

WORLD METEOROLOGICAL ORGANIZATION
WEATHER, CLIMATE AND WATER



EIGHTH SESSION

(CHRISTCHURCH, NEW ZEALAND, 25 - 29 NOVEMBER 2013)

DRAFT REPORT

1. OPENING OF THE SESSION (agenda item 1)

At the kind invitation of the Government of New Zealand, the eighth session of the RA V Working Group on Hydrological Services (WG HYS) opened at 9:30am on Monday 25 November 2013 at the National Institute of Water and Atmospheric Research (NIWA) at 10 Kyle Street, Riccarton, Christchurch 8011, New Zealand. A list of participants is provided in Annex I.

Mr Charles Pearson (New Zealand), Regional Manager for NIWA, welcomed the participants on behalf of NIWA and, noting the importance of improved management of water resources, stated how pleased he was to see such a wide representation from the Members of the region. He pointed out that Christchurch was still in recovery mode following a series of earthquakes over the past few years and that the value and benefits of early warning systems for such natural events had been well proven. This reinforced the benefits of flood forecasting and warning services provided by the National Hydrological Services.

On behalf of Mr Michel Jarraud, Secretary-General of WMO, Bruce Stewart (D/CLW) also welcomed the participants to Christchurch and thanked NIWA and the Government of New Zealand for hosting the meeting. He stressed the importance of closer relationships between meteorological and hydrological services, especially in areas of improved flood and drought management. He noted that it was now four years since the last meeting and that this would be an important meeting in setting a programme of work for the future, as well as exchanging experiences of the past. He urged participants to use the opportunity to network with other representatives from the Region.

In the absence of Mr Arie S. Moerwanto (Indonesia), Chair of the RA V WG HYS, Mr John Fenwick (New Zealand) was elected to chair the meeting.

A round of introductions and general comments was undertaken and significant points raised during this round are summarized under the introduction to Agenda Item 6.

2. ADOPTION OF THE AGENDA AND ORGANIZATION OF WORK (agenda item 2)

The session adopted the draft agenda (Annex II) and decided on the organization of work, including the working hours and work programme. It was noted that time had been set aside for sub-regional discussions (Pacific Islands and Southeast Asia) and that if time permitted, a visit could be arranged to the NIWA instrumentation laboratory and other facilities. Working Group members were provided with a memory stick containing all of the Documents for the session. Also, copies of presentations made during the sessions were uploaded to the session website.

3. REVIEW OF ACTIVITIES SINCE 7TH SESSION (including activities of CHy, Presidents of Technical Commissions and Presidents of Regional Associations) (agenda item 3)

The Working Group members were updated with respect to the activities of relevance to the region that had been undertaken since the last session in December 2009. This included the activities under the Commission for Hydrology, the Presidents of Technical Commissions and the Presidents of Regional Associations. Detailed information on the topics presented is contained in Document 3 for the session.

4. MODES OF OPERATION OF THE WORKING GROUP (including Task Teams) (agenda item 4)

The Working Group members were informed of the proposal for the modes of operation from their last meeting (a workgroup plus dedicated task teams) and discussed the proposed mode of operations for the future to be presented to 16th Session of RA V. There was general agreement that the Working Group should focus on a smaller number of achievable, focused activities of benefit to and meeting the needs of the Region, for example floods and droughts and water resources monitoring. The importance of both communications and leadership to enable successful activities under the modes of operations was stressed. The issue of resources was also discussed and it was recognized that WMO is there to facilitate activities and that while some funding was available for operations of the Working Group, this was limited and thus the in-kind contributions from the Members represented a considerable component of the resources available and also benefit could be drawn from close linkages to the Commission for Hydrology (CHy). It was also suggested that the Working Group could consider the modes of operation of other groups, such as the Typhoon Committee and that a linkage between the Climate Working Group and the Hydrology Working Groups may be beneficial. It was also pointed out that the bulk of the countries in RA V were developing countries and this needed to be taken into consideration when considering resource strategies. Potential donor groups for support funding were also discussed. It was agreed that this item should be revisited under agenda item 7.

5. CONSIDERATION OF DECISIONS OF RA-V-15, CHy-14, Cg-16 AND RELEVANT ECs (agenda item 5)

The Working Group members were updated with respect to the outcomes of a number of meetings that had occurred of relevance to the Region since the last session in December 2009. This included the outcomes of the 15th Session of Regional Association V, 14th Session of the Commission for Hydrology, 16th Congress and relevant Executive Councils. The Working Group discussed the topics raised in Document 5 and supported in particular those of relevance to the Region.

6. WORK PROGRAMME (agenda item 6)

The Working Group discussed the work programme as set out by RA V and the needs of the Region under a range of selected topics and areas. During Agenda Item 1, the Opening Session, there had been a round of introductions and country presentations by the participants in which they expressed their high priority needs and issues. It was decided that some of the points should be recorded in this part of the report so that the thoughts were not lost and would contribute to the development of the Work Plan. Some of the points raised included:

- Information and experience sharing across the Region is valuable, especially in regards to equipment, data management and analysis techniques;
- Capacity building remains a strong requirement of the Region;
- Impacts of climate change were becoming significant across the Region, including sea level rise, salt water intrusion into groundwater, frequency of typhoons and droughts, etc.;
- Flood forecasting was a major requirement, especially flash floods, as the islands are mostly small with short lead times; urban areas; and low land area, also with short lead times;
- Early warning-hazard based systems are becoming more important;

- Drought is a major issue for the Region, often overlooked due to the nature of the island setting;
- Groundwater quality is becoming an increasing issue, especially in time of drought; and
- Regional support mechanisms play a significant role in the Region.

