is necessary to upgrade the developed EFFS, especially flood forecasting technology using radar data. In addition to the deterministic flood forecasting, probabilistic flood forecasting technology should be applied to provide more informative information to the public.
2. The project will be driven by HRFCO of Korea with support of KICT and last 5 years from 2018 to 2022, with the following objects:

* Enhance TC Member’s capacity for flood forecasting using radar rainfall data & stochastic techniques
* Provide the various input data for flood forecasting
* Upgrade the LEVEL3 module of EFFS
* Evaluate the uncertainty of flood forecasting
* Suggest the procedure of stochastic flood forecasting

1. The basic methodology of enhancing the flood forecasting reliability to be applied in the project can be briefed as:

* Flash flood guidance
* Ensemble forecasting with rainfall & discharge scenario
* Pre-, Post processing method in ensemble forecasting

1. The roadmap of the project are described as:

* 2018: Analysis of the Status for using Radar Rainfall Data in TC regions
* 2019: Suggestion of the Establishment Direction & Techniques
* 2020: Modify the LEVEL 3 of EFFS
* 2021: Produce the Rainfall Ensemble in TC Members
* 2022: Development of Stochastic Flood Forecasting System

1. The implementation plan for 2018 was proposed as below:

* Analyze the status of flood forecasting with radar rainfall data in TC members
* Exchange & confirm the results of analysis
* Survey the flood forecasting with radar rainfall data in Republic of Korea

**New Proposal 3: Impact Assessment of Climate Change on Water Resource Variability in TC Members**

1. Climate change has currently been an utmost important environmental issue, which will challenge the existing water resources management practice in many ways. Climate change and its increased variability is expected to alter timing and magnitude of runoff, and consequently has significant implication for the existing water resources system as well as for future water resources planning and management. Quantitative assessment of water resources in the context of climate change is essential to sustainable water resources utilization. Suitable hydrological models have been believed a powerful toll in water resources assessment. During the past years, the Research Center for Climate Change of Ministry of Water Resources, China devoted great efforts to develop a monthly Water Balance Model namely RCCC-WBM model for regional water resources purpose by full considering complex environment changes (i.e. climate change, human activities). The model has been widely applied to major rivers across whole China, and exhibits a broad suitability.
2. The project will be drove from 2018 to 2020 by Information Center (IC) of the Ministry of Water Resource (MWR) with support from Nanjing Hydraulic Research Institute (NHRI). The project was proposed with following objectives, target and output:

* Objective: the proposal is to collect, collate, analyst, evaluate and develop the water resources modelling information for better decision management system so that to improve the capacity building among TC Members on better understanding water modelling and water resources management.
* Target: extension of the RCCC-WBM model by job training with TC expert on water resources modelling and decision-making process.
* Output: providing the sustainable water resources information for water resources manager decision making process.

1. The basic methodology of data processing and quality control to be applied in the project can be briefed as two steps: (1) collect the catchment average precipitation, temperature, pan evaporation, and discharge gauged at outlet hydrometric station; and (2) apply the RCCC-WBM model in target rivers or basins to simulate the changing trend of water resources in the context of the climate change.
2. To achieve the objective, there are two approaches for implementation of the project:

* Apply RCCC-WBM to wide catchment for water resources study assessment, improve Members’ capacity by having several training courses, and provide scientific supports for sustainable utilization of water resources of target catchments.
* Test suitability of RCCC-WBM to target catchments, organize 2-3 training workshops to train technicians of target Members, and apply RCCC-WBM to typical catchments of interested Members.

1. The roadmap of the project is described as:

* 2018: Collect hydro-meteorological data and general information of typical catchment with the supports from target countries, analyze hydrological features of these catchments, test performance of RCCC-WBM model, prepare training materials of RCCC-WBM model and organize the first workshop.
* 2019: Prepare training materials of RCCC-WBM model, organize the second workshop and help the trainees to apply the model to target catchments for hydrological modeling and water resources assessment
* 2020: Organize the third workshop, summarize the application results, and report to IWS.

1. The implementation plan for 2018 was proposed as below:

* to select pilot areas in China and participating Members;
* to collect hydro-meteorological data and general information of typical catchment with the supports from target countries;
* to analyze hydrological features of selected catchments, test performance of RCCC-WBM model;
* to prepare training materials of RCCC-WBM model; and
* to organize the first seminar.

1. Some participants expressed their interests to join this project and will provide further commitment for this AOP, such as DID Malaysia, Meteorological and Hydrological Department (MHD) of Laos, and etc.
2. The WGH AOPs for 2018 and beyond were summarized in Table 2.

