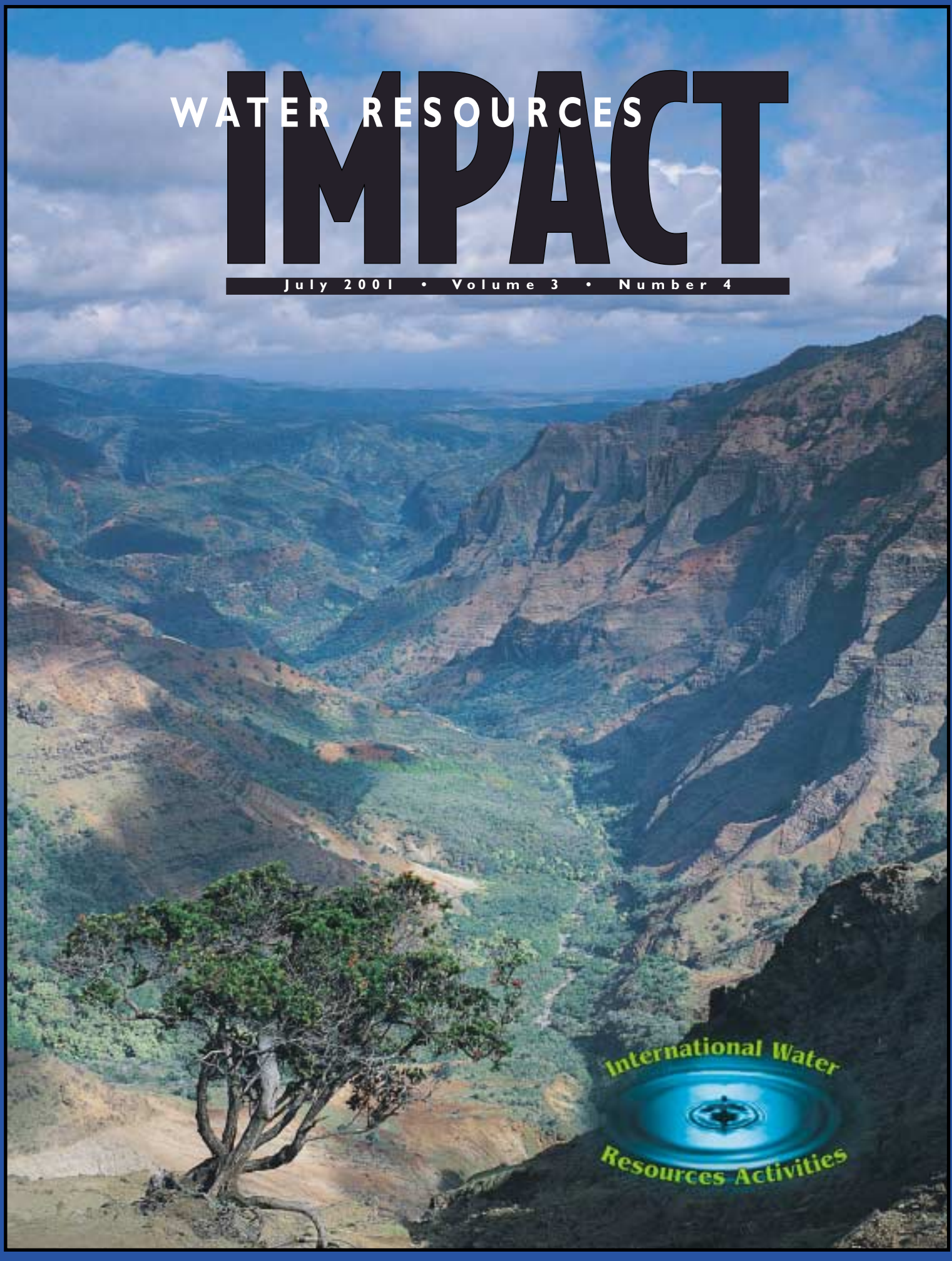
WATER RESOURCES

IMPACT

July 2001 • Volume 3 • Number 4



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WATER RESOURCES IMPACT

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Water Resources IMPACT is owned and published bi-monthly by the American Water Resources Association, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626, USA. The yearly subscription rate is $45.00 domestic and $55.00 foreign. Foreign Airmail Shipping Option, add $25.00 to subscription rate. Single copies of IMPACT are available for $8.00/each. For bulk purchases, contact the AWRA Headquarters office.

IMPACT is a magazine of ideas. Authors, Associate Editors, and the Editor-In-Chief work together to create a publication that will inform and will provoke conversation. The views and conclusions expressed by individual authors and published in *Water Resources IMPACT* should not be interpreted as necessarily representing the official policies, either expressed or implied, of the American Water Resources Association.

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Postmaster: Send address changes to *Water Resources IMPACT*, American Water Resources Association, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626.

ISSN 1522-3175
VOL. 3 • NO. 4
JULY 2001

INTERNATIONAL WATER RESOURCES ACTIVITIES

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Even in just the past few months, events have transpired which will shape the continue debates over how best to cope with the emerging global water crisis. The United States has much to offer developing countries and much to learn from their experiences. In this issue of Water Resources IMPACT, we continue the theme of international water resources activities begun in the March 2001 issue with descriptions of the technical assistance programs of a selection of Federal agencies, a report on the contributions of the Great Lakes as a learning and demonstration basin in the new HELP initiative, an introduction to the U.N. Convention on International Watercourses, and finally, a guide to some of the major players in the international water resources arena. As with the March issue, we hope that this collection of papers will encourage AWRA members to look for ways to contribute their expertise and experience to the resolution of international water issues.

Introduction

Feature Articles

WATER RESOURCES **IMPACT**
Volume 3 • Number 4 • July 2001

INTRODUCTION: INTERNATIONAL ACTIVITIES AND AWRA

David W. Moody and Faye Anderson

The pace of international activities provides an interesting contradiction. On the one hand, the implementation of concepts, such as integrated water and land resources management or the negotiation of agreements about the sharing of transboundary waters seem to proceed at a glacial pace. On the other hand, some international initiatives get adopted and put into practice in relatively short periods of time. In such cases, information and technical advice are needed within relatively short periods of time in order to have an impact on the shape and form of a new initiative, whether it be a technical assistance program or a major international meeting. The challenge for AWRA in the international area is to be there at the right time and in the right place to make a difference. To meet this challenge takes flexibility and innovation.

Since the first international activities issue of *IMPACT* was published in March 2001, many events have transpired. AWRA Executive Vice President Ken Reid and Faye Anderson attended the Third World Water Forum (WWF3) "Kick Off" Meeting in Kyoto, Japan, at the invitation of the Forum organizers. This meeting laid the groundwork for active participation by AWRA in this major international water policy forum, a sequel to the Second World Water Forum held in The Hague in March 2000. The nature of this participation has yet to be fully defined and will be the subject of discussion at the AWRA Annual Meeting in Albuquerque in November.

Faye Anderson, attended the Kyoto meeting to report on the results of her team's test of software created by the WWF3 organizers for the virtual water forum (see www.worldwaterforum.org). The organizers envision worldwide discussions of key areas in water resources management that will lead up to WWF3 in March 2003 in Kyoto. Faye will moderate a session on water information issues and the Internet.

At the same time as the WWF3 "Kick Off" meeting, David Moody attended the annual meeting of the Canadian Water Resources Association (CWRA) to reestablish ties with our sister association in Canada. He received a warm welcome from members of CWRA's board of directors and their new Executive Director, John Lilley. They expressed interest in joining with AWRA to develop a North American view of water resources that might be a contribution to the World Water Forum. These initial contacts need to be followed up with the possibility of holding a joint workshop on Canadian-US transboundary water issues and identifying case studies of successful implementation of integrated water and land resources management in both countries. Volunteers will be needed to come forward to assist and lead these proposed events.

Of course, the main focus of the past few months of the International Committee has been preparations for the AWRA/University of Dundee International Specialty Conference on "Globalization and Water Management: the Changing Value of Water." The final program consists of 70 technical presentations, 20 posters, a plenary session on the Hydrology, Environment, Life and Policy (HELP) initiative of UNESCO and the World Meteorological Organization (WMO), and a morning workshop on "The Essentials of Private Sector Participation: From Structuring the Project to Regulation." Interest in the meeting has been worldwide.

In this issue of *IMPACT*, we will examine the role of selected Federal agencies in international activities. The involvement of the National Weather Service (NWS), the U.S. Bureau of Reclamation (USBR), and U.S Agency for International Development (USAID) is diverse and exciting. Needless to say, many other Federal agencies have equally interesting activities. It is our hope that these may be presented in a future issue of *IMPACT*.

As with the March issue, we hope that these articles will raise your awareness of international water management efforts and stimulate your interest for the potential role of international activities in AWRA. We invite all interested members to play an active role in the International Committee's efforts and help to shape a global role for AWRA in the coming years.

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FEEDBACK! . . . Let us know what you think. We want to encourage dialogue. Write or e-mail your comments to the Associate Editor of this issue or to me. We appreciate everyone who has sent their comments to us so far and ask that you continue to do so. We would like to get everyone involved in some "conversation" on various topics.

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WATER RESOURCES IMPACT

INTERNATIONAL TRANSFER OF U.S. NATIONAL WEATHER SERVICE RIVER AND FLOOD FORECASTING TECHNOLOGY

Curtis B. Barrett and A. Sezin Tokar

INTRODUCTION

Water shortages are a part of daily life in the majority of the developing countries. This situation constitutes a threat to their political and economic stability, in addition to human health and the environment. In 1995, the World Bank reported that 80 countries with 40 percent of world population face water scarcity; 1 billion people do not have access to safe drinking water; 1.7 billion lack adequate sanitation; and 10 million people die each year from waterborne diseases (Serageldin, 1995). Most of the problem is occurring in regions that are susceptible to political and economic instability, such as the Middle East, North Africa, and Southeast Asia.

The rapid growth in population, an increase in demand for water, and the mismanagement and abuse of available resources further threatens water availability. According to the United Nations (1997), the world population will increase 50 percent by 2025 along with an increase in the need for food, development, and water, causing moderate to high stress for about the two-thirds of the population. Current water-use trends and pollution habits, combined with mismanagement, may cause serious water crises that could contribute to political tension and conflict in developing countries. This situation is further complicated by the fact that about 300 river basins and aquifers are shared by more than one country. Ismail Serageldin, of the World Bank, sounded a warning about the global water crisis when he stated that "the wars of the next century will be over water – not oil or politics" (Vidal, 1995). The problem in these situations is not only the lack of water, but also flooding that results from its abundance. Precipitation, which is the major contributor to Earth's fresh water, is unevenly distributed. When one part of the world is flooding, another part is suffering from droughts.

Current water-use trends and pollution habits, combined with mismanagement, may cause serious water crises that could contribute to political tension and conflict in developing countries

Floods and droughts have a major impact on the global economy and human suffering. In the United States (U.S.), 75 percent of presidential declarations of natural disasters are due to floods (Stallings, 1997). In 1993, the great Mississippi River flood caused over $16 billion in damages (U.S. Department of Commerce, 1994). Hurricane Mitch struck Central America causing unprecedented catastrophe in 1998. Over 50,000 people died, primarily from floods and mudslides. More than half of the infrastructure in Nicaragua and Honduras was destroyed. Flooding in Venezuela killed over 160,000 people, displaced over 400,000, and caused $2 billion in economic damages in 1999. In 2000, Southern Mozambique suffered tremendously from flooding which caused the death of about 1,000 people, displaced over 700,000, and had $1 billion in damages. In order to lessen the impact of droughts and mitigate human suffering and economic losses due to floods, water managers around the world need better information, data, and tools to make intelligent, accurate, and timely decisions. This need for forecasting of rivers and flood condition created a demand for the National Weather Service (NWS) river forecasting technology.

NATIONAL WEATHER SERVICE RIVER AND FLOOD FORECAST SYSTEM

The NWS, an agency in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) is responsible for providing river forecasts and flood warnings for the U.S. Flood forecasts protect life and property for the population residing within river floodplains while daily river forecast services aid in managing water resources for economic and environmental prosperity of the country. The NWS Hydrologic Forecast Service is provided for all major rivers in the U.S. and include site specific quantitative flood crest forecasts for over 4,000 locations. Over the past 20 years, the NWS has developed a state-of-the-art flood and river forecast system, National Weather Service River and Flood Forecasting System (NWSRFS). The system incorporates new advances in technology, such as development of automated flood warning systems. Some of the advancements in river forecast technology include:

- Use of line of sight radio, meteorburst, satellite, and new WSR-88D doppler radar system, in data collection and transmission.
- Automation of hydrometeorological observing systems at airports.
- Improvements in atmospheric, hydrologic, and hydraulic models.
- New methodologies in quantitative precipitation prediction.
- Use of satellites and radars in precipitation estimation.
- Improvements of computer hardware, software, and telecommunications.

These advances have allowed the NWS to provide world class forecast services to U.S. citizens and other people around the world.

NWSRFS is a collection of interrelated software procedures that perform wide variety of hydrologic/hydraulic

and data management operations (see Figure 1). It is a modular system that was implemented and tested in river basins with various hydrologic and climatic characteristics. In the U.S, the NWS operates 13 River Forecast Centers (RFCs) that use the NWSRFS to make short-term forecasts of rivers and floods (a day to a week), and long-term probabilistic river forecasts (a week to months into the future) in support of water-supply management and flood mitigation. The operational NWSRFS contains numerous hydrologic models that are used for forecasting across the wide range of hydrometeorologic conditions found in the U.S. The NWSRFS computer code and documentation are available on the Internet at no cost and can be obtained at http://hydrology.nws.noaa.gov/oh/tt/soft/hsoft.shtml.

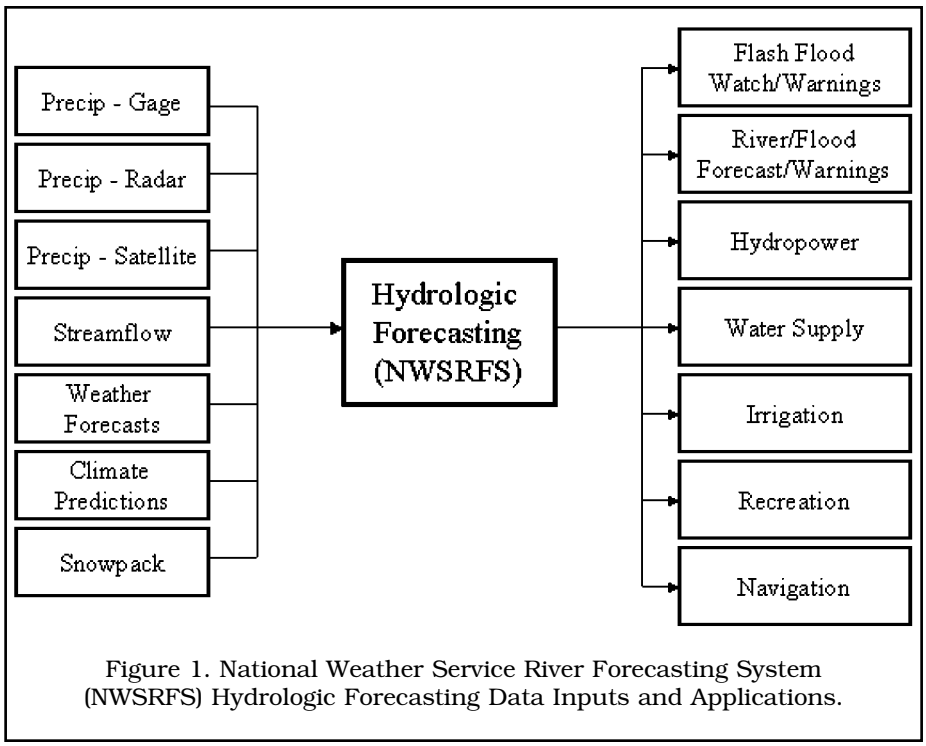

Figure 1. National Weather Service River Forecasting System (NWSRFS) Hydrologic Forecasting Data Inputs and Applications.

INTERNATIONAL TECHNOLOGY TRANSFER

Effective water-management technology is critical in many areas in the world where water problems are severe constraints on economic and social development. This is especially evident in parts of the developing world where the margin between starvation and subsidence is small. The growing need for water-management support technologies and tools has created a demand for the NWS river forecasting technology.

The NWS International Activities Office, in cooperation with the World Meteorological Organization (WMO), the U.S. Agency for International Development (USAID), the World Bank, United National Development Programme (UNDP), and other donor organizations is transferring the U.S. river and flood forecasting technology to many countries in the world where water shortages or floods threaten life and economic welfare. The NWS also works closely with other U.S. government agencies and the private sector to transfer this technology via major projects to hydrometeorological partners in other countries. The benefits from these activities are mutual. The experience and knowledge gained in implementation of the NWS technology abroad lead to improvements in the system used in the U.S. and make hydrometeorological data from around the world available to the U.S. The NWS successfully completed projects in the Nile River Basin, Egypt; Huai River, China; Panama Canal, Panama; Czech Republic; and has ongoing projects in Mexico, South Africa, Central America, and Central Asia.