6.1 Role, Operation and Management of NMHSs

The Working Group noted that WMO has previously provided guidance on the Role, Operation and Management of NHSs [WMO No. 1003]. The Working Group discussed the elements of this document and reflected on those aspects that are of most direct importance to the Region. Noting that WMO No. 1003 was still relevant and valid and that WMO had developed a training module around this document the Working Group proposed that one possible future action for the Region was to hold a training exercise based around the document, perhaps in association with the next RA WG HYS session.

6.1.1 Financing strategies for hydrology

Discussions focussed on the issue of the public good nature and cost recovery for hydrological services. The potential to develop cost recovery strategies, such as percentages of licence fees, for the operation of monitoring sites was discussed. The Working Group felt that more guidance and advice on such financing strategies was required, particularly in terms of implementing a sustainable quality assurance program. It was emphasised that at the end of the day, the decision of cost recovery from water sector activities was a national one, but that free and unrestricted exchange of data for safety of life and research purposes was promoted.

6.2 Quality Management Framework – HYDROLOGY

A presentation on the quality assurance approach of NIWA and their implementation of the ISO standards in the area of hydrological data collection (a copy of the presentation was uploaded to the session Website). The Group noted the growing importance of having a quality assurance programme and anecdotal evidence of this was provided with respect to erosion and inundation issues. Indonesia provided an example of the use of a national institution for the inspection of operations of gauging stations from an independent authority perspective. It was agreed that the money and time factors in implementing quality assurance needed to be taken into consideration, but that there were significant benefits. The Group agreed that the provision of guidance to NHSs for implementation of a Quality Management System (QMS) including the possible inclusion of case studies would be of benefit to the Region and could be considered for the Future Work Programme.

6.3 Data Collection (including WHYCOS)

The Working Group was updated on the status of the various Hydrological Cycle Observing System (HYCOS) components and also the outcomes of the 2011 World HYCOS (WHYCOS) review. There was discussion on the focus of the new HYCOS components (water resources management, flood forecasting and warning, etc), the commonalities between the components (practices, procedures, implementation plans, maintenance, vandalism, etc.) and the issues that grabbed the attention of donors, such as climate change and its impacts on water resources and disaster risk reduction and resilience. A presentation was made on the Pacific-HYCOS (a copy of the presentation was uploaded to the session website). The presentation finished by asking: Are HYCOS objectives still relevant to the Region and if so, how would you structure HYCOS Phase II based on the experience of Phase I?

The Pacific-HYCOS had provided some initial impetus for other initiatives, including, for example additional groundwater monitoring in Samoa. Issue of climate change (floods and droughts), health and food security was seen as new factors which will influence the need for more water resources information. A joint hydrology/meteorology effort was also promoted and a joint integrated approach with disaster risk reduction and climate change adaptation. The Pacific-HYCOS concept remains relevant and new issues were now of relevance, especially climate change, that necessitated a combined weather-climate-water approach, including integration of networks. It was therefore important that linkages with other RA Working Groups (such as tropical cyclones, disaster risk reduction and climate matters) are maintained. The outcomes of Pacific-HYCOS Phase I need to be up-scaled as part of a Phase II initiative. A linkage will need to be made with the Regional Integrated Water Resources Management Action Plan. Monitoring and evaluation was identified as an important component of future initiatives, especially in terms of ensuring political support, budget allocations and sustainability. The topics of gender mainstreaming and legislative support and value of hydrological monitoring for national planning for water resources management were also raised as being of importance.

Hydrological development has been achieved through the Pacific-HYCOS Phase I, including improved instrument housing (against vandalism). Capacity development/building was also seen as an essential component of the next Phase. The last hydrological technician training was in 2004 to 2006 and many people have moved on and the area of hydrological activity has also changed. The deterioration of the equipment that was purchased is also becoming an issue, especially with respect to the new types of equipment that were introduced. It will be important to look at the lessons learnt as part of the implementation stages for Phase II and thus a focused meeting on lessons learnt should be considered as part of the development of a Phase II implementation plan. Capacity development issues were further considered under Agenda Item 6.8.

The desire to implement an SEA-HYCOS, as discussed at the previous meeting, was again raised by Indonesia, Philippines and Malaysia and has been addressed in the Future Work Programme.

6.4 Current and emerging technologies for hydrometry and environmental monitoring

A presentation was made on advances in discharge measurement (a copy of the presentation was uploaded to the session website). A presentation was made on advances in data collection, communication systems and data management and analysis especially with respect to CliDE (Climate data for the Environment) (a copy of the presentation was uploaded to the session website). The presentation included details on Neon (NIWA) data access and management system. Neon delivers a 'measurement-to-web' service for near real-time environmental monitoring. Indonesia informed the meeting that training on data management would be held at the Indonesian Regional Training Centre early next year and asked NIWA to consider presenting the Neon at that training. It was requested that NIWA consider presenting the use of Neon at the International Conference on Urban Drainage in September 2014, Kuching, Malaysia organized by the Department of Irrigation and Drainage.

A presentation was made on data presentation using an expansion to CliDE that is currently being rolled out to the Pacific agencies (a copy of the presentation was uploaded to the session website). There was general agreement that data management and hydrological information systems in the region were in need of upgrade and that advances such as CliDE (Australian Bureau of Meteorology) and Neon (NIWA) would be of benefit. The topic of hydrological data management and information systems was seen as being an important area that needed to be covered by the Future Programme of Work.

The Working Group visited the NIWA velocity meter calibration tank and observed an ADCP gauging as part of a field trip as reported under Agenda Item 10.