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| Table 2 The summary of WGH AOPs in 2018 and beyond | | | |
| **Item** | **Projects** | **Driver** | **Duration** |
| AOP1 | Flash Flood Risk Information for Local Resilience | Japan | 2017~2019 |
| AOP2 | Application of Hydrological Data Quality Control System in TC Members | Korea | 2018-2022 |
| AOP3 | Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique | Korea | 2018-2022 |
| AOP4 | OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members | China | 2018~2020 |
| AOP5 | Impact Assessment of Climate Change on Water Resource Variability in TC Members | China | 2018~2020 |

1. **Selection of WGH Chairperson**
2. Following the decision of TC 49th Session (stated in paragraph 69: The Session noted that, WGH does not yet get consensus on its Chairperson selection, and agreed to coordinate and select its new chairperson and vice chairperson at 6th WGH meeting based on further communication among hydrological components of Members for the term of next two years to 51st Annual Session. Mr. Yoshio Tokunaga from ICHARM of Japan and Dr. CHO Hyo Seob from HRFCO of the Republic of Korea are requested to continue working as Chairperson and vice chairperson of WGH, respectively, until the selection)，the meeting coordinated and selected WGH new chairperson and vice chairperson.
3. The participants got consensus on WGH chairperson selection: to request Mr. Yoshio Tokunaga from ICHARM of Japan and Dr. CHO Hyo Seob from HRFCO of the Republic of Korea continue working as Chairperson and vice chairperson of WGH, respectively, to TC 51st Annual Session. Dr. HOU Aizhong from HFC of China continues serving as Vice-chairpersons of WGH to 51st Annual Session.
4. Based on deep discussion at TC 12th IWS WGH parallel session, WGH requested AWG to discuss and consider the possibility of Chair/Co-Chair system for WGH, which was accepted mostly and proposed by WGH, in a small group, and advise TC 51st Session for final decision. WGH will be obligated to follow the decision.
5. **Review TCTF allocation for WGH activities in 2017 and Proposal for 2018**
6. WGH reviewed the usage of the allocated budget of TCTF for WGH activities in 2017 shown in table 3.

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| Table 3 The summary of budget of TCTF to support WGH activities in 2017 | | |
| Item | AOP | TCTF(USD) |
| 1 | Support to attend Integrated Workshop (IWS) and other activities | 10,000 |
| 2 | Support publishing the two technical reports of AOP2 and AOP6 | 5,000 |
| 3 | Support activities related to OSUFFIM | 6,000 |
| 4 | Support hosting AOP 6 seminar with hosting 6th WGH working meeting | 3,000 |
|  | Total | 24,000 |
|  | *Special budget for supporting OSUFFIM Final workshop* | $6000 |

1. Based on the discussion, WGH proposed the budget request for its activities in 2018, shown in table 4.

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| Table 4 The summary of TCTF Budget Request for 2018 Activities | | | |
| Item | Projects | Driver | Budget |
| 1 | Support to attend Integrated Workshop (IWS) and other activities |  | 10,000 |
| 2 | Support AOP1: Flash Flood Risk Information for Local Resilience including hosting 7th WGH working meeting in Japan | Japan | 5000 |
| 3 | Support AOP4: OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members | China | 6000 |
| 4 | Support AOP5: Impact Assessment of Climate Change on Water Resource Availability in TC Members | China | 4000 |
|  | **Total** |  | **25,000** |
|  | *Special Request for OSFFIM Technical Report Publication* | China | 3000 |

1. **Conclusion of WGH**
2. On the basis of the outcomes 6th WGH working meeting and the discussion of the WGH Parallel Session at 12th IWS, the following conclusions were reached:

* The working meeting of WGH is very important to review hydrological activities, deep technical discussion and implementation status of WGH AOPs, and also is very necessary to prepare IWS and annual session. The funding support and contribution from the Republic of Korea played the vital role in organizing the annual working meeting in past years. WGH encourages more and wider resources to support the activities to keep its sustainability.
* To promote the capacity of forecasting, early warning and risk management for urban flood is an urgent need among TC Members, especially urban flood forecasting and inundation mapping. As the subsequent activity of TC first Cross-cutting project of Urban Flood Risk Management (UFRM), the on-going project of WGH on Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) is a tangible measure on this aspect and it will a play very meaningful and important role for TC Members to promote the capacity on the technique of urban flood forecasting and warning.
* Acquirement of high quality hydrological data is the most basic work in flood forecasting. At present, there is no hydrological data quality control system running well in TC Member countries. In order to improve the hydro-meteorological data quality control so that to promote the capacity of flood forecasting and warning in TC Members, it is very meaningful to develop an operational system for data quality control sharing among Members.
* In TC Members, water is considered as the core of sustainable development and a critical element for its socio-economic development. Water is the driver of the key sectors of its economy and will remain as a crucial element to sustain its healthy ecosystem which eventually affects the well-being of its population. Water is a finite resource and it is only renewable if well managed. Water can pose serious challenges to sustainable development but if managed efficiently and equitably, water would play a key enabling role in strengthening the resilience of social, economic and environmental systems in the light of rapid and unpredictable changes. Therefore, one of the key elements in managing water resources is to provide a comprehensive management instrument which could provide multiple functions including accounting for water resources, providing real time via on-line information and long term (projection) on water availability and variability, an assessment tool to evaluate operation options for efficient water allocation and a forecasting system to assist in the decision making process. It is necessary and important for WGH to conduct the cooperation on Impact Assessment of Climate Change on Water Resource Variability among TC Members for implementation of KRA 3 of Strategic Plan 2017-2021.
* Enhancement of the close collaboration with the AWG of WMO CHy, WMO RA II Working Group on Hydrological Services in several themes of common interest provides significant benefits to the Committee.