THE NWS EXPERIENCE AROUND THE WORLD

Mexico

The Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT-Mexican Ministry of Environment and Natural Resources) and NOAA signed a five-year agreement on meteorological and hydrological cooperation in May 1996 in Mexico City. Under this agreement, the Comisión Nacional del Agua (CNA-Mexican National Water Commission) and the NWS agreed in principle to a multiyear project to transfer NWSRFS and associated technologies to Mexico. The principal goal of the CNA-NWS project is to provide CNA staff with the training and practical experience needed to implement river forecasting technologies to mitigate the loss of life and property caused by floods and to improve the management of water resources. Project activities are defined by annual agreements and prepared on a calendar-year basis. The project is supported by the World Bank through the Programa de Modernización del Manejo del Agua (PROMMA-Modernization of Water Management Program in Mexico).

The CNA-NWS project provides Mexican counterparts with capacity development and on-the-job experience needed to implement the NWSRFS in selected river basins throughout Mexico that represent a variety of climatic and hydrologic characteristics. Capacity development of CNA staff is intended to assist CNA to sustain forecast systems that are currently in operation and implement new systems in other river basins in Mexico.

A major accomplishment of the project in 1999 and 2000 was to strengthen cooperation between the U.S. and Mexico in forecasting flooding in the Río Bravo/Rio Grande basin. The Comisión Internacional de Límites y Aguas (CILA) and the International Boundary and Water Commission (IBWC) are cooperating on the establishment of real-time exchanges of hydrometeorological data and information between the two countries. This effort will improve Río Bravo/Rio Grande forecasting and aid Mexican and United States forecast centers to lessen the hydrologic disasters in the basin.

The principal partner of the NWS in this project is the CNA's Gerencia de Aguas Superficiales e Ingeniería de

Ríos (GASIR-Surface Water and River Engineering Management), which is responsible for monitoring and managing Federal rivers and reservoirs in Mexico. From 1996 through 2000, the NWS and GASIR have implemented the NWSRFS in the Ríos Fuerte, Yaquí, Bravo, and Pánuco basins (see Figure 2). The CNA engineers were trained in hydrometeorological data analysis, model calibration, and NWSRFS operation and maintenance to operate the NWSRFS in Mexico. Training of CNA engineers and working with U.S. engineers during the implementation of these systems are essential to support the technology as CNA assumes operational responsibility for them. The NWS is also translating NWSRFS manuals into Spanish to aid CNA engineers in operating and maintaining the systems in Mexico.

During the last four years, GASIR and NWS also have evaluated and implemented associated technologies in support of NWSRFS implementation. GASIR and Gerencia de Servicio Meteorologico Nacional (GSMN-Mexican Weather Service) operate data collection networks in Mexico and these networks need to be strengthened and integrated with the forecast system. GASIR and GSMN are in the process of automating their networks and their data will be used to enhance operation of their forecast systems. Two potential additional sources of data for estimating precipitation, using radar and satellite were also evaluated. The Instituto Mexicano de Tecnología del Agua (IMTA-Mexican Water Technology Institute) assisted in these evaluations.

One of the principal goals of PROMMA is to decentralize the management of water in Mexico. Towards this goal, the NWS assisted CNA to establish Regional River Forecast Centers (RRFCs) in two CNA regions. The NWS and CNA also developed a database and Internet-based systems to store and exchange information and data between RRFCs and CNA headquarters. In 1999, the CNA Noroeste Region RRFC in Hermosillo, Sonora, started to test database and data transfer systems and operate the Ríos Fuerte and Yaquí NWSRFS.

To strengthen the capacity of CNA managers, the NWS conducted hydrologic study tours to the U.S. and conducted workshops on the NWSRFS, application of Geographic Information System (GIS) technology for flood forecast mapping, and reservoir Decision Support Systems (DSSs). In 2000, GASIR and NWS developed tools to visualize the extent of flooding in the Tampico area using GIS technology. In addition, GASIR and NWS compared current forecast models in Mexico to models in the NWS

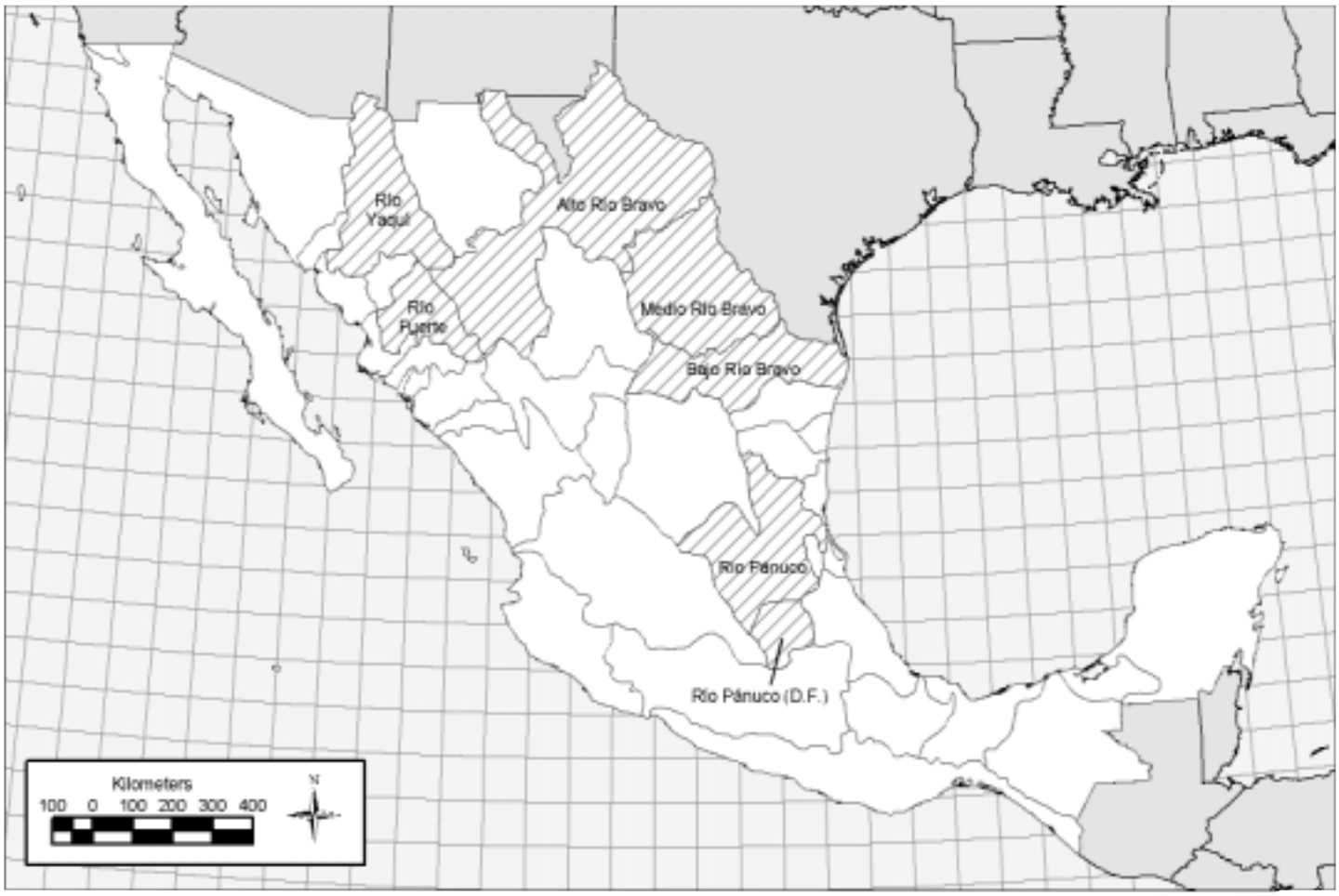

Figure 2. Location of the Rios Fuerte, Yaqui, and Bravo Basins.

RFS to evaluate the advantages and benefits of the models. The cooperation between NWS and CNA is scheduled to continue until 2005.

Figure 3. Panamá Canal Watershed.

Panama

The NWS project in Panama has provided technical assistance to the Panama Canal Commission (PCC) to implement the NWSRFS and its components designed specifically for the Panama Canal watershed (see Figure 3). The funding for the project was provided through the Interagency Service Agreement Between the Panama Canal Commission and the U.S. Department of Commerce, NOAA, NWS for the provision of services to establish a National Weather Service River Forecast System for the Panama Canal watershed for use by the PCC as executed on August 28, 1996. In December,1998, the NWS installed and tested the River Forecast System for the Meteorological and Hydrographic Branch of PCC. The PCC now uses the NWSRFS to operate Madden Reservoir which supplies lockage water for the Panama Canal.

Central America

After the destruction caused by Hurricane Mitch in 1998, the U.S. Department of Commerce is helping Honduras, Nicaragua, El Salvador, and Guatemala to rebuild their economies and to improve their capacity to respond to and mitigate against hurricanes and other natural disasters. The activities were started in 1999 and will be completed on September 2001. Consistent with its environmental and economic mandates, the Department's goal in assisting with the reconstruction of Central America is to strengthen regional capacity to make decisions that minimize the exposure of countries to future disasters and promote sustainable uses of natural resources (U.S. Department of Commerce, 1999). The Department's objectives are to provide key infrastructure elements, develop much-needed hydrometeorological forecasting and warning systems, help to promote more sustainable, resilient uses of coastal resources, build local and regional capacity for coastal hazards mitigation, and encourage disaster-resilient economic revitalization. The Department emphasizes training and capacity building to ensure the sustainability of infrastructure and systems once the implementation of the proposed work has been completed. The implementation plan for work in the region includes tasks in five areas:

1. **Base Infrastructure Reconstruction:** To reconstruct and improve geodetic, meteorological data collection, tide gage networks and develop satellite data receiving, processing and analysis capabilities.

2. **Forecast and Early Warning Systems:** To develop country strategic implementation plans, reconstruct and improve flood forecast networks, establish the NWSRFS flood forecast system on pilot basins (see Figure 4), establish automated flood warning systems for flash flood prone river basins (ALERT-Automated Flood Warning Systems), develop a regional seasonal climate prediction system, and training and capacity building.
3. **Disaster Preparedness:** To develop an approach to establish a regional center for disaster reduction, improve Hazardous Material (HAZMAT) spill prevention and response, training and capacity building, and develop a reservoir operation decision support framework.
4. **Sustainable, Resilient Coastal Communities:** To support sustainable uses of resources in the Gulf of Fonseca, develop long-term weather trends analyses for hazards mitigation, market incentives for resilient construction, resilient building codes/construction practices, and local capacity building and support.
5. **Economic Revitalization:** To develop trade.

The U.S. Department of Commerce's Project Implementation Plans for each country can be accessed at http://hydrology.nws.noaa.gov/oh/tt/index.shtml.

Central Asia/Aral Sea

In order to strengthen selected technical support capacities of Central Asian hydrometeorological institutes (Glavgidromets), the USAID invited a NOAA-NWS mission to Central Asia in May 2000 to discuss establishing a regional snowmelt river forecast system for selected subbasins of the Syr Darya River in the Aral Sea basin. The mission's visit resulted in an agreement between the NWS and USAID to conduct a pilot program, "Snow Melt

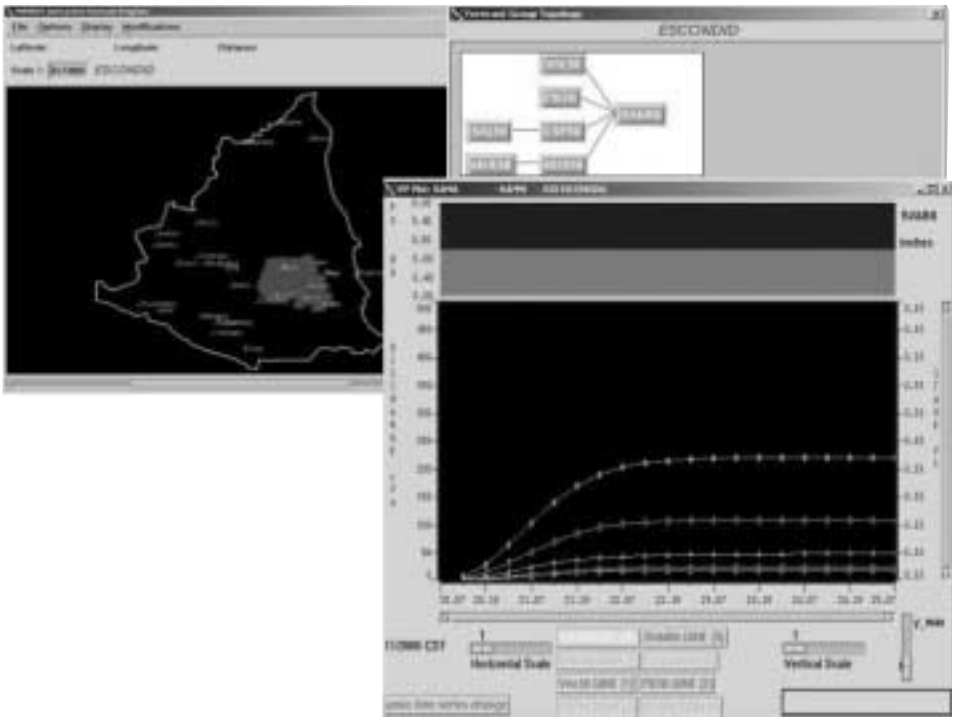

Figure 4. Rio Escondido NWSRFS, Nicaragua (NWSRFS Windows 2000 Version).

and River Forecast System for Selected Basins in Central Asia" in the 2000 and 2001 period.

A subsequent NOAA mission to Tashkent provided NOAA participants with an opportunity to become familiar with the institutional and hydrometeorological settings of Central Asia, develop links with selected other donor and lender programs, and further prepare to implement tasks to complete the project. During the visit, NOAA representatives joined representatives from Uzbekistan, Tajikistan, Kyrgystan, and Kazakhstan hydrometeorological agencies and participated in a WMO sponsored meeting on the Aral Sea Basin Hydrologic Observing System (ARAL-HYCOS) and on Water Resources Assessment. WMO staff provided a draft proposal to the NOAA mission to establish the ARAL-HYCOS system in Central Asia that would add a complementary communications capability to the network. During the visit to Central Asia, the NOAA representatives carried on technical discussions with the Swiss Aral Sea Mission (SASM), which is implementing a snowmelt runoff system that is greatly dependent on mapping the extent of snow in the area.

In order to assist in the mapping of the extent of snow, NOAA installed a High Resolution Picture Terminal (HRPT) in Tashkent, in 2001. This system acquires daily imagery over Central Asia from NOAA polar-orbiting meteorological satellites. USAID sponsored a meeting with the hydrometeorological institutes of Uzbekistan, Kazakstan, Kyrgystan, and Tajikistan and the SASM to establish a snowmelt forecast system advisory committee to coordinate NOAA forecast activities with other water-management activities in Central Asia.

China/Huai River

The NWS cooperated with Chinese Ministry of Water Resources to develop a prototype flood forecasting system in the Huai River basin as a basis for later application to the seven major rivers in China as a part of a centralized flood control dispatching system. The Ministry of Water Resources and NWS implemented the NWSRFS in the basin, trained Chinese engineers in operation of the system, and demonstrated the use of improved river forecast system. The project was funded by the World Bank.

Egypt/Nile River

The NWS recently completed the development of the Monitoring, Forecasting, and Simulation (MFS) system, a river forecasting system for the Nile River. The Nile project was funded by the U.S. Agency for International Development and the executing agency was the United Nations Food and Agriculture Organization (FAO).

The primary goal of the project was to monitor hydrometeorological conditions in the Nile Basin and provide forecasts of the Nile inflows into the High Aswan Dam with as much lead time as possible (see Figure 5). An additional goal was to regionalize forecast capabilities so that many of the ten riparian countries of the Nile basin could benefit from use of the Nile river forecasts. In addition to river and flood forecasting, the MFS system also is used for planning and implementation of strategies for the optimal use of the Nile's water resources. The project started in 1991 and was completed in 2000.

Figure 5. Nile River Basin.

South Africa

USAID and NOAA signed an agreement in February 1998 to implement the NWSRFS for the Vaal River Dam catchment in the Republic of South Africa (RSA). The development of the initial configuration of the NWSRFS was completed and installed on workstations in South African Department of Water Affairs and Forestry (DWAF) on December, 1998. DWAF personnel were trained in the use of the model calibration and system configuration. Training and model calibrations and system implementation for other basins in Southern Africa will continue during 2001.

OTHER ACTIVITIES

The U.S. and Vietnam have established a dialogue concerning the transfer of NWS technology to Vietnam. The NWS and the Central Committee for Flood and Storm Forecasting (CCFSC) seek to implement NWS technology to manage, forecast, and provide early warning of floods in the Red River basin.