6.5 Hydrological Forecasting and Drought Prediction

A presentation was made on the Associated Programme of Flood Management (APFM) and the Integrated Drought Management Programme (IDMP) (a copy of the presentation was uploaded to the session website). A presentation was made on a pilot flood forecasting and early warning system being implemented in Indonesia (a copy of the presentation was uploaded to the session Website). It was noted that the software (Delft-FEWS) being used was made available by Deltares. Presentations were made on the flood forecasting system being implemented in New Zealand, including “TopNet on the Desk” a Graphical User Interface (GUI) which allows users to run TopNet and visualize the results on their own computer (a copy of the presentation was uploaded to the session website). The software provided flood estimates for both gauged and ungauged river systems. A presentation was made on flood forecasting and warning operations in Malaysia (Integrated Flood Forecasting and River Monitoring (IFFRM) System) (a copy of the presentation was uploaded to the session website). The desire to cooperate with New Zealand in the implementation of TopNet in Malaysia was expressed.

The Working Group was informed that the Australian Bureau of Meteorology was considering the implementation of the United States Hydrological Research Centre’s Flash Flood Guidance System (FFGS). It was proposed that the region take a watching brief on advances in this regard. Access to improved quantitative precipitation estimates and quantitative precipitation forecasts was seen as the key to improved flood forecasting and warning. The Working Group also saw benefit in hydrological applications from seasonal climate outlooks. There was considerable discussion around the applicability of models to varying environments, both climatological and hydrological, and also on the precision required in rainfall estimates and peak flow measurements for flood forecasting and warning purposes. Depending on the situation and the accuracy required for the flood forecast, the precision of rainfall and high level flood gaugings were both of importance, especially when considering error propagation. The Working Group was informed that the Commission for Hydrology will soon publish a technical report on an intercomparison of flood forecasting models which will be distributed to all participants.

The Working Group discussed the topic of practicalities for improving the benefits of early warning systems and enabling them to be more effective, especially in situations where the lead times are short. It was noted that a range of options could be investigated including, but not limited to:

- Improved floodplain and flood management planning through hydrological inputs to planning and development proposals;
- Efforts to increase the lead time through improved cooperation between hydrological and meteorological services;
- Community education and awareness through response action plans developed in cooperation with emergency services; and
- Adoption of new, appropriate flood forecasting tools, including dissemination options.

The Working Group noted that the issue of drought was becoming increasingly important in the region and that early warning systems related to the onset of drought are required.

The Working Group expressed the desire to be kept informed of and, where possible, involved in developments associated with the Severe Weather Forecasting Demonstration Project in the region in general and the Coastal Inundation Forecasting Demonstration

Project in Fiji in particular. This was seen as an excellent opportunity to foster cooperation between the National Meteorological and Hydrological Services.

6.6 Climate Change Impact on the Water Sector

A presentation was made on the Global Framework for Climate Services (GFCS). It was noted that a meeting on the GFCS will be held in the Cook Islands in the first quarter of 2014 and it was agreed that involvement of the water sector in this meeting will be of considerable benefit to the Region as water resources are directly related to climatic factors and monitoring water resources will show the impacts of climate variability and change.

The Working Group members made country presentations on their national approaches to issues associated with climate change and water and some of the observations made are as follows:

- Climate change is just one of the factors that need to be taken into consideration in water resources management, others include, but are not limited to human activities, land use practices, population growth, urbanization, water resources allocation, pollution, etc.;
- Saltwater intrusion into aquifer systems is a problem across the Region which is linked to climate change amongst other factors;
- Increased experience of drought conditions have also been experienced in some countries and national drought polices are planned;
- The changes in frequency and severity of events (for example typhoons, cyclones, droughts in some areas) have had widely varying impacts;
- The quality and uncertainties of the regional downscaling activities is becoming increasingly important as capabilities improve;
- All countries face ongoing climate variability management issues and many of the practices and procedures are valid in a trending world, but need to be adjusted and modified, for example improving water use efficiency, use of rainwater harvesting, desalinization plants;
- There are a wide range of projects being implemented amongst a number of different groups and over coordination of activities may become important in the future;
- There has been an initial focus on coastal protection and also urban areas, with some studies of outer island issues;
- Climate change impacts on water security, infrastructure design information (hydrological design), protocols for storage operations are areas that have received attention;
- Most national planning processes are now taking climate change into consideration;
- The use of tariffs and licensing as a water resources management tool has been adopted in some areas;
- Improved observation systems, surface water and groundwater (quantity and quality), are required to monitor the impacts of climate change;

6.7 Water Resources Assessment

A presentation was made on the Technical Material for Water Resources Assessment, the web link to which is provided below. The program for the Commission for Hydrology on Water Resources Assessment was also described. It was noted that two regional workshops based on the material had been undertaken and that such a workshop in RA V would be beneficial. As with other manuals and reports provided by WMO, the Working Group members were asked to request hard copies of the documents by e-mail to the Secretariat if required.

6.8 Capacity Development and Training (including Regional requirements)

It was noted that New Zealand offers training for hydrological technicians through NZ Aid (accessible through the NZ High Commission in each country) which provides opportunities for on-the-job training. Philippines also noted that they have established training on hydrology for graduates that was available to regional participants. Training courses are also being developed by the New Zealand hydrological industry (including NIWA) as part of the New Zealand's qualifications framework. The WMO Secretariat reported on opportunities for capacity development available through the WMO and encouraged more requests for support from the hydrological community. The Working Group was also pleased to note that the Indonesian Regional Training Centre had been established in 2012.