1. **Recommendations of WGH**
2. On the basis of the outcomes 6th WGH workshop & meeting and the discussion of the Parallel Session of 12th IWS, the participants concurred to make the following recommendations to the TC 50th Session to be held in Hanoi from 28 Feb. to 03 March 2018:

* to appoint Mr. Yoshio TOKUNAGA from ICHARM of Japan as Chairperson of WGH; Dr. CHO Hyo Seob from HRFCO of the Republic of Korea and Dr. HOU Aizhong from HFC of China as vice chairperson of WGH, to TC 51st Annual Session.
* to request AWG to advise on the matter of Chairmanship for WGH. Before that WGH will follow its current TERMS OF REFERENCE in a consultative and harmonized manner.
* to request US$10,000 from TCTF in total for supporting WGH members participating TC 13th IWS.
* to request US$15,000 from TCTF in total for supporting overall WGH activities for 2018 calendar year.
* to request US$3,000 special budget to support publishing OSUFFIM technical report in 2018;
* To request MLIT and ICHARM of Japan to host WGH 7th working meeting with funding support in September 2018.
* to approve the proposal to conduct phase II for OSUFFIM as a continual project in a period from 2018 to 2020;
* to approve the initiatives of two AOPs in the period from 2018 and 2022 proposed by HRFCO of the Republic of Korea: (1) Application of Hydrological Data Quality Control System in TC Members; and (2) Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique.
* to approve the project in the period from 2018 and 2020 proposed by HFC of MWR and NHRI of China: Impact Assessment of Climate Change on Water Resource Variability in TC Members.
* to request HRFCO to continue maintaining and operating the WGH webpage for effective sharing information among WGH members with support from KICT and TCS.
* to re-appoint the focal point of WGH, Ms. Ji-Youn SUNG, HRFCO of the Republic of Korea as the liaison to WGH of WMO RA II for WGH of the Committee.
* to continue focusing on improving the ability to forecast hydrological phenomena and provide measures for the effectiveness of the improvements.

**Annex 1. Implementation Status of WGH AOP 2017**

**Annex 2.** **Successor Indicators of WGH AOP 2018**

**Annex 1. Implementation Status of WGH AOP 2017**

| **SP's KRA and SG** | **Objective Number** | **Objective** | **Action** | **Other WGs Involved** | **TCS Responsibility** | **Expected Quarter Completed** | **Other Organizations Involved** | **Success Indicators** | **Funding Required** | **Funding Sources** | **Completed**  **YES/NO** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b | 1 | Flash Flood Risk Information for Local Resilience | to develop a guidance tool for enhancing local resilience to flash flood disaster risks and disseminate it among the WGH member countries. | WGDRR  (TBD) | Coordination | (a) First (b) Second (c) Third (d) Fourth | PAGASA of Philippines(TBD) | (a) Technical Presentation  (b-d)Case Study in Japan and needs assessment |  | ICHARM, MLIT | YES  YES |
| KRA1  KRA 4 SG 4a  SG 4bKRA5  SG 5a  KRA 6 SG 6b | 2 | Extreme flood forecasting system | To complete the development of extreme flood forecasting system with PC-version  and publish the technical report including the theoretical background and system manual.  To operate the TC WGH homepage. |  | See above | (a) First (b) Second (c) Third (d) Fourth | RID of Thailand, PAGASA of Philippines  DMH of Laos | (a,b,c) To complete the development of extreme flood forecast system with PC-version  (c,d) To publish the technical report  (a, b, c, d) To operate the TC WGH homepage | $2500 | MOLIT | YES  YES  YES |
| KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b | 3 | Guidelines for extreme flood risk management in TC region | To hold the 6th WGH meeting in the R.O.K  To publish the guideline for extreme flood risk management including the field survey report. |  | See above | (a) First (b) Second (c) Third (d) Fourth | RID of Thailand,  PAGASA of Philippines  DMH of Laos | (b,c) To prepare and host the 6th WGH working meeting  (a, b, c) To publish the guideline for extreme flood risk management | $2500  Plus  $3000 | MOLIT, | YES  YES |
| KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b | 4 | OSUFFIM system development and trial operation | 1. Development of OSUFFIM operational system; 2. Trial operation of OSUFFIM operational system in pilot cities; 3. compile the user guideline both in Chinese and English  4. have a workshop to distribute the outcomes of OSUFFIM; 5. start 1-2 new pilot cites in TC members |  | See above | (a) First (b) Second (c) Third (d) Fourth | Dongguan Flood Management Office  RID of Thailand,  PAGASA of Philippines | (a,b,c) Complete the development of OSUFFIM operational system  (a,b,c) Trial operation of OSUFFIM in Chinese and Thailand  (d) publish user guideline in English;  (d)Final workshop  (d) Field investigation to 1-2 new cites in Members | $6, 000  +  Special $6000 for supporting the final workshop | SYS Uni.  RID,  PAGASA.  DID,  NMHS,  DMH  TCTF | YES  On-going  On-going  Yes  Yes |