The NWS International Activities Office receives and hosts delegations from all around the world. Some of the countries that recently have visited the NWS include Thailand, China, Vietnam, Korea, Taiwan, Turkey, Poland, Czech Republic, and Venezuela.

Additional information regarding the NWS International Activities hydrologic projects can be obtained at http://hydrology.nws.noaa.gov/oh/tt/index.shtml.

LITERATURE CITED

Serageldin, Ismail, 1995. Toward Sustainable Management of Water Resources. World Bank, Direction in Development Series, Washington, DC.

Stallings, E.A., 1997. The Benefits of Hydrologic Forecasting. A Report to the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. National Weather Service Office of Hydrology, Silver Spring, Maryland.

United Nations Department for Policy Coordination and Sustainable Development, 1997. Comprehensive Assessment of Fresh Water Resources of the World.

U.S. Department of Commerce, 1994. The Great Flood of 1993. Natural Disaster Survey Report, National Oceanic and Atmospheric Administration.

U.S. Department of Commerce, 1999. Implementation Plan for Reconstruction Work in Central America. U.S. Department of Commerce, Washington D.C. *Available at* http://hydrology.nws.noaa.gov/oh/tt/index.shtml.

Vidal, John, 1995. As the World Runs Dry . . . Next, Wars Over Water? World Press Review 42(11):8.

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A. Sezin Tokar, Hydrologist, Consultant to NOAA, NWS, International Activities, provides technical advice and directions to the U.S. National Weather Service for transfer of river and flood forecasting technology to client countries. She is currently involved in projects in Mexico and Honduras and was part of the team who developed the Nile Monitoring, Forecasting, and Simulation System. She has extensive experience in precipitation-runoff modeling and associated technology. She was a National Research Council Post Doctoral Fellow in the National Weather Service from 1996 to 1997 and holds a Ph.D. in Civil Engineering with an emphasis on Water Resources and Hydrology from the University of Maryland.

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INTERNATIONAL ACTIVITIES OF THE U.S. BUREAU OF RECLAMATION

Richard H. Ives

The Bureau of Reclamation, an agency of the U.S. Department of the Interior, is one of the principal water management agencies of the Federal Government. Reclamation was established in 1902 to "reclaim" the arid and semi-arid lands of the 17 Western States for settlement through the development of irrigated agriculture. Today it operates about 180 water projects in the West, totaling some 600 dams and reservoirs, including such behemoths as Hoover Dam and Grand Coulee Dam. It is the largest water wholesaler in the country, bringing water to more than 31 million people and irrigating 10 million acres of land. Reclamation also operates 58 hydroelectric powerplants, generating more than 40 billion kilowatt hours of electricity annually; enough to serve 6 million homes. In recent years, the role of the agency has evolved from a developer of water resources to principally a manager of water resources. The management of water resources in the water-short American West, with its array of competing uses, is an ever-increasing challenge.

While Reclamation is largely known for its accomplishments on the landscape of the American West, it has also been actively involved in the international arena for many decades. Although international activities have always represented a small portion of the agency's overall program, Reclamation has played a significant role in a number of other countries. It operates on a government-to-government basis, with funds being provided by the host country, the World Bank, the United Nations, or the U.S. Agency for International Development (USAID). In addition, Reclamation's international programs usually focus on institutional capacity building for a counterpart technical agency, either through formal training programs or through technical assistance efforts.

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Reclamation was only sporadically involved in international activities in the 1920s and 1930s and an organized program did not emerge until the late 1940s. After World War II, much of the world was undergoing major reconstruction and the U.S. was at the forefront of these efforts. The Cold War had set in and the U.S. was anxious to see that the "free world" could feed itself; the development of irrigated lands was viewed as a critical need throughout the world. Reclamation was tapped by the U.S. State Department (State) to play a leading role in this process and the international program developed from an extracurricular activity to a full-fledged Reclamation-wide operation, with a budget of nearly $2 million in 1952 (roughly equivalent to $13.5 million in today's dollars). Consistent with the agency's domestic program focus at that time, much of this early international work related to water project development. For example, in 1952 Reclamation was working on planning studies involving projects in 21 countries, covering some 17 million acres of irrigated land, and hydropower of more than 4,200 megawatts of installed capacity.

Over the years Reclamation has assisted numerous countries in their assessments of the water and land resources in selected river basins. Some of the larger or better known efforts have focused on the Blue Nile in Ethiopia (1958-1964), Han River in Korea (1966-1971), Helmand River in Afghanistan (1960-1971), Litani River in Lebanon (1954-1958), and the Sao Francisco River in Brazil (1964-1973). In most cases, however, Reclamation assistance has been focused on specific projects, such as the Pa Mong Project (Thailand-Laos), Snowy Mountains Scheme (Australia), Aswan High Dam Power Station Rehabilitation Project (Egypt), and the Three Gorges Dam Project (China). While it has assisted others on dozens of water projects over the decades, only Reclamation's involvement with the Three Gorges Dam involved any controversy. In 1984 Reclamation agreed to assist the Chinese in several technical areas related to the Three Gorges Dam. Reclamation withdrew in 1994, however, and it was subsequently determined that no U.S. Government agency should be involved with this gigantic and controversial project.

Reclamation's international activities have closely followed trends in American foreign policy over the years, as the countries involved have changed, mirroring changes in U.S. foreign policy interests. For example, there was major Reclamation involvement in Southeast Asia over several decades, concluding in the mid-1970s. During the late-1970s, considerable effort was expended in the Sahel Region of Africa where a devastating drought was then taking its toll. With the signing of the Camp David Peace Accord in 1979, foreign policy emphasis shifted to the Middle East, and Reclamation was soon engaged in several countries in that region. When the broader Middle East Peace Process began in 1992, State assumed a leadership role in the area of water resources and Reclamation was asked to provide technical support to State. Reclamation later assumed a major role in assisting State in establishing the Middle East Desalination Research Center in Muscat, Oman, where Israeli and Arab technical specialists could work together on topics of regional interest.

South Africa emerged as a major area of interest in U.S. foreign policy in the mid-1990s and Reclamation was soon engaged in providing assistance to that country in areas related to water law, water conservation, and river

basin management. State has recently begun working with other nations in efforts to reduce potential international transboundary conflicts in selected river basins around the world. To help achieve this goal, Reclamation was asked by State to help develop a river basin commission to manage the Okavango River Basin, shared by Angola, Namibia, and Botswana. In April 2001, Reclamation led a study tour to the Colorado River Delta and the Everglades for eight Commissioners of the Okavango River Basin Commission. Closer to home, with the passage of the North American Free Trade Agreement in 1994, Reclamation has been seeing an ever-increasing number of requests for collaboration with Canadian and Mexican counterparts.

More recently, the focus on development and on specific water projects has waned in the international program. The current program is a mixture of technical assistance, technical cooperation, and training activities, relating to a wide array of topics, such as dam safety, desalination, river basin management, and water conservation.

Technical assistance programs are offered at either Reclamation facilities in the U.S., or in another country at the facilities of a counterpart governmental water agency. Each technical assistance program is designed to address the specific needs of the requesting agency, and technology transfer and capacity building are routinely integrated into each program. Some examples of ongoing technical assistance activities include:

• BRAZIL – Technical assistance and training is being provided to the Brazilian Ministry of the Environment, Water Resources, and Legal Amazona, with emphasis on the development and management of water resources in the semi-arid region of northeastern Brazil. Reclamation personnel, involving both a resident team and U.S.-based technical experts, serve as advisors to Brazilian counterparts and assist them in reviewing studies, proposals, plans and specifications, construction practices, and operation and maintenance procedures.

• MEXICO – Reclamation recently began to provide assistance in dam safety to the Mexican National Water Commission, under the auspices of a broader agreement on water management. Recent program activities have included the presentation of three workshops in Mexico by Reclamation dam safety and emergency action planning experts.

• SAUDI ARABIA – Reclamation has long been cooperating with the Saline Water Conversion Corporation by providing technical assistance and training in desalting technology and related fields. Activities have been undertaken in both the Kingdom and in the U.S. and a substantial portion of the program has been provided through American private sector firms and universities.

• TAIWAN – Reclamation has been providing technical assistance and training in the areas of water resources

management, sedimentation, water planning, and dam safety.

Technical cooperation, or technology exchange, is another important component of the international program. Through the exchange of technical and scientific information, Reclamation seeks to improve the technical capabilities of its personnel for application in the agency's domestic program. This can be accomplished through several means, including participation in formal cooperative science and technology (S&T) exchange programs. A formal S&T program, with each side normally funding its own costs for mutually agreed-upon activities, includes an arrangement whereby findings and results are shared between the parties. Significant savings can occur by sharing the cost of technological developments and exchanging technology that was independently developed. Some examples of ongoing technical exchange programs are:

• CHINA – Cooperation is ongoing with the Ministry of Water Resources in the areas of water resources management and water conservation. In addition, Reclamation has been providing support to the U.S. Irrigation Association related to the establishment of an irrigation equipment demonstration project in Shandong Province.

• JAPAN – Reclamation and the Public Works Research Institute are cooperating in the areas of water quality management to protect natural waters; reservoir operation methods for sustaining water quality and ecosystems; and watershed management planning.

Reclamation has routinely assisted water resource agencies of other countries by providing technical training programs for their personnel. Training programs are tailored to fit the specific needs that have been identified and they vary in length from two days to as long as one year. Most training programs combine office assignments and field visits or study tours to Reclamation offices; programs may also include classes at universities, visits to irrigation districts, and meetings with the private sector and non-governmental organizations. Reclamation typically develops training programs for more than 150 international trainees annually and costs for these programs are reimbursed to Reclamation. Reclamation also makes arrangements for the one-day visits of more than 800 international visitors annually; there is no charge for such programs. Finally, Reclamation organizes international workshops on various technical topics; in 2001, workshops are being offered on dam safety, integrated water resources management, and canal automation. Recent examples of training programs that have been offered include:

• AUSTRALIA – A training program relating to major regulated rivers was offered with coverage of the following topics: environmental management, operational procedures, water availability assessments, emergencies, modeling systems, and arrangements for water sharing.

• CHINA – A program for a Chinese group from the Mekong River Basin entailed an overview of Reclamation's management of the headwaters of the Colorado River, assessment of mechanisms for basin-wide coordination, and an evaluation of how impacts on downstream neighbors were addressed.

• INDONESIA – Reclamation offered a dam safety training program covering a variety of areas including the essentials of dam safety inspections, monitoring, and surveillance; construction techniques, materials, contracting and inspection; seismic design criteria; downstream hazard classification determination; and use and development of emergency preparedness plans.

Reclamation's international program has always been a dynamic one, and it is likely to remain so for the foreseeable future. With the recent change in administrations, there are likely to be new directions and different foreign policy priorities. In addition, other countries' issues with regard to water resources are continually changing, periodically resulting in requests for new training or technical assistance programs with Reclamation. In 2002, Reclamation will celebrate it 100th anniversary. Our history and the history of water resources-related activities in the American West are closely interrelated. As we move into the new Millennium, we anticipate that our international role in working with other countries to design management strategies to provide safe and sustainable water supplies will also continue to be an important part of Reclamation's mission.

Further information about Reclamation's current activities and history may be obtained from its website at http://www.usbr.gov.

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TOWARDS A WATER SECURE FUTURE: THE ROLE OF USAID IN WATER RESOURCES MANAGEMENT

Meg Findley, Morris Israel, and Christopher Scott

ABOUT THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

The U.S. Agency for International Development (USAID) is an independent federal government agency operating under the foreign policy guidance of the Secretary of State. With less than one-half of 1 percent of the federal budget, USAID works around the world on agricultural and economic development, democracy, enhanced human capacity through education, control of population growth, improved human health conditions, environmental conservation, conflict prevention, and humanitarian response to natural or man-made disasters. The agency takes a decentralized, bottom-up approach in providing assistance to developing countries.

USAID is headquartered in Washington, DC, but its strength is its field offices, or Missions, located in more than 75 countries with activities in over 100. USAID works closely with a vast array of partners, from host country governments to grass-roots organizations, private voluntary organizations, universities, American businesses, United Nations organizations, other governments, bilateral and multilateral donors, and other U.S. government agencies. USAID has working relationships with more that 3,500 American companies and over 300 U.S.-based private voluntary organizations.

The gradual warming of the Earth's atmosphere suggests that we are entering a period of increased frequency and severity of climate-related disasters such as drought, flooding, and catastrophic storms

USAID's origins go back to the Marshall Plan reconstruction of Europe after World War II and the Truman Administration's Point Four Program. In 1961, President John F. Kennedy signed the Foreign Assistance Act into law and created USAID by executive order. Since that time, USAID has been the principal U.S. agency to extend assistance to countries recovering from disaster, trying to escape poverty, and engaging in democratic reforms. Water resources management is an important part of maintaining each of these objectives and has always played a key role in USAID assistance abroad.

USAID's EVOLVING ROLE IN WATER RESOURCES MANAGEMENT

USAID's early involvement in water and water-related activities began in the 1960s with emphasis on irrigated agriculture, community water supply, and a handful of large dam construction projects. These early efforts were relatively capital and infrastructure intensive, and included, for example, investment in Egypt's Aswan Dam and Pakistan's Tarbela Dam. During the 1970s, the emphasis of USAID assistance shifted from dam construction towards community water supply and sanitation for health and increased assistance to water user associations and community organizations to improve service provision and civil society's role in the water sector. USAID responded to the International Drinking Water Decade in the 1980s with the implementation of the Water and Sanitation for Health (WASH) Program, which had as a major focus the improvement of child survival through clean drinking water supply, better hygiene, and enhanced wastewater treatment and sanitation.

USAID evolved in the 1980s, with some exceptions in the Middle East, away from infrastructure projects. Watershed management within forestry and/or agricultural contexts received increasing attention, as did industrial pollution prevention. In fact, environmental activities were seen as legitimate "development objectives" in and of themselves, and USAID began supporting coastal resources management in the mid-1980s for the first time. The increased focus on integrated water resources management (IWRM) in recent years reflects the growing consensus that access to adequate supplies of clean freshwater is paramount to addressing the challenges in sustainable development faced by the global community. IWRM is a participatory planning and implementation process, based on sound science, which brings together stakeholders to determine how to meet society's long-term needs for water and coastal resources while maintaining essential ecological services and economic benefits.

TODAY: USAID'S APPROACH TO INTEGRATED WATER RESOURCES MANAGEMENT

As part of the U.S. government effort to provide international leadership in advancing a holistic approach to water resources management, USAID is working to actively promote the concept of integration through a "blue revolution." The agency actively promotes linkages across various sectors, e.g., agriculture/irrigation, public health/water supply and sanitation, urban development, economic development, habitat protection and biodiversity (see text boxes). Increasingly, USAID is drawing on the water-related expertise of and partnering with other U.S. Government (USG) agencies, academia, private sector, and community-based organizations. Internally USAID has addressed cross-sectoral integration through the creation of an interdisciplinary Water Team (contact Alan Hurdus <alhurdus@usaid.gov>) with members from various agency units: environment, economic growth and

agricultural development, humanitarian response, and regional bureaus.

Three central elements are at the core of the USAID Water Team's activities:

1. Provide *technical and managerial assistance* to USAID country missions and partners to incorporate IWRM approaches in field programs and policies.
2. Provide *education and outreach* opportunities to missions and partners by producing and distributing information on relevant USAID, USG, and other donor capabilities in IWRM.
3. Provide *international leadership and coordination* within USAID, and vis-à-vis other USG agencies and donors, through exchange of lessons learned, development of universal guidelines, and adoption of IWRM practices by the wider development community.

USAID's PORTFOLIO OF WATER-RELATED PROGRAMS AND ACTIVITIES

USAID presently supports water-related activities in about one-third of the countries defined as water-short (see Figure 1). [Water-short countries are those with average annual water resources less than or equal to 1,700 cubic meters per person. Water shortage is based on estimates of a country's renewable freshwater supplies and does not include fossil groundwater or spatial or temporal variations in available water resources. Once a country experiences extreme water scarcity (less than 1,000 cubic meters per person per year), it can expect chronic shortages of freshwater that threaten food production, hinder economic development, and damage ecosystems.] Of the 48 countries projected to be water-short in 2025, USAID currently implements substantial water programs in at least 15. The degree to which countries and regions will face future water scarcity depends

Figure 1. Geographic Distribution of Current USAID Water-Related Activities. The countries on the map that have documented water-related obligations in the "Results, Review, and Resource Request Reports" (R4 reports), part of the Agency's annual reporting system, are as follows: Eritrea, Ethiopia, Guinea, Kenya, South Africa, Tanzania, Uganda, Bangladesh, Egypt, India, Indonesia, Jordan, Lebanon, Morocco, Nepal, Philippines, Israel (representing the West Bank/Gaza Mission), CAR countries, Bosnia-Herzegovina, Cyprus, Kosovo, Poland, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Panama, Paraguay, Mexico, Peru.

in large part on whether they face physical or economic water scarcity, and how equitably water is distributed among geographic areas and between the rich and the poor (Cosgrove and Rijsberman, 2000). While some countries may have sufficient water resources, they will need to finance significant storage, treatment, distribution, and other service infrastructure to avoid falling below the water shortage threshold.