The issues of Capacity Development were also taken up under the side meetings, the final discussion on the Future Work Programme (Agenda Item 7) and discussions on the WMO Strategic Plan (Agenda Item 9).

7. FUTURE WORK PROGRAMME (agenda item 7)

The Working Group broke into two sub-groups, the Pacific Island participants and the South-east Asian participants and discussed topics and activities that they would like to see considered by the next session of the RA V Working Group on Hydrological Services. The outcomes of these discussions and report back session are provided in Annex III and Annex IV as input to the Draft Technical Plan and Implementation Programme for consideration at the 16th Session of RA V to be held in April-May 2014.

With respect to the mode of operation for the next session of the RA WG HYS, the participants proposed that the model of a Working Group on Hydrological Services and a small number of dedicated Task Teams be retained.

The Working Group strongly recommended that the Working Group on Hydrological Services should be re-established with a Draft Technical Plan and Implementation Programme (Annex V) formulated around the outcomes of the discussions on the Future Work Programme (Annex III and Annex IV), especially when consider the current status of hydrological services in the Region. The Working Group also noted that meeting only once every four years is a limiting factor in terms of making substantial achievements and that opportunities for further interactions should be made through workshops or training events organized during the intersessional period and the use of electronic means. Considerable advances have made through closer interactions within the meteorological community and such advances are now necessary for the hydrological community, including improved interactions and relationship between meteorology and hydrology.

The Working Group agreed that the draft Technical Plan (Annex V) will be circulated for prioritization by the participants, taking into consideration in particular the needs of the SIDS, and finalization by the Secretariat by end of January 2014.

8. COOPERATION WITH OTHER INTERNATIONAL ORGANIZATIONS

(agenda item 8)

The Working Group was informed of cooperation with other relevant Intergovernmental Organizations including the Global Water Partnership on the APFM and IDMP, UNESCO-IHP (including the signing of new Working Arrangements), UN Water, SPC and SPREP.

A brief comment was made on the activities of SPC with respect to water, noting that many of these activities had been identified during the course of the discussions. The issue of interactions with professional and technical organizations at both the regional and international level, including hydrographic, hydrological, engineering and scientific groups such as the AHA, Institution of Engineers, AWA, IAHS, IAHR, to name a few was raised. The group noted that there had been some interaction with these groups on a personal basis and a group basis, nationally and at the international level. Examples included the establishment of Professional Charters associated with the Institution of Engineers and membership of AHA. It was agreed that there were significant advantages for increasing the presence and awareness of the Pacific and South East Asia issues and capabilities in continuing and improving such relationships. It was also agreed that contributions from the region should form the basis of involvement to ensure this promotion and awareness.

9. STRATEGIC PLAN 2016-19 (agenda item 9)

The Working Group was informed of the development of 2016-2019 WMO Strategic Plan and the current proposals for the priority areas. The Working Group members stressed the importance of capacity development, but also requested greater clarification of what constituted capacity development as there are many aspects to it. The participants requested to be sent a copy of the current draft of the Strategic Plan so that they could better formulate their comments and contributions. The Secretariat agreed to do this when sending out the draft report of the meeting.

10. OTHER BUSINESS (agenda 10)

The Working Group members raised and discussed the following issues:

- The Working Group strongly promoted improved and formalized linkages between the Permanent Representatives and Hydrological Advisers, including by ensuring that correspondence from WMO is circulated to the HA:
- It was suggested that future meetings include an ice breaker session and other indicatives to promote a team approach; and:
- The need for identification of a vice-chair was stated by the participants.

11. ADOPTION OF THE REPORT (agenda item 11)

The Working Group reviewed the draft report and made a number of recommended changes which will be incorporated in a final draft version to be distributed for final comments prior to adoption by 31 January 2014. The agreed final report will be used as base document for the preparation of material for input to the next RA V session.

12. CLOSURE OF THE SESSION (agenda item 1)

The session closed at 14:40 on Friday 29 November 2013.

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APPROVED AGENDA

1. **OPENING OF THE SESSION**
2. **ADOPTION OF THE AGENDA AND ORGANIZATION OF WORK**
3. **REVIEW OF ACTIVITIES SINCE 7TH SESSION (including activities of CHy, Presidents of Technical Commissions and Presidents of Regional Associations)**
4. **MODES OF OPERATION OF THE WG HYS (including Task Teams)**
5. **CONSIDERATION OF DECISIONS OF RA-V-15, CHy-14, Cg-16 and relevant ECs**
6. **WORK PROGRAMME**
 - 6.1 Role, Operation and Management of NMHSs
 - 6.2 Quality Management Framework – HYDROLOGY
 - 6.3 Data Collection (including WHYCOS)
 - 6.4 Current and emerging technologies for hydrometry and environmental monitoring
 - 6.5 Hydrological Forecasting and Drought Prediction
 - 6.6 Climate Change Impact on the Water Sector
 - 6.7 Water Resources Assessment
 - 6.8 Capacity Development (including Regional requirements)
7. **FUTURE WORK PROGRAMME**
8. **COOPERATION WITH OTHER INTERNATIONAL ORGANIZATIONS**
9. **STRATEGIC PLAN 2016-19**
10. **OTHER BUSINESS**
11. **ADOPTION OF THE REPORT**
12. **CLOSURE OF THE SESSION**

SUMMARY OF PACIFIC ISLAND BREAKOUT GROUP

Summary of group work on the Hydrology/Hydrogeology training needs identified for the Pacific Hydrologist/Hydrogeologist

Participants: Reenate Tanua Willie(Kiribati), Andre Siohane (Niue), Taaniela Kula (Tonga), O'fa Faanunu (Tonga Met office), Reggie White (RMI Weather Service), Amataga (Sulu)Penaia (Samoa), Issac Lekelalu (Solomon Islands), Erickson Sammy (Vanuatu), Maino Virobo (PNG), Wilson Rani (Cook Islands), Sepesa Gauna (Fiji), Jan Gregor(facilitator - ESR NZ) , Henry Taki (WMO) Peter Sinclair (facilitator - SPC)

Objective: Identify from the participants through group work key training needs for a hydrologist and hydrogeologist in the region and what is the best delivery mechanisms or modalities to deliver this. Overall objective is to seek guidance on how these needs can be incorporated into a programme of support for professional development of hydrologist and hydrogeologist in the Pacific region.