**Annex 2. Successor Indicators of WGH AOP 2018**

| **KRA** | **Objective Number** | **Objective** | **Action** | **Other WGs Involved** | **TCS Responsibility** | **Expected Quarter Completed** | **Other Organizations Involved** | **Success Indicators** | **Funding Required** | **Funding Sources** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| KRA 2  KRA 3  KRA 4 | 1 | Flash Flood Risk Information for Local Resilience | To develop a guidance tool for enhancing local resilience to flash flood disaster risks and disseminate it among the WGH member countries. | WGDRR  (TBD) | Coordination | (a) First (b) Second (c) Third (d) Fourth | PAGASA of Philippines  (TBD) | (a.b) To prepare an interim report on actual disaster experiences and cases of good practice in English  (b.c.d) To introduce IFI platform and survey potential site in WGH Member  (c.d) To hold one-day workshop in conjunction with WGH 7th working meeting in Japan and make its report | 5,000 | ICHARM, MLIT |
| KRA2  KRA3  KRA4 | 2 | Application of Hydrological Data Quality Control System in TC Members | To analyses the status of data quality control in TC Members |  | See above | (a) First (b) Second (c) Third (d) Fourth | DID will like to take part | (a)(b)(c) Analyze the status of hydrological data monitoring and management in TC members  (d) Exchange & confirm the results of analysis  (c)(d) Survey the Hydrological Data Quality Control System in Republic of Korea |  | MOLIT |
| KRA2  KRA3  KRA4 | 3 | Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique | To analyses the status of radar data application in flood forecasting in TC Members |  | See above | (a) First (b) Second (c) Third (d) Fourth |  | (a)(b)(c) Analyze the status of flood forecasting with radar rainfall data in TC members  (d) Exchange & confirm the results of analysis  (c)(d) Survey the Radar Data application in Flood Forecasting system in Republic of Korea |  | MOLIT, |
| KRA2  KRA3  KRA4 | 4 | OSUFFIM phase-II: extension of Application of OSUFFIM | to extend the application of OSUFFIM in selected Members |  | See above | (a) First (b) Second (c) Third (d) Fourth | DID will like to take part | (a) select 2 or 3 new pilot cities.  (b)-(c) maintain the operation system in Hat Yai city of Thailand and Dong Guang city of China; field survey, data collection and study urbanization pattern in selected new pilot cities;  (d) conduct kick-off meeting for discussing work plan; summarize the operation in Thailand and China; Publication. | 6000  + 3000 special request | HFC;  SYS Uni.  China |
| KRA3 | 5 | Impact Assessment of Climate Change on Water Resource Variability in TC Members | To selected pilot catchments and to prepare training materials of RCCC-WBM model |  | See above | (a) First (b) Second (c) Third (d) Fourth | DID will like to take part | (a)-(b)to select pilot areas in China and participating Members;  (b)-(c)to collect hydro-meteorological data and general information of typical catchment with the supports from target countries;  (c)-(d)to analyze hydrological features of selected catchments, test performance of RCCC-WBM model; prepare training materials of RCCC-WBM model; and  (d) to organize the first seminar. | 4000 | HFC;  NHRI,  China |

• KRA 1: Enhance capacity to monitor mortality and direct economic loss caused by typhoon-related disasters.

• KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

• KRA 3: Improve typhoon-related flood control and integrated water resource management.

• KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

• KRA 5: Enhance Typhoon Committee’s Regional and International collaboration mechanism.