Facing water shortage and water insecurity involve an integrated, multi-pronged approach with attention paid to the water resource base, its environmental underpin nings, human uses, impacts and outcomes in a range of sectors. While many current USAID water-related programs are sector-specific, IWRM elements are increasingly being integrated into these. Part of the new approach is to expand the scope of sector-specific activities. Historically, USAID has directed a considerable amount of resources towards various aspects of water management totaling at least $11 billion over the last 30 years. Meanwhile, the World Water Council estimates that $70-80 billion, excluding direct investment by industry, is invested each year to provide water services (Cosgrove and Rijsberman, 2000).

The following figures are based on USAID's current water-related investment portfolio, which is well over $350 million annually. Figure 2 shows the distribution of water-related expenditures by major activity areas.

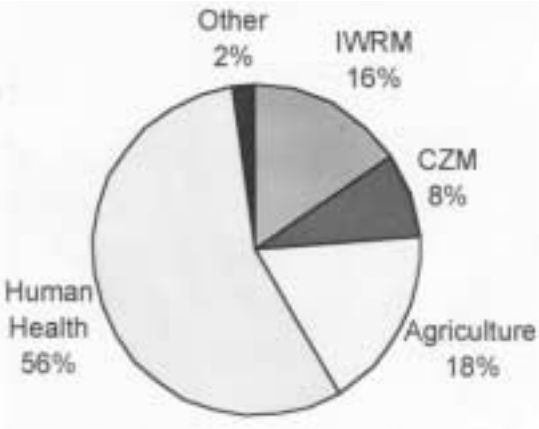

Figure 2. Distribution of USAID Expenditures for Water-Related Activities (FY 2000).

(Category definitions: Human Health – Drinking water supply, sanitation, wastewater treatment, and pollution prevention; Agriculture – Irrigation, water for livestock, and soil and water conservation; CZM – Coastal zone management and coral reef conservation; IWRM – Integrated Water Resources Management of ground water, surface water, and watersheds including water quality monitoring; equitable water access; planning and policy implementation; Other – Fisheries, aquaculture, aquatic biodiversity, aquatic ecotourism, disaster preparedness and drought/flood forecasting.)

The combination of the Middle East's strategic importance and the region's extreme water scarcity results in a large share of USAID's expenditures in water-related activities being directed to this region, as shown in Figure 3, which compares USAID water expenditures in Egypt, Jordan, and West Bank/Gaza with those in all other regions of the world combined.

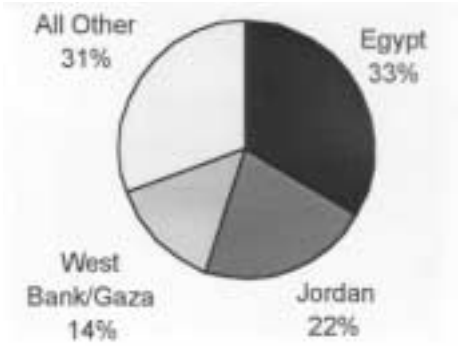

Figure 3. Middle East Focus of USAID Expenditures for Water-Related Activities.

USAID HELPS THE GLOBAL COMMUNITY FIND SOLUTIONS TO WATER RESOURCES MANAGEMENT CHALLENGES

The world human population has now passed 6 billion and is projected to increase to around 9 billion by 2050 (UNPD, 1998). Nearly all of the projected 3 billion or so people to be added over the next half century will be born in countries already experiencing water shortages (Brown, 2000a). To compound the pressure on available water resources, slightly less than one one-hundredth of 1 percent of the world's total supply of water is easily accessible freshwater; the world's water supply is for all practical purposes a finite resource. Various adaptive mechanisms have been put in place around the world to deal with water shortage, many with serious consequences of their own.

Ground Water – Its Use and Abuse

A significant proportion of global water supply exists as ground water. Ground water is a critical component of supply for cities, industries, and agriculture. And where it exists in accessible quantities, it is often preferred for its reliability in comparison to erratic surface supplies. Yet the depletion and pollution of ground water is identified by many professionals as the single greatest problem of water resources management for the coming century (Seckler *et al.,* 1999). Most solutions involve some combination of increased recharge rate, reduced pumping, increasing overall efficiency gains, and reducing or eliminating contaminant sources (Shah *et al.,* 2000). As with all other water resources management issues, however, active aquifer management must be undertaken through stakeholder participation and whole basin analysis based on projected demand. USAID is engaged in many activi-

ties around the world that will ultimately help protect ground water quality while ensuring reliable supplies. Many of USAID's IWRM programs in Morocco, Haiti, Jordan, and West Bank/Gaza include an aquifer management component. Specific attention to management of ground water resources is a relatively new area of emphasis for USAID, and it is anticipated that the agency will increasingly engage in ground water management activities over the next decade.

Integrated Activities Help Jordan Manage Scarce Water Resources for Multiple Sectors

Through integrated support from USAID's Improved Water Resources Management program, Jordan can help serve the needs of diverse stakeholders that rely on the country's extremely limited water resources. Water sector initiatives are strengthening public sector water institutions and key private-public partnerships, improving water use efficiency and the quality of treated wastewater so that it can be used for agricultural and industrial purposes, thereby increasing the quantity of fresh water available for human consumption in both rural and urban areas.

World Food Security Threatened By Growing Water Demands

Feeding the world's growing population will be severely challenged in coming decades by competition over increasingly limited water resources. On a global scale, irrigated agriculture accounts for just 17 percent of the total cropland area, yields 40 percent of agricultural output, and consumes nearly 70 percent of total developed water supply (Postel, 1998). Exactly how much water will be needed to meet projected food demand is not well understood, but studies suggest that at least 20 percent more irrigation water will be needed by 2025 (Postel, 1997). Meanwhile, aquaculture has become the fastest growing sector of the world food economy, and is now poised to overtake cattle ranching as a source of food by 2010 (Brown, 2000b). Aquaculture offers both benefits and constraints to the equation, producing "water efficient" fish while exacting a heavy toll on habitat and water quality, and increasing evaporative losses from freshwater ponds.

USAID works with other donors through the Consultative Group on International Agricultural Research promoting water-saving technologies and improvements in the construction, efficiency and delivery of irrigation systems. Millions of dollars were spent for the reconstruction of areas damaged by Hurricane Mitch throughout Latin America and the Caribbean, which included rebuilding many irrigation systems. Activities to protect agricultural production in general against future disasters are still underway in El Salvador, Guatemala, Nicaragua, and Honduras. USAID also supports activities in fisheries and aquaculture in countries such as Bangladesh, the Philippines, Kenya, and Colombia.

The Importance of Water Resources Management to Human Health

At any one time, around half of all people in developing countries suffer from one or more of the six main diseases associated with inadequate water supply and sanitation (United Kingdom Department for International Development, 1998). (The six diseases are diarrhea, ascaris, dracunculiasis, hookworm, schistosomiasis, and trachoma, and are transmitted to or between humans in a variety of ways, most of which relate to a lack of quantity or quality of water.) Total mortality and morbidity (sickness) can only be estimated, but 3-4 million people die each year of waterborne diseases, including 2 million children from diarrhea alone (Cosgrove and Rijsberman, 2000). When water shortages and unsanitary living conditions are added to the effects of polluted water, these factors are responsible for more than 12 million deaths worldwide each year. Also of recent but growing concern is the incidence of drinking water contaminated with a variety of man-made chemicals and heavy metals. The water resources management goal for human health is to deliver water, sanitation, and improved hygiene practices (i.e., education) as a package to communities. Water-related activities aimed at safeguarding human health are the largest group of USAID's water-related expenditures on an annual basis. Projects included drinking water supply, sanitation, wastewater treatment, and industrial pollution prevention and control activities. The lion's share of these projects are in the Asia and the Near East region, primarily in Egypt, Jordan, and West Bank/Gaza, but programs in water supply and sanitation are part of the portfolio in many countries in which USAID works.

Growing Urbanization Calls for New Approaches and Technologies

Cities account for just 2 percent of the planet's surface area, yet by 2005 they will be home to half of the world's population (Hinkel, 1999). The concentration of people and the increasing rate of urbanization place cities squarely in the center of the global water management challenge. Cities today account for 60 percent of all water allocated for domestic human use. The challenge of urban water management is multi-faceted, but often centers on the fact that cities, especially the growing number of megacities, simply do not have large enough surface water sources and ground water recharge areas within feasible proximity to sustain growing water demand. Poor or nonexistent planning compounds the urban water management problem. Integrated planning and water resources management, together with the use of new technologies for water supply, treatment, conservation, and reuse, offer the most viable options for meeting these otherwise daunting challenges. The bulk of USAID assistance in urban environments, both in terms of expenditures and geographic scope, is manifested in water supply, sanitation, wastewater treatment, and industrial pollution prevention and control activities aimed at improving human health.

Coastal Zone Management and Coral Reef Conservation

Two-thirds of the world's population is found within 250 miles of a coast (Hinrichsen, 1998). Of the world's 15 largest cities, all but two are located on coasts. Coasts contain some of the planet's most biologically productive habitat, and in turn support a disproportionate amount of economic output per unit area. Yet as stewards of the earth's coastal zone, we undermine our own efforts with widespread habitat loss, overharvesting, destructive fishing, and failures to address land based sources of marine pollution. Half of the world's wetlands were destroyed in the 20th century, and 25 percent of coral reefs have now been lost. Coral reefs play a critical but often undervalued role in the sustainable development options for coastal residents throughout the world, yet are becoming increasingly vulnerable to a combination of direct human impact and the effects of global warming. By late 2000, 27 percent of the world's reefs had been "effectively lost," a 17 percent increase in just 8 years (Wilkinson, 2000).

Through the process of integrated coastal management, sustainable development in coastal areas can be effectively tackled at the ecosystem scale, with strong emphasis on water resources management. It is ultimately about forging the right balance between competing human uses of water and natural resources, while ensuring that environmental health and productivity are not compromised in the long term. Many of USAID's coastal activities are implemented through a cooperative agreement with the Coastal Resources Center at the University of Rhode Island (http://www.crc.uri.edu/). The USAID-URI partnership promotes improved processes of governance, participation, and stewardship toward the management of multi-sectoral activities within the coastal zone and surrounding watersheds in such countries as Tanzania, Mexico, Indonesia, Egypt, and Jamaica. USAID is a leader in promoting a major global effort aimed at coral reef conservation, the International Coral Reef Initiative.

Unprecedented Losses to Aquatic Biodiversity

The world's freshwater ecosystems – lakes, rivers, and wetlands – are showing signs of pollution and overexploitation, and freshwater biodiversity is suffering unprecedented loss as a result. Humans already use more than half of all available freshwater supplies for agriculture, industry, and domestic use. But that figure is growing, and it is estimated that by 2025 human use of the planet's total available freshwater may exceed 70 percent (Postel, 1998). Growing human demand often means less freshwater to sustain instream flows needed to support healthy biota. The core of any management efforts must emphasize recognizing and sustaining freshwater ecosystem values and services as the foundation for further effort at water resources management and sustainable development. USAID water resources and biodiversity specialists work on a variety of critically threatened aquatic wetlands and ecosystems around the world. USAID's approach to sustainable development and aquatic biodiversity is largely focused on the conservation of aquatic habitats, thereby protecting all of the species residing within the ecosystem.

Disaster Preparedness and Global Climate Change

The gradual warming of the Earth's atmosphere suggests that we are entering a period of increased frequency and severity of climate-related disasters such as drought, flooding, and catastrophic storms. Record losses from weather-related disasters were incurred in 1998 when more than $90 billion in economic losses were tallied from storms, floods, droughts, and fires worldwide, exceeding the $55 billion in losses for the entire decade of the 1980s (Hinrichsen *et al.*, 1998). Forests and wetlands are needed to absorb and slow floodwaters, yet on a global scale these resources are disappearing at alarming rates. Climate change will potentially affect the geographic location of ecosystems, the structure and function of their biological communities, and thus, their ability to provide ecological goods and services. Semi-arid regions are in turn likely to become more vulnerable to drought and/or flood-drought cycles that will similarly necessitate stepped-up efforts at integrated water resources management at the river basin scale. Such change could have equally serious implications for future water supply. On the vulnerability and adaptation side of the global climate change challenge, water resources managers must begin work on many fronts to ensure that the economic and land-use policies and conditions are in place to guide appropriate private-sector investment and resource use patterns. USAID works jointly with the National Weather Service (NOAA) and the U.S. Geological Survey (USGS) to help countries establish monitoring systems to help forecast extreme events. These activities also included vulnerability assessments and the formulation of mitigation plans aimed at saving lives and money in the face of future drought and storm events. Important recent or ongoing examples of USAID support in this area include Central America, devastated by Hurricane Mitch, and Mozambique, hit hard by floods in two successive seasons.

Upper Watershed Management Ensures Proper Functioning of the Panama Canal

Numerous studies, including one conducted by USAID, have demonstrated the link between the environmental protection of the Panama Canal Watershed and the effective long-term operation of the Panama Canal. Efficient operation of the Panama Canal relies on the water from the 326,000-hectare watershed, as each ship passage requires 52 million gallons of fresh water. USAID promotes institutional strengthening, public education, and support for municipal governments in the areas of sustainable forest management practices in the upper watershed as well as water quality monitoring to help assure the availability of adequate volumes of water for canal operations by minimizing sedimentation and drainage of contaminants into the Canal.

Women and the Poor : The Most to Lose and the Most to Gain From Effective Water Resources Management

In many developing countries, men and women manage water resources very differently, based on cultural differences in gender roles, and therefore access to clean water and sanitation directly affects the well-being of girls and women. Time spent fetching water and caring for sick children is lost to more productive activities, and girls often stay out of school because of such duties. Girls' enrollment and attendance in school are negatively affected by poor sanitary conditions. When attention to gender is incorporated into development projects, the outcome should not be assumed to be projects specifically designed for women beneficiaries. Rather, the emphasis should be on ensuring that projects are not targeted towards activities predominantly affecting men; in these cases, gender analysis can ensure that women are not left out of the equation for the equitable allocation of water resources. USAID urges its program managers to be aware that their activities may have significant differential effects by social group and watch to ensure that neither women nor men are disproportionately affected. The integrated water resources management plans in Morocco and El Salvador serve as good examples of how attention to gender issues can enhance crosscutting linkages across a broad development portfolio.

Morocco Adopts an IWRM Approach That Works

The economy of Morocco depends heavily on agriculture, so plans for economic growth and modernization are hostage to rainfall patterns and the way water is managed in aggregate. On the human level, inadequate supplies of potable water and sanitation are major household burdens and cause disease. To alleviate this constraint to prosperity and social development, USAID/ Morocco has worked since 1995 to improve water resources management in the agricultural, urban and industrial sectors. Current activities include:

(1) Support for the creation and institutional development of a basin agency to manage water resources in the Souss Mass River Basin in southern Morocco.

(2) Improving watershed management through community-based erosion control programs, benefiting farmers and urban water users downstream.

(3) Improving water quality by treating urban and industrial pollutants.

(4) Providing water, sanitation, and municipal services in fast-growing towns and cities, benefiting the urban poor.

(5) Training municipal officials in financial management and environmental planning, benefiting urban residents through better governance and service delivery.

Transboundary Waters: A New Concern for Global Security?

The global water management challenge is complicated by the fact that nearly half of the world's population lives within some 300 river basins shared by two or more countries. In the face of growing demand and increasing water scarcity, dependence on shared river basins and aquifers suggests urgency in the need to forge international agreements on the management and allocation of these shared resources. Water ignores political boundaries, and even where a watercourse serves to delineate sovereign states, we must work to promote whole basin management based on ecosystem principles. Global security demands that we must hold basin management as a common goal for regional cooperation, ensuring that upriver riparians do not deprive downriver riparians of water access in terms of quantity or quality.

There are plenty of examples to illustrate how transboundary water resources can engender tension, yet also rally cooperation. India and Bangladesh have quarreled over allocation rights for the Ganges. The Jordan River basin plays a huge role in peace talks between Israel and the Palestinians. Egypt fears overuse of the Nile by upstream Sudan and Ethiopia. Turkey's damming and irrigation schemes on the Tigris and Euphrates are felt as threats by Syria and Iraq downstream. In fact, over 90 percent of Middle East water resources are transboundary, while Africa alone contains over 60 international rivers (Cosgrove and Rijsberman, 2000). Every major river is transboundary in Southern Africa, a region where at least four countries will face serious water shortages within 30 years (Cosgrove and Rijsberman, 2000).