Approach: Participants were split into two groups and with a facilitator guided through the following questions over two separate sessions (Tuesday afternoon and Thursday morning)

Group work 1:

1. **What are the essential functions of a hydrologist for your country?**
2. **What qualifications, skills and experience are required?**
3. **What skills and experience already exists, identify the gaps**

Group work 2:

1. **What are some examples of training experiences or approaches that worked for you?**
 - **Why did they work? Why didn't they work?**

After each session the groups reported back

Outcomes Summary

Whilst the participants were split into two groups surface water and groundwater, it was interesting to note that whilst the specific skills for the hydrologist and hydrogeologist are different the generic functions are very similar and whilst the content will differ the training needs are also very similar. For instance rainfall runoff and drainage skills are required by both surface and groundwater hydrologists in every country to assist with urban design and drainage issues

Core functions for hydrologist and hydrogeologist in the Pacific identified include:

- Water resource Assessment and Monitoring
- Data processing and management
- Application and communication of data and information
- Providing expert technical advice

Each group identified that formal qualifications for a hydrologist/hydrogeologist were important for the professional recognition at both an individual and national level.

The lack of an established career path at a national level was seen as an impediment to the development of hydrological professionals and recognition or value that is accorded to a hydrologist/hydrogeologist in the Pacific.

The visibility and awareness of a hydrologist/hydrogeologist was most prominent during time of floods and drought, and it was the skills in Flood Forecasting and Drought Management which are considered amongst the most important and relevant in the Pacific.

Other skills which were commonly identified as lacking or requiring strengthening included:

- Foundation Skills: Statistics, computers (excel), surveying techniques, equipment maintenance, communication and negotiation skills
- Reporting
- Hydrological skills: water balance, database management, design skills, data analysis, GIS, geological and hydrologic foundation skills, application of specific software and modelling

Training modalities that the groups identified that had worked best in the past for the groups (in order of priority) are identified in the following table.

Training modalities - surface water	Training modalities - ground water
1. Regional training short courses: eg NIWA or SPC	1. Regional short course training eg NIWA , SPC
2. Internship or attachment to external organisation eg SPC NIWA	2. University training or accredited coursework
3. Technical attachment in country eg PACTAM or consultant	3. Internship or attachment to an organisation eg SPC, NIWA
4. University training or accredited coursework	4. Technical attachment in country eg PACTAM or consultant
5.	5. Course work in hydrology with overseas agencies Japan, Korea

Modalities of training that participants believed worked best based on past experiences included Short course work for specific and targeted skills and internships with other organisations where there was an opportunity to experience hands on mentoring.

Participants also noted that training

- needed to be consistent requiring regular reinforcement
- there should be a mix of theory and practical.
- should be relevant to the Pacific and country situation and needs
- should be programmed rather than piecemeal.
- should result in formal certification or accreditation

Identified pathway for generating a career in hydrogeology/hydrology by participants
 High schools leavers => Pre requisite online courses to identify potential candidates => short course specializations to help with job and to address any deficiencies ie foundation USP, maths/chemistry => Recognised university qualifications => trained professionals with updated skills via shortcourses.

Group Exercise 1

Groundwater Functions and Skills 26/11/2013 Christchurch, (Niue, Tonga, Samoa, Kiribati, SPC)

Water Resource Assessment	Hydrologic and Anthropological Impact in Urban Environment	Data Management	Communication Reporting	Policy/Legislation
<ul style="list-style-type: none"> • Water Quality Testing • Geophysical investigations • Monitoring of freshwater lens • Data interpretation • Geological interpretation • Biological/microbiological processes and sampling techniques • Computer literacy • Project management • Field investigation techniques <ul style="list-style-type: none"> ○ Drilling ○ Monitoring network scheduling and sampling ○ Calculation of Safe and sustainable yield • Data analysis • Borehole design • Instrumentation installation, care, 	<ul style="list-style-type: none"> • Climate analysis • Drainage design and modelling • Drainage engineering 	<ul style="list-style-type: none"> • Mapping • Surveying topo • GIS • Modelling • Database management • Data entry • Mathematics • Quality control • Database developer 	<ul style="list-style-type: none"> • Public relations • Networking • Communications with ministers to community • Train of trainer TOT • Broad knowledge of other sectors and relationships with water 	<ul style="list-style-type: none"> • Policy and legislation literate (understanding) • Communication skills (complex information explained simply) • Negotiation skills • Political science and linking science to policy. • Land ownership issues

maintenance, and installation <ul style="list-style-type: none"> • Rainwater harvesting knowledge 				
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Qualifications

Technician

High School Certificate, trade skills (Plumbing), Diploma in Civil Engineering or Earth science (offered as training support?)

Hydrologist: Tertiary qualifications (science based), Post graduate qualifications in Hydrogeology, Water engineering or Water Resource Management, (offered as training support?).