There have been many important developments in recent years in the bilateral, regional, and international management of transboundary water resources. India has concluded significant agreements with neighboring states, including its signing of the Ganges Treaty with Bangladesh, followed by agreements with Nepal and Pakistan on the Mahakali and the Indus basins respectively (Salman and de Chazournes, 1998). However, the absence of a comprehensive set of international legal norms has complicated the task. In 1997 the U.N. General Assembly ratified the Convention on the Non-navigational Uses of International Watercourses, but the general legal principles it contains offer few practical guidelines for how to approach water allocation among riparians, the central issue in most water conflict (Wolf, 1999). Nevertheless, a growing body of experience suggests that cooperation, rather than conflict, is the norm, and that the building of trust and confidence among sovereignties is central to managing conflict.

Competing demand between sovereign states typically calls for the establishment of a watershed or basin commission tasked with planning and management authority and comprising multiple parties and stakeholders. While water quantity is often the major issue, it is often more politically astute to focus early attention on water quality and ecosystem management issues for which consensus may be easier. The commission should work to ensure that its members develop a common understanding of the basin's historical, present, and projected future hydrology, while recognizing that land and water resource management must go hand-in-hand. The goal is to develop a multi-sectoral, integrated planning system based on sound science, information sharing, transparency, and decision-making rules that are clear and explicitly understood by all parties (Cosgrove and Rijsberman, 2000).

Central Asian Republics Collaborate on Aral Sea Basin Water Resources Management

USAID works with the Central Asian Republics on the improvement of management capacity to address environmental issues in the Aral Sea Basin. Activities concentrate on the management of Aral Sea tributaries, global climate change, and the protection of the Caspian Sea environment from petroleum sector exploration. USAID provides assistance to establish water user associations and to improve water pricing and privatization of local water use rights, water quality, waste management guidelines, pollution fines systems, and multipurpose (power vs. irrigation) management of dams (including water sharing). Accomplishments over the past year include:

(1) Establishment and training of an expert group on modeling for optimal water resource use decision-making in the Aral Sea basin.
(2) Training of water officials to assess, calculate, and recover operation and maintenance costs for hydroelectric facilities.
(3) Formation of an initial working group to assist in the development of water quality standards.
(4) Assessments of the strength of Water User Associations and the state of legal and regulatory legislation in each Central Asian republic.

USAID is engaged in transboundary management of coastal areas and river basins in several regions around the world: the Central Asian Republics, Southern Africa, the Belize-Mexico border, Central America (Rio Lempa and the Gulf of Fonseca), and the Caucasus. Future effort is expected to grow in this area of water resources management for the agency as new projects are currently under planning and consideration. For example, a design team planned a transboundary water management activity in the Trans-Caucasus Region, including Georgia, Armenia, and Azerbaijan. The activity focuses on promoting cooperation and building capacity for water management in the Aras and the Kura River Basins. In addition to activities directed at specific regions around the world, USAID is a leader in representing transboundary issues at major international fora such as the World Water Forum with other donor countries and institutions.

USAID Helps Raise Awareness and Commitment to Transboundary Water Resources Management at the 2nd World Water Forum

The United States announced the launching of the multi-donor collaborative effort in transboundary water resources management, the Global Alliance for Water Security for the 21st Century, at the 2nd World Water Forum and Ministerial Conference in The Hague, The Netherlands, in March 2000. Hosted by the World Commission on Water for the 21st Century and the Dutch government, the conference brought together high ranking government officials, water professionals, the business community, NGOs and international organizations from more than 140 countries to discuss and reach consensus on the key elements of a World Water Vision and a Framework for Action. The 3rd World Water Forum is scheduled for 2003 in Japan.

FUTURE DIRECTIONS

Lessons from past experience and a recent analysis and evaluation of USAID's water portfolio reveal several principles that lead to greater effectiveness in water resources management:

1. An integrated, cross-sectoral, and participatory approach is the preferred strategy for successful water resources management in the long-term.
2. Sound science, including the determination of water budgets at the river basin scale, should be used as the basis for water resources management.
3. Water resources must be managed at the appropriate scale (either basin or subbasin) and level (international, national, provincial, or local) to ensure ecosystem integrity and international cooperation over shared resources.
4. Participatory planning and transparent decision-making should be instilled to enhance political will, self-reliance, and stewardship by relevant stakeholders.
5. Water should be treated as both an economic good and a basic human need, towards the goal of full cost recovery for water services with targeted subsidies for the poorest of the poor.
6. Countries should be encouraged to adopt the "users and polluters pay principle."
7. Water allocation mechanisms must increasingly encompass environmental as well as human use values.
8. Infrastructure and water service delivery should be demand-driven and service oriented, with every opportunity explored for public-private partnerships.

Global consensus has emerged that the integrated approaches promoted through IWRM offer the best hope for achieving greater effectiveness, efficiency, and sustainability in water resources management. The approach helps to protect the world's environment, foster economic growth and sustainable agricultural development, promote democratic participation in governance, and improve health.

USAID recognizes that water for multiple human and ecosystem requirements must be managed in an integrated manner. The prevailing sectoral focus needs to incorporate other approaches, including better governance, participatory planning and implementation, and private-public partnerships. While the challenge is great, so are the opportunities.

LITERATURE CITED

Brown, L.R., 2000a. Population Growth Sentencing Millions to Hydrological Poverty. Worldwatch Issue Alert (June). Worldwatch Institute, Washington, DC. *Available at* http://www.worldwatch.org/chairman/issue/000621.html *assessed* June 26, 2001.

Brown, L.R., 2000b. Fish Farming May Soon Overtake Cattle Ranching as a Food Source. Worldwatch Issue Alert (October). Worldwatch Institute, Washington, DC. *Available at* http://www.worldwatch.org/chairman/issue/001003.html *assessed* June 26, 2001.

Cosgrove, W.J. and F.R. Rijsberman, 2000. World Water Vision: Making Water Everybody's Business. Report prepared for the

World Water Council. London, Earthscan Publications, Ltd., 108 pp. *Available at* http://www.worldwatercouncil.org *assessed* June 26, 2001

Hinkel. R., 1999. Coastal Megacities and Sea-Level Rise. Trends and Future Challenges for U.S. National Ocean and Coastal Policy (January 22), Washington, D.C.

Hinrichsen, D., 1998. Coastal Waters of the World: Trends, Threats, and Strategies. Island Press, Washington, D.C., 298 pp.

Hinrichsen, D., B. Robey, and U.D. Upadhyay, 1998. Solutions for a Water-Short World. Population Reports, Series M, No. 14. Johns Hopkins University School of Public Health, Population Information Program, Baltimore, Maryland.

Postel, S., 1997. Last Oasis: Facing Water Scarcity. Norton and Co., New York, New York, 239 pp.

Postel, S., 1998. Water for Food Production: Will There Be Enough in 2025? BioScience 48(8):629-637.

Salman, S.M.A. and L.B. de Chazournes (Editors), 1998. International Watercourses: Enhancing Cooperation and Managing Conflict. World Bank Technical Paper 414.

Seckler, D., D. Molden, and R. Barker, 1999. Water Scarcity in the Twenty-First Century. International Water Management Institute, Water Brief No. 1.

Shah, T., D. Molden, R. Sakthivadivel, and D. Seckler, 2000. The Global Situation of Groundwater. International Water Management Institute.

United Kingdom Department for International Development, 1998. Guidance Manual on Water Supply and Sanitation Programmes. Department for International Development, United Kingdom.

UNPD (United Nations Population Division), 1998. World Population Prospects: The 1998 Revision. 1. United Nations Population Division, New York, New York.

Wilkinson, C. (Editor), 2000. Status of Coral Reefs of the World: 2000. Report of the Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Cape Ferguson, Queensland, Australia.

Wolf, A.T., 1999. Water and Human Security. Aviso 3 (June), Global Environmental Change and Human Security Project, Woodrow Wilson Center, Washington, D.C.

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WATER RESOURCES IMPACT

A GLOBAL INITIATIVE FOR HYDRO-SOCIO-ECOLOGICAL WATERSHED RESEARCH

Theodore A. Endreny

Clean and plentiful freshwater sustains our global environmental and social economies, but the threat that current water quality and quantity problems will likely worsen has prompted the United Nations (U.N.) to identify water as "the most critical environmental issue of the 21st Century" (Bonell and Askew, 2000). The most basic water science, the hydrological cycle, speaks to the complexity of managing this life-giving resource that traverses the litho-, hydro-, bio-, and atmospheres of the globe at various rates, each increasingly impacted in volume and quality by human behavior. To protect against global water shortages and/or contamination, the multiple sociologic and ecologic issues within the water cycle need attention, and management plans hoping to achieve hydro-socio-ecological-sustainability will hence require participation from an experts skilled in each of these subgroup areas. According the U.N., the time has come for hydrologists of physical and biological training and desirous of meaningful work to reconnect with colleagues that are policy makers and lawyers, environmental managers, members of citizen groups, and most importantly, watershed residents.

Mindful of the suggestive power in an acronym, the Hydrology for Environment, Life, and Policy (HELP) Initiative grew out of a joint meeting of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and World Meteorological Organization (WMO) to assist in creating hydro-socio-ecological management plans. The HELP Initiative was designed to combine advanced experimental hydrologic research with the most pressing sociologic and ecologic demands for water resource management and policy, creating for the first time a global hydrology program that was purely socio-ecologic needs driven. After nearly two years of preparatory work, dealing with the details of fitting HELP into a crowded U.N. agenda, both UNESCO and WMO are now ready to select approximately 10 pilot basins, within which HELP will develop management plans for water, and five themes, which include: (1) climate, (2) food, (3) pollution and human health, (4) environment, and (5) conflict.

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Prior to setting a course for socio-ecological needs driven watershed research, the U.N. identified the following obstacles to implementation of sustainable water management plans: (1) a lack of global demonstration watersheds that show how appropriate hydrological practices can protect social and environmental resources (see Anderson, 2001, for a discussion of the many international programs that address the separate issues of sociology, ecology, and hydrology); (2) a lack of coordination in dialogue between countries and basins for sharing lessons learned (see Sklarew *et al.*, 2001, for an internet initiative addressing this concern); (3) a decline in national programs of field-oriented water quality and quantity monitoring and research (see Fraser *et al.*, 2001, in their discussion of how the U.N. GEMS/Water program has addressed this same trend); and (4) a paradigm lock that has traditionally delayed the implementation of hydrologic discovery to the benefit of society because scientists do not grasp what water users and managers require and managers do not grasp what scientific alternatives are available (see Figure 1). The design of the HELP Initiative responds directly to these obstacles and the looming global water scarcity and quality crisis.

THE COMPONENTS OF HELP

Goals, Outcomes, and Funding of HELP

Most fundamentally, the HELP Initiative is about (1) meeting basic human needs through sustainable freshwater resource development; and (2) creating socio-economic and ecologic benefits to watershed residents and stakeholders through sustainable, integrated water use management, and advanced hydrologic research. To achieve these very important outputs, the HELP Initiative intends to support the development of new data sets and watershed management models that assist watersheds achieve sustainability. Funding for this program is limited, providing just enough support for the directors of science, water policy, and water resource management of a project to review, oversee, and partially coordinate HELP basin fieldwork, to meet with technical advisory panels, and for other task force operations. Direct funding for implementation of management plans within each HELP basin will need to come from other sources, most likely from within the host country.

Themes, Issues, and Criteria for HELP

The HELP Initiative has solicited participation from basins where the science of process hydrology can bring significant benefits to multiple issues involving water law and policy, water resources management, and ultimately, stakeholder needs, specifically around the five themes

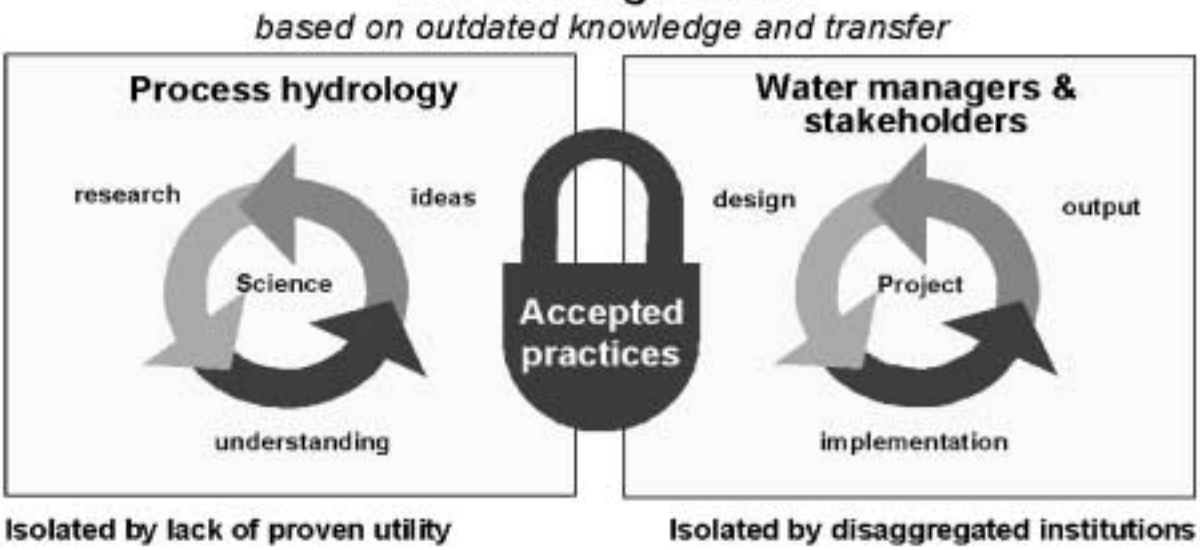

Figure 1. Illustration of HELP Paradigm Lock (where scientists do not grasp or research the critical management questions and policy makers do not ask for the latest scientific theory that could aid management).

of climate, food, human health, environment, and conflict.

When these issues are integrated within the basin, its physical size is of little concern. HELP recommends that several basic issues exist for a basin to qualify for inclusion within the Initiative, yet the initiative recognizes that issues will vary with global location. The general issues addressed by HELP projects are:

- Threats to sustainability
- Impact of global-scale problems
- Transboundary aspects
- Long-term trends
- Ecological damage
- Social and political impacts
- Economic growth or decline
- Population pressure
- Risks to human health
- Potential for improved management

Once a basin proposed for inclusion in the HELP Initiative has satisfied the conditions outlined above, it must meet five criteria established by the U.N.:

- Provide an opportunity to study a water policy or management issue for which hydrological process studies are needed.
- Provide a cooperative relationship between relevant national and local agencies and the execution of the HELP program to ensure sustainability of technology transfer.
- Provide adequate local capacity to participate in the program.
- Provide monitoring of a minimum range of key variables and parameters.
- Provide data, information, and technological expertise that are shared openly and adhere to international data standards as well as quality assurance and quality control standards.

Most critical to the above list of requirements are the second and fifth factors, which address the issues of getting support to launch the program, and then taking time to share the results with other basins that were unable to participate in the HELP Initiative.

The Environment, Life, and Policy of the HELP Initiative

A method to determine whether a basin should consider participation in the HELP Initiative involves asking if the hydrologic sciences can simultaneously, and in an integrated fashion, improve the watershed's environmental function, human standard of living, and water policy and management. These three components, environment, life, and policy, must lend themselves to cooperate with hydrology, prodding the hydrological scientists, to consider new monitoring, tools, and models that address the complexity of sociologic and ecologic interactions within bounds of water policy and the principles of sustainable management. Further, the presence of a cooperative, inter-disciplinary group of water scientists, water policy makers, and water managers is the litmus test to examine whether the infrastructure is in place for HELP participation.

Guidelines for Participation in HELP

While the HELP guidelines provide a statement of themes, issues, and criteria for participation in this hydro-socio-ecological initiative, many potential participants may want an example of how to get started on the process. The HELP Initiative provides a set of seven steps that were partly completed by the Motueka Watershed in New Zealand, where the organizational planning that linked watershed environment and social needs preceded fieldwork by nearly two years. The suggested steps to integrate sociologic and ecologic issues into an advanced hydrological research initiative include:

- Form an interdisciplinary team of scientists, policy makers, and managers.
- Consult with relevant, interested stakeholder communities to identify key real-world issues prior to the planning.
- Determine tractable issues given consideration of current scientific methods, tools, laws, and culture.
- Identify conceptual models describing how catchment-scale mechanisms operate, interact and exert downstream effects.
- Team gather historic information on climate, land use, social/economic change to help check model predictions using past conditions and predict future states of the catchment.
- Formalize conceptual models into mechanistic simulation models appropriate for integrated management use.
- Explore alternate management decisions to obtain hydro-socio-ecologic sustainability.

Pilot Basin Nominations for HELP Participation

Nominations for Pilot HELP basins have been solicited for participation in this initiative with the aim of creating a global network of experimental hydrological catchments representative of many climates, cultures, and hydrologic, ecologic, and sociologic needs. Table 1 lists the basins that have expressed interest in participating in the HELP Intiative.