Surface water Functions and Skills 26/11/2013 Christchurch, (Vanuatu, Fiji, Solomon Islands, PNG, Samoa)

1. Water Resources Monitoring

- Baseline hydrological data (Quantity)
- Water quality (drinking and recreational)
 - Microbiological, chemical, physical
- Extremes
 - High flow/ low flow
 - Contamination

2. Data processing and management

- Data analysis
- Research
- Modelling
- Archiving and auditing

3. Data application

- Planning and design
- Awareness
- Regulation/policy
- Disaster management (floods and droughts) contamination
- Dissemination

4. Training

5. Providing expert advice, including Environmental Impact Statements and assessment of relevant development applications

Qualifications, skills and experience

Technician - senior high school and vocational

Hydrologist - 1st degree and post grad diploma

Skills and experience

Technician

- Electronics /IT/computer skills/handyman/installation of equipment including calibration
- Survey skills
- Safety , can swim, drive /first aid
- Water quality testing

Hydrologist

- Maths/statistics/computer modelling/database management
- GIS
- Communication to ministers, senior officials, community
- Making sense of the data
- Understand the environment/ science / and regulations
- Report writing skills
- Hazard and risk assessments
- Project management
- Well connected to other departments - networked, access or knowledge of traditional/tacit knowledge
- Water balance calculation

- Catchment characterisation
- Providing expert advice
- Geological skills
- Engineering design and planning (for hydropower , water supply and drainage)
- Negotiation skills
- Drought and flood forecasting (handicapped by computer technology)
- Design of monitoring programmes

Country Specific Needs and Gap analysis

Samoa - 26/11/2013

What skills and experience already exist and what gaps are identified?

Skills and experience that already exist

- Cross section surveying
- Data collection and data input
- Equipment calibration and installation
- GIS and mapping
- Identification of catchment characteristics
- Communications (officials and community)
- Water quality testing
- Providing expert advice and policy development
- Drilling groundwater monitoring bores, bore design & constructions
- Pump installation and tests

Gaps Identified

- Formal hydrological training/skills
- Drought and flood forecasting/modelling
- Extreme events measurement/recording (eg flood)
- Data auditing (QA)
- Tacit and traditional knowledge/skills
- Hazard and risk management
- Water balance calculations
- Telemetry
- Flood early warning system (rainfall radar systems)
- Groundwater mapping
- Groundwater modelling

Kiribati - 26/11/2013

What skills and experience already exist and what gaps are identified?

Skills and experience that already exist

- Monitoring of boreholes /data gathering
- Analysis of borehole data

Gaps Identified

- Installation of boreholes, and supervision of construction
- Surveying, benchmarking
- Pumping tests, time series monitoring

- Mapping of water quality
- Calibration of flow meters (use of pumping data for the interpretation of water resource)
- Strengthening of data management
- Reporting , comparison of borehole data with pump gallery (and rainfall) data

Niue

Skills and experience that already exist

- Using of basic groundwater monitoring equipment and instruments
- Water quality parameters/sampling/analysing
 - Pollution and threat activities
- Pumping tests
- Pumping selections/demand/yield
- Legislations, regulations/policies
- Rainwater collection system design
- Community and stakeholder engagement
- Communications and media
- Hydrology basics
- Design and constructions??

Gaps Identified

- Data analysing - excel skills
- Telemetry
- Calibration of instruments
- Software and modelling
- National database in hydrology and others

Vanuatu

Water technician

Skills and experience that already exist

- Electronics
- Computer skills
- Handy man
- Safety
- Can swim
- Can drive
- Installation and calibration of equipment
- Water quality testing

Gaps Identified

- IT
- Survey Skills

Vanuatu - Hydrologist

Skills and experience that already exist

- Maths/statistics
- Database management
- GIS
- Communication to Ministers, senior officials, communities
- Making sense of the data
- Understand environment, science and regulation
- Report writing skills
- Hazard and risk assessments
- Project management
- Well connected to other parts of government (networking)
- Water balance calculations
- Providing expert advice
- Catchment characteristics
- Geological skills
- Good negotiation skills'
- Design of monitoring programs

Gaps Identified

- Drought and flood forecasting
- Engineering design and planning (Hydropower, water supply, drainage)

Solomon Islands - Essential Functions of Hydrologist in Solomon Islands

Hydrologist

Skills and experience that already exist

Water resource Monitoring (Quantity)

- Flow (stream and rivers)
- Rainfall totals and intensity - water supply and hydropower
- Environmental flows
- Water level (flood warning)
- Flow (stream) and groundwater resources (climate)

Water resources monitoring (quality)

- Physical (pH, temp, cond, tds)
- Chemical (N,P, etc)
- Microbiological (coliforms)

Water Resources Monitoring (Extremes)

- Floods
- drought

Data Management (acquisition, etc)

- processing QA
- archiving
- audit reports

Applications of Data

- design flows (Supply, energy, CC application)

- environmental flows (warning)
- products /services (awareness)
- regulatory/prosecution

Solomon Island - Hydrologist

Skills and experience that already exist

- computer skills: data entry, acquisition, gauging procedures and calculations, archiving
- field work: equipment assemblage, calibration and testing, installation and maintenance

Gaps Identified

Technician

- upgrading computer skills for office and field (on going training reqd)
- securing right persons

Hydrologist

- specific/targeted post graduate courses based on country needs (eg hydrological forecasting, floods and droughts forecasting)