In June 2001, the HELP Interim Management Committee (IMC) met in Wallingford, U.K., to provisionally classify the nominated basins based on the application demonstrating stakeholder involvement, focus on HELP issues, meaningful and achievable activities, and agency support. The IMC analyzed these nominations noting their strengths and weaknesses and the degree to which the basin programs conformed to the concepts of HELP and grouped the nominations into three categories:

- Operational HELP Basin – Management in an operational basin has implemented the HELP philosophy of an active interface between management, science and society and is functioning to integrate a number of the HELP themes and issues.

- Evolving HELP Basin – An evolving basin has expressed a clear intent to manage a basin following the HELP philosophy and has a comprehensive project plan that includes the participation of HELP stakeholder groups in basin management. Budgetary support is available and the management program is awaiting implementation. One year after implementation of the project plan, the basin may be designated an operational basin.

- Proposed HELP Basin – A proposed basin has achieved initial operational activity and has just begun the process of involving stakeholders and identifying key HELP issues. In some cases, more information is needed to determine its status.

A goal of the process is to identify from among the "operational" basins a select number that are provisionally designated "World Reference HELP Basins." These basins will serve as examples of best management practices. Of the 24 nominated basins, none were considered at the quality of a "reference" basin, but four received a ranking of "operational," 14 were ranked as "evolving" and six were considered "proposed," indicating that additional information was needed. Table 1 reports these rankings.

While certain areas are possibly underrepresented in Table 1, such as central Asia and Africa, the HELP Initiative is open to future basin participants. After the pilot basins have had a chance at fine-tuning the HELP program, which will take at least one year after their anticipated selection during the summer of 2001, nominations for additional basins will be solicited.

THE ROLE FOR HELP IN THE U.S.

Threats and Benefits of the HELP Initiative

Threats to the five HELP themes of watershed sustainability are present globally, even in countries with more developed environmental management programs, yet management programs in these countries may view the HELP Initiative as a burden because it introduces additional work that is un-funded. In instances where functional watershed management agency relationships exist, such as those practiced by the U.S. Environmental Protection Agency and Environment Canada within the Great Lakes, HELP would not create new burdens, but rather encourage programs to strive for the more challenging goals of hydro-socio-ecological sustainability. Benefits of the Initiative might be altruistic, such as working toward improvements in social and ecological systems, and sharing lessons learned with other needy basins. Benefits can also accrue directly to the watershed project. These might include:

- Using the U.N. HELP endorsement to garner addition-al funding for a novel research initiative.
- Pushing science, policy, and management members of watershed teams to reexamine perceived limits and consider new practices.
- Benefiting from the outside review of the UN as an independent assessor on the sustainability of a watershed management plan.

TABLE 1. Listing of Countries and Basins That Have Submitted Applications for Inclusion in the HELP Initiative.

Country or Countries	Basin	Preliminary Designation
Australia	Mount Lofty Ranges Basins	Operational
Australia	Murray Darling River Basin	Proposed
Brazil	Jua and Branco River Basins	Evolving
Cambodia, Thailand, Viet Nam	Lower Mekong Basin	Evolving
China	Tarim River Basin	Evolving
Germany	Spree-Havel River Basin	Proposed
Germany and Austria	Upper Danube Basin	Evolving
Japan	Yasu	Proposed
New Zealand	Motueka River Basin and Tasman Bay	Operational
India	Subernanekta River Basin	Evolving
Panama	Panama Canal	Evolving
Peru	Jequetepeque River Basin	Evolving
Puerto Rico	Luquillo Mountain Basins	Proposed
South Africa	Olifants River Basin	Evolving
South Africa	Thukela River Basin	Evolving
Sri Lanka	Walawe River Basin	Evolving
Tajikistan, Uzbekistan, Turkmenistan, Kyrgyzstan, and Kazakhstan	Aral Sea Basin	Evolving
United Kingdom	Thames	Evolving
United Kingdom	Upper Severn	Evolving
United States and Canada	Lake Ontario Basin	Operational
United States and Mexico	San Pedro River Basin	Evolving
United States (New York and New Jersey)	Hudson River Basin	Proposed
United States (Oklahoma, Colorado, New Mexico, Kansas, Texas, Missouri, Arkansas, Louisiana)	Red Arkansas River Basin (with Little Washita River focus)	Operational
United States (Washington)	Yakima River Basin	Proposed

- Accessing the HELP forum to learn helpful lessons from other basins that faced a similar problem.
- Revitalizing efforts to include all stakeholders in watershed management planning.

Demonstration and Learning Basins in the U.S.

Numerous successful watershed management plans have been coordinated among U.S. and Canadian hydrologists, water policy makers, and water resource managers within the Great Lakes basin. These lakes represent nearly 20 percent of the global surface freshwater supply, have nurtured agricultural, fishing, industrial, and post-industrial economies, have suffered from pollution by metals, organics, chemicals, nutrients, sediments, and exotics, and have benefited from advanced scientific methods, political stability, public participation, and the financial resources that have enabled plans to be implemented (Fuller and Shear, 1995). Taken altogether, these factors suggest that many lessons from the Great Lakes could be shared with, or demonstrated within, the HELP basin community. At the same time, new problems arise, such as predicted water level changes caused by climate change and invasive species arriving in boat ballasts, which will require new management strategies and lessons, suggesting that the Great Lakes could serve both as a learning and demonstration basin. Given the size of the Great Lakes basin, which extends through numerous states and provinces, it was determined that by focusing on the 90,000 km^2 Lake Ontario basin and the 18,000 km^2 lake, the receiving body for the four upgradient lakes, the hydro-socio-ecological issues remained mostly the same and the management coordination of the basin study became less complex.

INTERNATIONAL LAKE MANAGEMENT STRUCTURE

Cooperative international management of Lake Ontario reaches back to the beginning of the 20th Century. In 1905 the International Waterways Commission was created to advise both Canada and the U.S. about water levels and flows in the Great Lakes, particularly in relation to hydropower development. In 1909 the Boundary Waters Treaty was signed, creating the International Joint Commission (IJC) management authority. The IJC's authority includes resolving transboundary water resource disputes through scientific and policy analysis performed by numerous affiliated scientists and governmental agencies (Galloway and Clamen, 2001). While water quality management has become a focus of IJC activity beginning in the late 1960s, it could be argued that the Great Lakes have only recently been host to comprehensive socio-ecological studies that address the HELP socio-ecologic themes of sustainability. For example, the Lakewide Management Plans (LaMPs) that are commissioned by the IJC (IJC, 1999) begin to integrate hydrology, life, and environment and could serve as a template for future HELP Initiative projects. Donahue *et al.* (2001) discuss another potential integrative success in the Great Lakes, which is the creation of a new U.S.-Canadian team to address how management of water levels to meet human needs impacts ecological systems, and then potentially explore innovative hydraulic and hydrologic management alternatives.

SUMMARY

The HELP Initiative is an exciting opportunity for hydrologists tired of operating without inputs from ecological and social user groups. The program presents hydrologists with a new audience of users, potentially breaks open the paradigm lock, and asks that they demonstrate how new technologies and theory can help achieve socio-ecologic sustainability. Although seemingly trivial, given the presence of water data on the Internet (see Donahue *et al.*, 2001, on the Great Lakes Informa-tion Network), a major concern for U.S. participation in the HELP Initiative may be the difficulty in providing a single and comprehensive clearinghouse for pertinent hydro-socio-ecological research results. Use of common scientific literature search engines for keywords "Lake Ontario" and each of the HELP issues and themes resulted in fewer than 100 articles. This surely does not represent the numerous studies available for demonstration.

Additional information on the HELP Initiative may be obtained at http://www.unesco.org/science/help.

ACKNOWLEDGMENTS

The author first thanks the Great Lakes Research Consortium for funding that supported a review of the HELP Initiative and the nomination of the Lake Ontario Basin as a potential HELP demonstration site. Second, thanks to all those scientists, policy makers, and water resource managers interested in furthering this discussion.

LITERATURE CITED

Anderson, F., 2001. The Internationalizing World of Water Management, Water Resources Impact 3(2): 3-8, 2001. *Also available at* http://www.awra.org/impact. *Accessed* June 20, 2001.

Bonell, M. and A. Askew (Editors), 2000. The Design and Implementation Strategy of the Hydrology for Environment, Life and Policy (HELP) Initiative. HELP Task Force, UNESCO, Paris, France, 67 pp. *Also available at* http://www.nwl.ac.uk/ih/help/help_documents.html. *Accessed* June 20, 2001.

Donahue, M., T. Crane, and C. Manninen, 2001. A Water Resources Management Decision Support System for the Great Lakes: International Water Issues on the U.S.–Canadian Border. Water Resources Impact3(2): 16-19. *Also available at* http://www.awra.org/impact. *Accessed* June 20, 2001.

Fuller, K. and Harvey Shear (Editors), 1995. The Great Lakes: An Environmental Atlas and Resource Book (3rd Edition). U.S. Environmental Protection Agency, Great Lakes National Program Office, EN40-349/1995E, Chicago, Illinois.

Fraser, A., R. Dobarts, and K. Hodgson, 2001. The United Nations Environment Programme Global Environmental Monitoring System/Water Programme. Water Resources IMPACT 3(2):26-28. *Also available at* http://www.awra.org/impact. *Accessed* June 20, 2001.

Galloway, Jr., G. and M. Clamen, 2001. The International Joint Commission: A Model of Cooperation in Dealing with Boundary Water and Transboundary Environmental Issues. Water Resources IMPACT 3(2):12-15. Also available at http://www.awra.org/impact. *Accessed* June 20, 2001.

International Joint Commission (IJC), 1999. International Joint Commission Lake Ontario Stage I Lakewide Management Plan Review. International Joint Commission (October 4, 1999), 11 pp. Also available at http://www.ijc.org/comm/lostage1.html. *Accessed* June 20, 2001.

Sklarew, D., S. Annis, J. Mendler, and M. Hamid, 2001. Forging a Global Community to Address International Waters Crises: The IW:LEARN Project. Water Resources IMPACT 3(2):20-25. *Also available at* http://www.awra.org/impact. *Accessed* June 20, 2001.

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WATER RESOURCES IMPACT

INTERNATIONAL WATER LAW FROM HELSINKI RULES TO THE UNITED NATIONS CONVENTION ON THE LAW OF THE NON-NAVIGATIONAL USES OF INTERNATIONAL WATERCOURSES

Khaled Abu-Zeid

INTRODUCTION

The potential for water conflicts over transboundary waters is high, especially in times of scarcity. There are more than 300 major river basins, covering about 50 percent of the total land area of the Earth. Many of these river basins cross country borders, even more so today due to the break up of the Soviet Union and Eastern Europe (Sherk *et al.,* 1998). These basins include the Nile River, with 10 countries sharing the basin, and the Danube River, shared by 17 countries. The need for an international law to govern the equitable sharing of water resources between countries emerged long ago. Efforts on the professional, nongovernmental, governmental, and intergovernmental levels have been exerted to achieve such law. The most important outcomes of these efforts are the two frameworks given by the 1966 Helsinki Rules and the 1997 United Nations (UN) Convention. This article presents a comparison of some guidelines provided in the two frameworks and lays the ground for further development that may be needed to achieve a comprehensive international law for the equitable utilization of international water resources.

The International Law Association (ILA), a nongovernmental organization founded in 1873, has a consultative status with a number of U.N. agencies. ILA's work on international water law began in 1954. The general principle of ILA's work is contained in Article IV of the 1966 Helsinki Rules (ILA, 1967), which state that the equitable utilization principle governs the use of international drainage basin waters. The Helsinki Rules have played an important role in the codification and progressive development of this branch of international law (Bourne, 1998). States refer to these guidelines to the present day and some countries have recommended that elements of the Helsinki Rules be incorporated into the U.N.'s framework convention on watercourses that was later developed in 1997.

The need for an international law to govern the equitable sharing of water resources between countries emerged long ago; efforts on the professional, nongovernmental, governmental, and intergovernmental levels have been exerted to achieve such law

In the late 1960s, the U.N. decided to assign the international water law topic to its International Law Commission (ILC) for detailed study. In May of 1997, after more than quarter of a century of working on the topic, the U.N. General Assembly adopted a framework convention on the Law of the Non-Navigational Uses of International Watercourses.

The U.N. Convention (United Nations, 1997a) was adopted by a recorded vote of 103 in favor, 3 against, and 27 abstentions, as follows:

In Favor: Albania, Algeria, Angola, Antigua and Barbuda, Armenia, Australia, Austria, Bahrain, Bangladesh, Belarus, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Cambodia, Cameroon, Canada, Chile, Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Djibouti, Estonia, Federated States of Micronesia, Finland, Gabon, Georgia, Germany, Greece, Guyana, Haiti, Honduras, Hungary, Iceland, Indonesia, Iran, Ireland, Italy, Jamaica, Japan, Jordan, Kazakstan, Kenya, Kuwait, Lao Peoples Democratic Republic, Latvia, Lesotho, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Maldives, Malta, Marshall Islands, Mauritius, Mexico, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Norway, Oman, Papua New Guinea, Philippines, Poland, Portugal, Qatar, Republic of Korea, Romania, Russian Federation, Samoa, San Marino, Saudi Arabia, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Sudan, Suriname, Sweden, Syria, Thailand, Trinidad and Tobago, Tunisia, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Viet Nam, Yemen, and Zambia. Against: Burundi, China, and Turkey. Abstaining: Andorra, Argentina, Azerbaijan, Belgium, Bolivia, Bulgaria, Colombia, Cuba, Ecuador, Egypt, Ethiopia, France, Ghana, Guatemala, India, Israel, Mali, Monaco, Mongolia, Pakistan, Panama, Paraguay, Peru, Rwanda, Spain, United Republic of Tanzania, and Uzbekistan. Absent: Afghanistan, Bahamas, Barbados, Belize, Benin, Bhutan, Cape Verde, Comoros, Democratic People's Republic of Korea, Dominican Republic, El Salvador, Eritrea, Fiji, Guinea, Lebanon, Mauritania, Myanmar, Niger, Nigeria, Palau, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Senegal, Solomon Islands, Sri Lanka, Swaziland, Tajikistan, The former Yugoslav Republic of Macedonia, Turkmenistan, Uganda, Zaire, and Zimbabwe.

Thirty-three countries were absent during the convention's adoption and some countries that favored the convention do not have any international watercourses within their territories. The 37-article convention, including its 14-article annex, represents substantial progress in the development of international water law. It addresses issues such as the nonnavigational uses of international watercourses; measures to protect, preserve, and manage international watercourses; and flood control, water quality, erosion, sedimentation, saltwater intrusion, and living resources within the watercourses.

Similar to the 1966 Helsinki Rules, the 1997 U.N. Convention offers principles – such as *equitable and reasonable use and no significant harm* – with which states sharing an international watercourse are to conform when using international waters. However, controversial issues have resurfaced relating to the use of the terms "watercourse" versus "drainage basin," and international water versus transboundary and "shared" water, as well as a countries' rights versus obligations, the factors to be considered in the assessment of equitable and reasonable use, the priority weight that may be given to the equitable use factors, and the level of harm that may be considered significant. Questions that remain unanswered include whether upstream countries are entitled to use all of the water that originates on their territories, whether prior developments of downstream countries are protected against subsequent uses by their upstream neighbors, how can water-use conflicts be resolved, and should human water needs be favored over other water needs.

Country responses to these issues vary in accordance with their location – upstream or downstream – on the watercourse. States adopt positions that favor their particular interests. Upstream states support rules that give them control of the waters that originate in their territory, in line with the doctrine of absolute territorial sovereignty. In contrast, downstream states appeal to the doctrines of prior appropriation (vested rights) and, in some cases, absolute territorial integrity, and embrace an approach that would provide them with unaltered flow (in terms of quality and quantity) of the waters that enter their territories. On the other hand, countries with no transboundary watercourses may adopt an environmental protection position, extending the principle of no harm to biological organisms and wildlife that may be affected by the upstream water users, and the impact on water quantity and quality downstream.

In light of the above mentioned upstream/downstream differences and realizing the reasonable justifications that lie behind these differences, this article attempts to stimulate the readers' interest in comparing the Helsinki Rules to the U.N. Convention, in understanding their impact on upstream versus downstream states, and in monitoring the evolution of international water law.

Presented below are some of the articles that constitute the 1966 Helsinki Rules and 1997 U.N. Convention and that are relevant to equitable water utilization among states sharing international waters.

EXCERPTS FROM THE HELSINKI RULES ARTICLES

The following are excerpts of articles in the Helsinki Rules on the Uses of the Waters of International Rivers, which was adopted by the International Law Association at its 52nd conference, held at Helsinki in August 1966 (ILA, 1967).

Chapter 1 (General)

Article II: An international drainage basin is a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus.

Article III: A "basin State" is a State the territory of which includes a portion of an international drainage basin.

Chapter 2. (Equitable Utilization of the Waters of an International Drainage Basin)

Article IV: Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.

Article V:

I. What is a reasonable and equitable share within the meaning of article IV to be determined in the light of all the relevant factors in each particular case.

II. Relevant factors, which are to be considered, include, but are not limited to:

1. The geography of the basin, including in particular the extent of the drainage area in the territory of each basin State;
2. The hydrology of the basin, including in particular the contribution of water by each basin State;
3. The climate affecting the basin;
4. The past utilization of the waters of the basin, including in particular existing utilization;
5. The economic and social needs of each basin State;
6. The population dependent on the waters of the basin in each basin State;
7. The comparative costs of alternative means of satisfying the economic and social needs of each basin State;
8. The availability of other resources;
9. The avoidance of unnecessary waste in the utilization of waters of the basin;
10. The practicability of compensation to one or more of the co-basin States as a means of adjusting conflicts among uses; and
11. The degree to which the needs of a basin State may be satisfied, without causing substantial injury to a co-basin State.

III. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is reasonable and equitable share, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Article VI: A use or category of uses is not entitled to any inherent preference over any other use or category of uses.

Article VII: A basin State may not be denied the present reasonable use of the waters of an international drainage basin to reserve for a co-basin State a future use of such waters.

Article VIII:

1. An existing reasonable use may continue in operation unless the factors justifying its continuance are outweighed by other factors leading to the conclusion that it be modified or terminated so as to accommodate a competing incompatible use;

2. (a) A use that is in fact operational is deemed to have been an existing use from the time of the initiation of construction directly related to the use or, where such construction is not required, the undertaking of comparable acts of actual implementation; (b) Such a use continues to be an existing use until such time as it is discontinued with the intention that it be abandoned;

3. A use will not be deemed an existing use if at the time of becoming operational it is incompatible with an already existing reasonable use.

EXCERPTS FROM THE U.N. CONVENTION ARTICLES

The following are excerpts of articles in the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (United Nations, 1997b).

Part I (Introduction)

Article 2 (Use of Terms): For the purposes of the present Convention: (a) "Watercourse" means a system of surface waters and ground waters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus; (b) "International watercourse" means a watercourse, parts of which are situated in different States.

Part II (General Principles)

Article 5 (Equitable and Reasonable Utilization and Participation):

1. Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse States with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse.

2. Watercourse States shall participate in the use, development, and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.

Article 6 (Factors Relevant to Equitable and Reasonable Utilization):

1. Utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:

(a) Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
(b) The social and economic needs of the watercourse States concerned;
(c) The population dependent on the watercourse in each watercourse State;
(d) The effects of the use or uses of the watercourses in one watercourse State on other watercourse States;
(e) Existing and potential uses of the watercourse;
(f) Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;
(g) The availability of alternatives, of comparable value, to a particular planned or existing use.

2. In the application of article 5 or paragraph 1 of this article, watercourse States concerned shall, when the need arises, enter into consultations in a spirit of cooperation.

3. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Article 7 (Obligation Not to Cause Significant Harm):

1. Watercourse States shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States.

2. Where significant harm nevertheless is caused to another watercourse State, the States whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures, having due regard for the provisions of articles 5 and 6, in consultation with the affected State, to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation.

Article 8 (General Obligation to Cooperate):

1. Watercourse States shall cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order to attain optimal utilization and adequate protection of an international watercourse.

2. In determining the manner of such cooperation, watercourse States may consider the establishment of joint mechanisms or commissions, as deemed necessary by them, to facilitate cooperation on relevant measures and procedures in the light of experience gained through cooperation in existing joint mechanisms and commissions in various regions.

WATERCOURSE VERSUS DRAINAGE BASIN

The main difference between the 1966 Helsinki Rules and the 1997 U.N. Convention is that the Helsinki Rules pertain to the water in an "international drainage basin"

while the U.N. Convention pertains to the water in an "international watercourse." While the definition of the two terms "drainage basin" and "watercourse," as mentioned in the excerpts of the articles shown above, may appear to be very similar, they are quite different when it comes to the use of the waters in a drainage basin versus the use of the waters in a watercourse. One major difference is that the Helsinki Rules would consider the water that falls on the drainage basin and is used before flowing into a common terminus as beneficial water use for the State in place, whereas the U.N. Convention would not consider any water use from outside of the watercourse as part of the water budget to be equitably utilized. Examples of beneficial unaccounted water uses in international river basins include rainfed agriculture and natural forests (Abu-Zeid, 1997). The consideration of this issue has a very significant impact on states sharing rivers that traverse extremely different climate environments.

Falkenmark (1999) stated that it is becoming more and more evident that what has to be shared between those upstream and those downstream in a river basin is not the water currently going in the river, as the U.N. Convention on Non-navigational Uses of International Watercourses suggests, but rather the rainfall over the river basin. Sustainable, water-dependent, socio-economic development will simply not be possible without taking an integrated perspective on all water-dependent and water-impacting activities in a river basin and their relative upstream\downstream relations (Falkenmark, 1999).

Eckstein (1998) reported that the lack of a more comprehensive and hydrologically sound application of the U.N. Convention to interrelated water resources suggests that it was formulated without a firm understanding of hydrologic reality. The U.N. Convention may be viewed as providing guidelines pertaining to the use, management, and preservation of only a portion of the hydrologic cycle, especially when considered in the context of hydrologic reality. Eckstein (1998) draws attention to the fact that it is not uncommon to have related surface- and ground waters (such as a stream and an underlying aquifer) flowing in different geographical directions and toward different termini. Thus, under the U.N. Convention, any use or management scheme developed for the stream would not be bound by the U.N. Convention's principles with regard to the underlying ground water.

EQUITABLE UTILIZATION IN HELSINKI RULES VERSUS THE U.N. CONVENTION

The relevant factors for the reasonable and equitable utilization of international watercourses or waters of international drainage basins as stated in the Helsinki Rules (Article V. II.1-11) versus the U.N. Convention (Article 6.1.a-g) may also appear similar. However, some of them are significantly different:

- **Factor a** in the U.N. Convention relates to factors 1, 2, and 3 in Helsinki Rules. The U.N. Convention de-emphasized the drainage area's extent in basin states as a geographic factor. It also de-emphasized the contribution of water in each state as a hydrologic factor.
- **Factor b** in the U.N. Convention relates to factor 5 in the Helsinki Rules. The social and economic needs factor is similar between the Helsinki Rules and the U.N. Convention.
- **Factor c** in the U.N. Convention relates to factor 6 in the Helsinki Rules. Although the population factor is mentioned in Helsinki Rules and the U.N. Convention, its application is different because Helsinki Rules talks about the population dependent on the waters of the basin, which may be different from the population dependent on the watercourse as mentioned in the U.N. Convention.
- **Factor d** in the U.N. Convention relates to factors 10 and 11 in the Helsinki Rules. However, the U.N. Convention de-emphasized, in the equitable utilization article, the compensation factor and the prevention of substantial injury to co-basin States. It generally stated the factor as being the effect of the watercourse's use in one watercourse state on other watercourse states.
- **Factor e** in the U.N. Convention relates to factor 4 in the Helsinki Rules. The U.N. Convention eliminated the "past utilization of waters of the basin" as a factor, and maintained the "existing utilization of the watercourse" as a factor. The U.N. Convention also added "potential uses" to the "existing utilization" factor, which may have added ambiguity to the factor, as there is no common standard for assessing potential water uses.
- **Factor f** in the U.N. Convention relates to factors 7 and 9 in the Helsinki Rules. The U.N. Convention, by combining factors 7 and 9 of the Helsinki Rules in a more general factor as in factor f, may have limited satisfying economic and social needs of each watercourse state to the watercourse water only without considering other water resources within the watercourse States. This issue is even more amplified in the U.N. Convention by the fact that factor 8 in the Helsinki Rules was eliminated in the U.N. Convention.
- **Factor 8** of the Helsinki Rules was used to address the "availability of other water resources" either in the river basin or the state as a whole. Although factor g of the U.N. Convention may appear to be the same as factor 8 of the Helsinki Rules because one has the phrase "availability of alternatives" and the other has the phrase "availability of other," they are completely different. Whereas the Helsinki Rules address the availability of other water resources, the U.N. Convention addresses the availability of other uses. One looks at alternatives on the supply side while the other looks at alternatives on the demand side. The U.N. Convention, by eliminating the possibility of looking at "other available water resources" within the basin and the state as a potential relief to water conflicts over limited water resources, may be looked at as defeating the objective of its development. This relates back to the scope of the convention, which does not consider the waters of the basin but rather the waters in the watercourse, in which case direct beneficial use of rainfall may not be considered in the water budget assessment of the watercourse states.

Direct beneficial use of rainfall is a substantial amount of water, which if properly assessed, could significantly switch the balance of equitable utilization formulas. The World Water Council (WWC) defines this water as Green Water, or soil water, which is the portion of rainfall that is stored in the soil and then evaporates or is incorporated into plants and organisms. In its World Water Vision 2000, the WWC estimates the annual global Green Water to be 60,000 km^3, compared to only 40,000 km^3 of Blue Water, which is defined as the portion of rainfall that enters into streams and recharges ground water. It is apparent how significant Green Water is in resolving water conflicts, not only because of its amount but also, because of how much Green Water contributes to food production. Sixty percent of global food production comes from the Green Water (Cosgrove and Rijsberman, 2000). Nevertheless, Green Water is transformed daily into Blue Water (the U.N. Convention definition of watercourse) by the effects of continuous urbanization or deforestation practices. A proper water resources assessment is an essential step for the equitable utilization of shared water resources. It provides the opportunity for cooperation among riparian countries of a river basin to develop the untapped water resources in the basin rather than compete over already utilized water resources. It defines each country's actual utilized water as extracted surface and ground water as well as any beneficial evapo-transpiration resulting from rainfall on the river basin. It accounts for all possible potential water resources in each country, within or outside the river basin, whether it's river runoff, ground water, direct rainfall, or evaporation losses that could be saved (Abu-Zeid, 1997).

On the other hand, unlike the U.N. Convention, the Helsinki Rules include harm as one of the factors to be considered in the overall assessment, and not the equitable utilization, of water resources. This distinction is important since, under the Helsinki Rules, it is clear that a use that causes significant harm could be justified under the principle of equitable utilization. The same is not quite so evident in the approach adopted in the 1997 U.N. Watercourses Convention, although States could argue articles 5 through 7 of the U.N. Convention mean the same thing. In practice, adopting equitable use, compared with no significant harm, as the governing rule can yield quite different results. The no significant harm rule acts as a veto on future development and tends to protect the status quo (i.e., the prior appropriations of the State first to develop) (Sherk *et al.,* 1998).

CONCLUSIONS

Helsinki Rules and the U.N. Convention are both framework documents that provide very useful guidelines for future agreements and policies on the utilization of international waters. Scientific research, publications, and readers' feedback will eventually contribute to the future enhancement and elaboration of a comprehensive international water law to incorporate a more reasonable

scientific and legal approach to the use of international waters.

Scientific knowledge among legislators and policymakers should provide the scientific base for sound international and domestic laws, policies, and regulations governing the environment. The technical and scientific community must become more involved in the political, legislative and judicial process, and must be embraced by those communities to ensure that the development of policies, regulations, and management and conservation efforts do not contradict with the realities of science.

Water resources and law professionals, associations, and councils are encouraged to form joint scientific commissions and committees to supplement the efforts of the United Nations International Law Commission to develop a comprehensive international water law.

[Note: The views and conclusions expressed in this article are those of the author only and should not be interpreted as necessarily representing the official policies, either expressed or implied, by any specific governmental, commercial, or international agency.]

LITERATURE CITED

Abu-Zeid, K. 1997. Proper Water Resources Assessment: An Opportunity for Conflict Resolution in International River Basins. Ninth World Water Congress on Water Resources Outlook for the 21st Century: Conflicts and Opportunities. International Water Resources Association (IWRA), Montreal-Canada, September 1-6, 1997, Paper 2 B 408-A TP1.1 1.

Bourne, C.B., 1998. International Water Law, Selected Writings of Professor Charles B. Bourne. Centre for Energy, Petroleum, and Mineral Law and Policy (CEPMLP), CEPMLP Internet Journal, University of Dundee, Scotland. Volume 3, Article 10. *Available at* http://www.dundee.ac.uk/cepmlp/journal/, *accessed* June 18, 2001.

Cosgrove, W.J. and F.R. Rijsberman, 2000. World Water Vision, Making Water Everybody's Business. Report prepared for the World Water Council. London. Earthscan Publications, Ltd., 108 pp. *Available at* http://www.worldwatercouncil.org/, *accessed* June 18, 2001.

Eckstein, G.E., 1998. Hydrologic Reality: International Water Law and Transboundary Ground-Water Resources. "Water: Dispute Prevention and Development" Conference, American University Center for the Global South, Washington, D.C. *Available at* http://www.internationalwaterlaw.org/Articles/GlobalSouth.htm, *accessed* June 18, 2001.

Falkenmark M, 1999. Competing Freshwater and Ecological Services in the River Basin Perspective – Benefiting from a New In-The-Box Thinking. Proceedings of the Stockholm International Water Institute (SIWI)/IWRA Seminar "Towards Upstream/Downstream Hydrosolidarity," Stockholm, Sweden.

International Law Association, 1967. The Helsinki Rules on the Uses of the Waters of International Rivers. Report of the Committee on the Uses of the Waters of International Rivers, International Law Association, London. *Available at* http://www.internationalwaterlaw.org/IntlDocs/Helsinki_Rules.htm, *accessed* June 18, 2001.

Sherk, G.W., P. Wouters, and S. Rochford, 1998. Water Wars in the Near Future? Reconciling Competing Claims for the World's Diminishing Freshwater Resources – The Challenge of the Next Millennium, CEPMLP Internet Journal, University of Dundee, Scotland, Volume 3, Article 2. *Available at* http://www.dundee.ac.uk/cepmlp/journal/, *accessed* June 18, 2001.

United Nations, 1997a. United Nations General Assembly Press Release GA/9248. *Available at* http://www.internationalwaterlaw.org/IntlDocs/Convention_Press.htm, *accessed* June 18, 2001.

United Nations, 1997b. Convention on the Law of the Non-navigational Uses of International Watercourses. *Available at* http://www.un.org/law/ilc/texts/nnavfra.htm, *accessed* June 18, 2001.

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UNDERSTANDING THE INTERNATIONAL WATER MANAGEMENT ARENA: A NEWCOMER'S GUIDE TO THE MAJOR PLAYERS

Faye Anderson

This paper is a basic guide to selected international organizations and programs currently active in international water management activities. By no means is it a comprehensive listing. It is primarily intended to be an introduction for a relative newcomer to the international arena. Website addresses are provided for each listing so that readers can readily find information about these organizations and programs.

As one explores the organizational landscape of international water policy and management, several trends become apparent. First is the dynamic environment within which water organizations operate. Organizations face increasing competitive pressures to innovate in order to survive. Existing water organizations are merging, changing their names, updating their missions, and delivering new products. At the same time, new organizations are being created, including the formation of coalitions of existing organizations and 'virtual' organizations.

A second trend is the emergence of partnering as a dominant organizational strategy. Groups are devoting significant resources to partnering and networking activities to more effectively carry out their missions. Traditional thinking about an organization as a self-contained entity is evolving to incorporate new models of flexible relationships.

Groups are devoting significant resources to partnering and networking activities to more effectively carry out their missions; traditional thinking about an organization as a self-contained entity is evolving to incorporate new models of flexible relationships

Finally, previous distinctions between an organizations and programs are blurring. It is increasingly difficult to differentiate between program activities established to produce particular products and the infrastructure or network of people who voluntarily band together to support implementation of the program. Given the proliferation of water organizations and their increased partnering activities, the following list of organizations and programs may serve as an introduction to this complex organizational landscape.

MAJOR INTERNATIONAL ORGANIZATIONS AND PROGRAMS

Blue Planet Project
http://www.canadians.org/blueplanet/index2.html

The Council of Canadians' project addresses the impacts of trade and privatization on water and water services. It seeks to mobilize an international network to protect water as a common resource and a basic human right. On December 8, 2000, at a meeting on the global pressure to turn water over to private water corporations in Cochabamba, Bolivia, the Cochabamba Declaration was issued. Blue Planet organized "Water for People and Nature: An International Forum on Conservation and Human Rights" in Vancouver, British Columbia, this past July 5-8, 2001. The project is focusing on some very controversial issues in international water management.

Global Applied Research Network (GARNET)
http://info.lut.ac.uk/departments/cv/wedc/garnet/grntover.html

GARNET facilitates the sharing of applied research information between researchers working in the water and sanitation sector worldwide. All aspects of water supply and sanitation, including technology, management, and health and social factors are covered. Network members are drawn from a variety of institutions, including education institutions, NGO's, government agencies, international organizations and consultancies.

Global Environment Monitoring System (GEMS/Water)
http://www.cciw.ca/gems/intro.html

GEMS is a United Nations Environment Programme (UNEP) activity housed at the Canada Centre for Inland Waters (CCIW). CCIW is one of the world's leading centers for water research with a primary mission of collecting environmental information and knowledge about the Great Lakes. The GEMS/Water Programme is oriented towards understanding freshwater quality issues throughout the world. Major activities include monitoring, assessment, and capacity building. Sixty-nine countries participate in their data collection activities.