PNG - Hydrologist

Skills and experience that already exist

- Some higher learning institutions in PNG provide basic hydrometry courses
- The mining industry provides support to its professional experts to undergo long term post graduate courses
- Graduate courses
- Private environment management firms engage fresh graduates to undertake hydrology tasks

Gaps Identified

- Legislation does not provide adequate support to the work of the hydrologist
- No career path developed for the aspiring hydrologist
- The demand of these professions are available but there is a lack of in country
- Resource support is lacking
- Young graduates are not attracted due to the rarity of the profession
- High staff turnover (young graduate)
- Identifying the value of the hydrological data and information in environment management, resource development and planning

Cook Islands

Skills and experience that already exist -Hydrologist

- Maths
- Data base management
- GIS
- Communication to heads of organisations
- Understand the environment and regulations
- Project management
- Networking skills

- Water balance calculations
- Catchment characterisation
- Engineering design and planning
- Flood forecasting
- Design of monitoring

Gaps Identified -Hydrologist

- Statistics, computer modelling
- Understanding the science
- Report writing skills
- Hazard and risk management
- Provide expert advice
- Geological skills
- Drought forecasting

Cook Islands

Skills and experience that already exist -Technician

- Electronic/IT/computer skills
- Handyman - installation, calibration
- Survey skills
- Safety - swim, drive 4x4

Gaps Identified -Technician

- First aid
- Water quality testing skills

Fiji

Skills and experience that already exist -Hydrologist

- Data collection
- Data entry, updating and archiving hydrological data
- Data analysis

Gaps Identified

- Capacity building in terms of WMO standard qualifications (esp for hydrology technician)
- Training for hydrology scientific officer in data analysis and flood forecasting

Tonga

Skills and experience that already exist -Hydrologist

- Understanding of hydrological processes
- Electrical measuring
- Computer operations
- Surveying , map reading and air photo interpretation
- Hydrogeology
- Water quality testing
- Analysis of hydrological data
- Data storage and retrieval

- Instrument maintenance

Gaps Identified

- Mathematics
- Statistics
- Electrical principles
- Meteorology
- Hydraulics
- Hydrometry - surface water
- Competency level of skills - needs refreshing
- Only a few staff available
- Lack of vehicle
- Lack of laboratory space
- No hydrologist

Summary of training needs and training modalities

Country	Essential national hydrology functions identified	Training needs	Previous training approaches applied	What was previously considered was most effective and what was missing	Institutional support provided required at the national level to perform essential functions
SW	1. Water Resources Monitoring 2. Data processing and management 3. Data application 4. Training 5. Providing expert advice	Varied from country to country, refer to country specific requests Common or notable themes include: <ul style="list-style-type: none"> • Specific skills: First aid training, 4WD training • Formal training/qualifications in hydrology, especially in areas of drought management and flood forecasting • specific skills eg statistics, computers • No obvious career path for hydrologists 	Regional - SOPAC 2004-2006 (<i>good v relevant</i>) formal qualification received Country internship @ NIWA (<i>good</i>), one on one time, with time and space to respond and reflect In house country - (<i>Very useful during project but afterwards support is stopped.</i>) Higher level skills training JICA, USP, Free online WMO COMET	<ul style="list-style-type: none"> • Topics are relevant, training is complete part of a package of training rather than piece meal • Recognition/certification • Mix of theory and practical • Regular training and refreshing of skills. • A good foundation was considered important. Missing <ul style="list-style-type: none"> • Recognition of hydrologists and data and skills being valued • Basic knowledge of in all skills for hydrologist • No career path, people fall into hydrology rather than by design 	<ul style="list-style-type: none"> • Time to complete online course • Recognition that training for hydrologists is needed and important to get functioning hydrologists, is not a role that can be performed by on the job training alone
GW	1. Water Resource Assessment	Varied from country to country, refer to	<i>In priority of most effective training</i>	1. Targeted short courses 2. University training and	NA

	<ol style="list-style-type: none"> 2. Hydrologic and Anthropological Impact in Urban Environment 3. Data Management 4. Communication /Reporting 5. Policy/Legislation 	<p>country specific requests</p> <p>Common or notable themes include:</p> <ul style="list-style-type: none"> • Specific skills: eg statistics and data analysis, telemetry, equipment maintenance and calibration • Some specific field survey techniques eg surveying, borehole construction /design, pumping tests • Reporting skills • Communication and negotiation skills and transfer of knowledge skills "Train the trainer" 	<p><i>previously received</i></p> <ol style="list-style-type: none"> 1.Targeted short course Eg WQ, GIS, data Management NIWA, SPC hydrology training 2.University Training - Formal Qualification 3. Twinning - internship/mentoring attachment to an organisation short term 1-3 weeks 4. TA support, ie PACTAM, capacity building. 5. Medium term - JICA, KOICA course for 3-12 months 	<p>recognised qualifications</p> <ol style="list-style-type: none"> 3. Twinning - attachments for short periods and potential mentoring 4. Short term specific training of skills 5. TA support <p>Missing NA</p>	
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Pathway for generating a career in hydrogeology/hydrology

High schools leavers => Pre requisite online courses to identify potential candidates => short course specializations to help with job and to address any deficiencies ie foundation USP, maths/chemistry => Recognised university qualifications => trained professionals with updated skills via shortcourses

SUMMARY OF SOUTHEAST ASIAN BREAKOUT GROUP

PROPOSALS FOR FUTURE WORK PROGRAMME

Thematic Area 1 – Hydrological Data Management

Activities:

1. Optimization of networks;
2. Integration of networks – WMO Integrated Global Observing System (WIGOS);
3. Data Management policies – application of Resolution 25 (Cg-XIII);
4. Metadata standards;
5. Data communications systems, cell phones, mesh networks, telemetry;
6. Quality assurance – quality management; and
7. Data presentation – information systems (Delft FEWS, Neon, etc).

Thematic Area 2 – Disaster Risk Reduction

Activities:

1. Forecasting models, capabilities and constraints (SECAM, TopNet);
 2. Rainfall based forecasts;
 3. Comparison of FFGS and IFAS type systems;
 4. Authority and regulation;
 5. Flood and hazard mapping – flood risk mapping;
 6. Redundancy of systems;
- Linked to DRR Programme:
7. Message content and distribution systems;
 8. Operational risk management;
 9. Post-event relief support;
 10. Hazard mapping – multi-hazard; and
 11. Community awareness and response actions.
- Linked to other WGs (weather, marine, etc):
12. Quantitative Precipitation Estimates (QPE) ;
 13. Quantitative Precipitation Forecasts (QPF) – (SWFDP);
 14. Storm surge – flood interactions (CIFDP).

Thematic Area 3 – Water and Climate

1. Coupling between hydrology and meteorology modeling;
2. Dam management;
3. Accuracy of and access to projections - evaluation of projects against what has happened;
4. Infrastructure design information (1.5 factor?);
5. Water use efficiency;
6. Water security – water resources assessment, groundwater protection;
7. Impacts of land use management decisions;

8. Integrated Drought Management (IRBM); and
9. Rainwater harvesting practices – low impact development.

Thematic Area 4 – Capacity Development

Activities:

1. Pacific Islands Capacity Development exercise;
2. Hands-on-training;
3. Regional Training Centres, Philippines training (3-4 year time frame) ;
4. Hydrological data management;
5. Inspection practices – quality assurance – quality management; and
6. Flood forecasting – BoM Competencies work.

Cross-Cutting Issues:

1. SEA HYCOS
 - Transboundary river basins;
 - Water management in a changing climate; and
 - Water policy – water scarcity (IRBM).
2. PACIFIC HYCOS Phase II

Draft RA V Working Group on Hydrology Technical Plan and its Implementation Programme

(2014 – 2017)

1. PROVISION OF TRAINING & CAPACITY BUILDING

Deliverables	Activities	Responsible	When (Years)
A set of competencies for provision of hydrological services, including technicians and professionals	Establish a sub-group of the WG to develop appropriate competencies and related training requirements	Chair to designate WG Members; Sub-group: SPC	2014, 2015
Technical training carried out in at least one country per year (topics to include highest priority as determined by Members)	Identify Members requiring this training; seek sponsorship; undertake the training;	Members needing support of this kind; trainers and sponsors; WMO: SPC	2014, 2015, 2016, 2017
Training in quality assurance to be provided	Training session based on guidance material developed under data management theme	Lead by NZ and based on guidance developed under data management theme; WMO	2015, 2016
Catalogue of available of technology in use in the Region	Survey of instrumentation in use;	Lead by SPC; WMO; HYCOS projects	2016, 2017
Reinforced communication platform for hydrological services in the region	Build on IWRM forum, e-mail and other platforms	Lead SPC and Pacific HYCOS for Pacific and SEA HYCOS for SEA,	2015, 2016

2. HYDROLOGICAL DATA MANAGEMENT

Deliverables	Activities	Responsible	When (Years)
Guidance material on the establishment of a quality assurance programme, including finance strategies	Development of a guidance manual with case studies.	NZ and other members as appropriate	2014, 2015
Guidance and training on water information systems, Neon and Delft-FEWS	Workshop on improved presentation of hydrological data and information	Secretariat to invite participants under guidance of Chair;	2014, 2016

Deliverables	Activities	Responsible	When (Years)
Pacific HYCOS Phase II concept document	Establish a sub-group of the WG to develop concept document; consultancy	Chair to designate WG Members; Sub-group; SPC;WMO	2014, 2015
SEA HYCOS Phase I concept document	Establish a sub-group of the WG to develop concept document; consultancy	Chair to designate WG Members; Sub-group; WMO	2015, 2016

3. DISASTER RISK REDUCTION

Deliverables	Activities	Responsible	When (Years)
Improved Quantitative Precipitation Estimates and Forecasts	Joint activities with SWFDP	Chair to nominate representatives from WG to link to SWFDP	2014, 2015, 2016, 2017
Guidance on rainfall based flood forecasts	Development of guidance material	Chair to designate WG Members; Sub-group	2014, 2015, 2016, 2017
Improved Flood Forecasting Systems and Techniques	Implementation of FFGS in the Region: Reports on regional applications; IFAS, TopNet, IFFRM, Delft-FEWS etc	Chair to designate WG Members; Sub-group; Indonesia; Australia	2014, 2015, 2016, 2017
Improved linkages with DRR community	Hydrological inputs to end-to-end multi-disaster warning systems - CIFDP	Chair to nominate representatives from WG to link to CIFDP	2014, 2015, 2016, 2017

4. WATER AND CLIMATE

Deliverables	Activities	Responsible	When (Years)
Improved Drought Monitoring and Management Capabilities	Evaluate accuracy of seasonal predictions for water management purposes; Improve water elements in CliDE;	Chair to designate WG Members; Sub-group: Link to RA WG on Climate	2014, 2015, 2016, 2017

Deliverables	Activities	Responsible	When (Years)
Benefits achieved for the water sector through the implementation of GFCS	Involvement in GFCS activities Represent WG in GFCS initiatives	Chair to nominate representatives from WG to link to RA V WG on Climate	2014, 2015, 2016, 2017