Global Energy and Water Cycle Experiment (GEWEX)
http://www.gewex.org/

GEWEX was initiated by the World Climate Research Programme (WCRP) to observe, understand and model the hydrological cycle and energy fluxes in the atmosphere, at land surface and in the upper oceans. GEWEX is an integrated program of research, observations, and science activities ultimately leading to the prediction of global and regional climate change.

Global Environment Facility (GEF)
http://www.gefweb.org/

GEF is currently the principal funding mechanism for the global environment. It is a multilateral financing mechanism, created in 1991, addressing global environmental issues that do not normally get funded through national, bilateral, or other international financial mechanisms. GEF provides grants and concessional funding to recipient countries for projects and programs that protect the global environment and promote sustainable economic growth. GEF was established to forge international partnerships and finance projects that address four critical threats to the global environment: biodiversity loss, climate change, degradation of international waters, and ozone depletion. In 1994, 34 nations pledged $2 billion and in 1998, 36 nations pledged $2.75 billion in support of GEF's mission. GEF projects and programs are managed through three implementing agencies: the UN Development Programme (UNDP), the UN Environment Programme (UNEP) and the World Bank. More information on GEF's water-related projects can be found at http://www.gefweb.org/meetings/WaterForum/index.htm.

Global International Waters Assessment (GIWA)
http://www.giwa.net

The aim of GIWA is to produce a comprehensive and integrated global assessment of international waters, to describe the ecological status of and the causes of environmental problems in 66 water areas in the world, and to focus on the key issues and problems facing aquatic ecosystems in transboundary waters. This four-year, UNEP-led, GEF-funded initiative is located at Kalmar University in Sweden. The first GIWA General Assembly meeting will be held in October 2001 in Sweden.

Global Water Partnership (GWP)
http://www.gwpforum.org/

The official mission of the Global Water Partnership is to "support countries in the sustainable management of their water resources." GWP is located in Sweden and established to complement the work of the World Water Council (WWC) and its World Water Vision activities. GWP is charged with translating this vision into action through its regional Technical Action Committees. The *Framework for Action* document guides in translating Vision activities into reality.

Hydrology for the Environment, Life and Policy (HELP)
http://www.nwl.ac.uk/ih/help/index.html

The HELP Initiative grew is a collaborative effort of the United Nations Educational, Scientific, and Cultural Organizations (UNESCO) and the World Meteorological Organization (WMO). It encourages the water policy, water resources management and scientific communities to work together within a field-oriented context so that science is closely integrated with policy and management needs. Through a global network of catchments, HELP focuses on setting scientific agendas to address critical water policy and water management issues, including climate, food, pollution and human health, environment, and conflict. HELP endeavors to truly integrate water science and management.

Inter-American Water Resources Network (IWRN)
http://www.iwrn.net/

The Inter-American Water Resources Network is a network whose purpose is to build and strengthen water resources partnerships throughout the Americas. It promotes horizontal collaboration among members of the water resources community, facilitates technical cooperation and information sharing, and develops opportunities for education and training. Their technical secretariat is housed at the Organization of American States. IWRN is sponsoring its Fourth Inter-American Dialogue on Water Management in September 2001 in Brazil.

International Association for Hydraulic Engineering and Research (IAHR)
http://www.iahr.nl/

The International Association for Hydraulic Engineering and Research is an international, nongovernmental organization of engineers and scientists working in hydraulics and hydraulic engineering. IAHR's mission is to advance applied and basic research on water-related issues and to contribute to the optimization of the world's water resources. IAHR tries to achieve its goals by a wide variety of international exchange activities and by offering a common infrastructure for the hydraulic research and engineering community.

International Association of Hydrological Sciences (IAHS)
http://www.cig.ensmp.fr/~iahs/

The International Association of Hydrological Sciences is an international, non-governmental organization that deals with hydrology and water resources. IAHS was established in 1922, incorporating the International Commission of Glaciers, which had been set up in 1894, with the aim of bringing together hydrologists from all countries to promote the hydrological sciences. Its *International Commission on Water Quality (ICWQ)* promotes the advancement of water quality aspects of hydrological systems, including assessment and management.

International Commission on Irrigation and Drainage (ICID)
http://www.icid.org/

The International Commission on Irrigation and Drainage is "dedicated to enhancing the worldwide supply of food and fiber for all people by improving water and land management and the productivity of irrigated and drained lands through appropriate application of irrigation, drainage, and flood management techniques. The ICID mission is to stimulate and promote the development and application of the arts, sciences and techniques

of engineering, agriculture, economics, ecological and social sciences in managing water and land resources for irrigation, drainage, flood management and river training applications, including research and development and capacity building for achieving sustainable irrigated agriculture."

International Commission on Large Dams (ICOLD)
http://genepi.louis-jean.com/cigb/anglais.html

The International Commission on Large Dams is a nongovernmental International Organization that provides a forum for the exchange of knowledge and experience in dam engineering. The Organization aims to ensure that dams are built safely, efficiently, economically, and without detrimental effects on the environment.

International Hydrological Programme (IHP)
http://www.unesco.org/water/ihp/

IHP is UNESCO's intergovernmental scientific cooperative programme in water resources. It is a vehicle through which member states can upgrade their knowledge of the water cycle and thereby increase their capacity to better manage and develop their water resources. It aims to improve the scientific and technological basis for the development of methods for the rational management of water resources. The Programme constitutes a framework for applied research and education in the field of hydrology and water management.

International Network of Basin Organizations (INBO)
http://www.oieau.fr/riob/friobang.htm

INBO networks basin organizations to develop ongoing dialogue with those responsible for global river basin management, and to facilitate exchanges of experiences and expertise among them. It promotes sound management and facilitates the implementation of tools for institutional and financial management. INBO seeks to develop and strengthen river basin organizations all over the world.

International Private Water Association (IPWA)
http://www.ipwa.org/

IWPA is a nonprofit corporation established to promote opportunities for private sector investment in water systems, wastewater treatment, desalination, irrigation, flood control, and other water-related infrastructure projects worldwide. The Association also works to promote public-private partnerships in water utilities throughout its member's respective regions.

International Rivers Network (IRN)
http://www.irn.org/

IRN was established in 1985 as a nonprofit all-volunteer organization. IRN's mission is "to halt and reverse the degradation of river systems; to support local communities in protecting and restoring the well-being of the people, cultures and ecosystems that depend on rivers; to promote sustainable, environmentally sound alternatives to damming and channeling rivers; to foster greater understanding, awareness and respect for rivers; to support the world wide struggle for environmental integrity, social justice and human rights; and to ensure that our work is exemplary of responsible and effective global action on environmental issues."

International Water and Sanitation Centre (IRC)
http://www.irc.nl/

IRC is an independent, nonprofit organization supported by and linked to the Netherlands Government, the United Nations Development Programme (UNDP), the United Nations Children's Fund (UNICEF), the World Health Organization (WHO), the World Bank and the Water Supply and Sanitation Collaborative Council (WSSCC). Its areas of concentration include community-based technologies; participation and community management; gender awareness; hygiene promotion; operation and maintenance; monitoring and evaluation; information management; community water resources management; and resource center development. IRC maintains a very useful website for obtaining information on international water issues and events.

International Water Association (IWA)
http://www.iwahq.org.uk

IWA was formed in 1999 by the merger of two long established international organizations, the IAWQ (International Association on Water Quality) and IWSA (International Water Services Association). IWA's vision is to be the leading international membership association for the improvement of urban water management worldwide in an environmentally sustainable way. IWA covers all aspects of water supply and treatment, wastewater collection, treatment and disposal and overall management of water quality and quantity including environmental and public health issues.

International Water Management Institute (IWMI)
http://www.cgiar.org/iwmi/

Formerly called the International Irrigation Research Institute, IWMI conducts a worldwide research and capacity building program to improve water resources and irrigation management through better technologies, policies, institutions, and management. The International Water Management Institute is a scientific research organization focusing on the use of water in agriculture and on the water needs of developing countries. IWMI works with partners in the south to develop tools and methods to help these countries eradicate poverty through more effective management of their water resources.

International Water Resources Association (IWRA)
http://www.iwra.siu.edu

IWRA is an international, nongovernmental, educational organization connecting professionals, students, and individuals who are concerned with the sustainable use of water resources around the world. The mission of this

professional society is to improve and expand the understanding of water resources issues through education, research, and information exchange between countries and across disciplines.

The Pacific Institute
http://www.pacinst.org/

The Pacific Institute for Studies in Development, Environment, and Security is an independent, nonprofit center created in 1987 to conduct research and policy analysis in the areas of environment, sustainable development, and international security. Underlying all of the Institute's work is the recognition that the pressing problems of environmental degradation, regional and global poverty, and political tension and conflict are fundamentally interrelated, and that long-term solutions require an interdisciplinary perspective.

Stockholm International Water Institute (SIWI)
http://www.siwi.org

SIWI is an umbrella organization for various water related research activities, and it has made significant contributions to international efforts addressing the global water crisis. SIWI's work is conducted close cooperation with universities, technical institutes and other scientific institutions in Stockholm and elsewhere in Sweden and the world. Since 1991, SIWI has sponsored their annual *Stockholm Water Symposium*, which is convened each August, to help develop practical solutions and strategies to alleviate the world water crisis. The SWS is the venue for the awarding of the *Stockholm Water Prize*, given annually in honor of outstanding achievements in science, engineering, technology, education or public policy related to protection of the world's water resources. This prize is often referred to as the Nobel Prize for water.

United Nations Commission on Sustainable Development (UNCSD)
http://www.un.org/esa/sustdev/csd.htm

The UNCSD was created after the 1992 Rio Conference (UN Conference on Environment and Development) to follow-up on the implementation of Earth Summit agreements, including Agenda 21 – a plan for achieving sustainable development. The UNCSD is a functional commission of the UN Economic and Social Council (ECOSOC). It conducted the Earth Summit +5 meeting in 1997 and the *Rio +10* meeting is planned for September 2002 in Johannesburg, South Africa (for ongoing updates, see http://www.johannesburgsummit.org/). The *International Conference on Freshwater* being held in December 2001 in Bonn Germany is a preparatory meeting for the water sector leading up to the Johannesburg Summit (see http://www.water-2001.de).

United Nations Development Programme (UNDP)
http://www.undp.org

UNDP's mission is "to help countries in their efforts to achieve sustainable human development by assisting them to build their capacity to design and carry out development programs in poverty eradication, employment creation and sustainable livelihoods, the empowerment of women and the protection and regeneration of the environment, giving first priority to poverty eradication." UNDP draws on expertise from developing countries, United Nations specialized agencies, civil society organizations and research institutes. UNDP supports technology transfer, adaptation, and access to the most effective technology. Within its areas of focus, UNDP has several water related initiatives, including those partnered with GEF and UNEP, and also has the Sustainable Development Network Programme.

UNDP/World Bank Water and Sanitation Program (WSP)
http://www.wsp.org/english/index.html

The WSP is an international partnership of the world's leading development agencies concerned with water and sanitation services for the poor. Its mission is to alleviate poverty by helping the poor gain sustained access to improved water and sanitation services. It is managed through a head office in Washington, D.C., and four regional offices in South Asia, East Asia and the Pacific, Africa, and the Andean Region. Operating in more than 30 countries, the Program's strength derives from its strong field presence, a well-established network of sector specialists, and its ability to respond to the changing demands of its clients.

United Nations Environment Programme (UNEP)
http://www.unep.org

UNEP was established after the 1972 U.N. Conference on the Human Environment (Stockholm) and is intended to serve as the U.N.'s environmental conscience. UNEP's *Freshwater Unit* exists to promote integrated management and use of freshwaters, enhance environmental quality and promote environmentally-sustainable socio-economic development. In fulfilling this Mission, the Freshwater Unit is continuing its fundamental work in promoting the integrated management and use of freshwater resources in international drainage basins, and in facilitating development of training materials and courses that contribute to this mission. UNEP's *Global Programme of Action* is a source of conceptual and practical guidance to be drawn upon by national and/or regional authorities in devising and implementing sustained action plans to prevent further degradation of the marine environment from land based activities. UNEP's *Regional Seas Programme* is an action-oriented programme that focuses not only on the mitigation or elimination of the consequences but also on the causes of environmental degradation. It has a comprehensive, integrated, results-oriented approach to combating environmental problems through the rational management of marine and coastal areas. The Programme includes 13 regions, involving more than 140 coastal States and Territories. UNEP's *Water Branch* seeks to develop policy-relevant assessments of the state of freshwater and marine resources; develop tools and guidelines for sustainable management

and use of freshwater and coastal resources; promote international cooperation in the management of river-basins and coastal waters with focus on control of pollution from land-based sources and on the special needs of Small Island Developing States (SIDS); and support and institutional servicing of regional seas conventions and action plans.

United Nations Food and Agriculture Organization (FAO)
http://www.fao.org

Founded in 1945, the FAO works to alleviate poverty and hunger by promoting agricultural development, improved nutrition, and the pursuit of food security. FAO offers direct development assistance, collects, analyzes and disseminates information, provides policy and planning advice to governments and acts as an international forum for debate on food and agriculture issues. FAO is active in land and water development, plant and animal production, forestry, fisheries, economic and social policy, investment, nutrition, food standards and commodities and trade. It also plays a major role in dealing with food and agricultural emergencies. FAO has a major programme on fisheries intended to promote sustainable development of responsible fisheries and contributing to food security.

United Nations Educational, Scientific and\ Cultural Organization (UNESCO)
http://www.unesco.org/

UNESCO's main objective is to contribute to peace and security in the world by promoting collaboration among nations through education, science, culture and communication in order to further universal respect for justice, for the rule of law and for the human rights and fundamental freedoms which are affirmed for the peoples of the world, without distinction of race, sex, language or religion, by the Charter of the United Nations. UNESCO is also home to the *U.N. World Water Development Report* initiative incorporating around 24 U.N. organizations working together to create a biennial assessment of the world's freshwater. This is a major multipartner initiative to assess and biennially report on the state of the world's freshwater. The year 2003 is slated by the U.N. as the International Year of Freshwater. The *International Hydrological Programme* is UNESCO's major water-related program.

WaterAid
http://www.wateraid.org.uk/index.html

WaterAid was created in 1981 by the people and organizations of the British water industry as a response to the U.N. Water Decade (1981-1990). It is an independent charity registered with the charity commissioners. WaterAid's vision is of a world in which all people have access to safe water and sanitation. WaterAid aims to work through partner organizations to help poor people in developing countries achieve sustainable improvements in their quality of life by improved domestic water supply, sanitation and associated hygiene practices.

Water Associations Worldwide
http://www.wef.org/conferences/affiliations/waw.jhtml

The WAW is a coalition of water associations (including AWRA, AWWA, IWA WEF, ASCE/EWRI, and five others from around the world). They recently formed to address their common needs and goals. WAW represents over 320,000 water professionals globally. WAW seeks to advance international water management through the cooperation of their organizations and members.

Water For People (WFP)
http://www.water4people.org/

Water For People is a nonprofit, charitable organization in the United States and Canada that helps people in developing countries obtain safe drinking water. WFP partners with local organizations to provide financial and technical assistance to communities, depending on their needs. WFP implements projects by working in conjunction with local indigenous development organizations. As communities are involved in project decisionmaking, a sense of ownership for completed projects is nurtured. In this way, the efforts of WFP are sustainable because local people gain the experience, skills and confidence to manage their completed projects.

Water Supply and Sanitation Collaborative Council (WSSCC)
http://www.wsscc.org/

WSSCC was established in 1990 at the end of the International Drinking Water Supply and Sanitation Decade. Its purpose is to maintain the momentum of the Decade, by providing a regular way for water and sanitation sector professionals to exchange views and experiences and develop approaches that will lead to faster achievement of the goal of universal coverage. *Global Environmental Sanitation Initiative (GESI)* is a new global activity led by an international steering committee under the umbrella of the Water Supply and Sanitation Collaborative Council (WSSCC). The overall aim of GESI is to raise the profile of sanitation and hygiene behavior globally through a major thrust in advocacy, collaboration and funding.

WaterWeb Consortium
http://www.waterweb.org

The WaterWeb Consortium, an outgrowth of the activities of the Inter-American Water Resources Network (IWRN), was created as a virtual organization to promote the sharing of water-related information using Internet and Communication Technologies. WaterWeb's goals are to advance water related issues, promote the use of quality information, and the sharing information with water use stakeholders and decision makers. WaterWeb sponsors the WaterWeb Ring connecting water related websites on the World Wide Web and sponsors the annual Water Information Summit. The *Fourth Water Information Summit* will be held in October 2001 in Panama.

Wetlands International (WI)
http://www.wetlands.agro.nl/

The mission of Wetlands International is to sustain and restore wetlands, their resources and biodiversity for future generations through research, information exchange and conservation activities. WI aims to be the world's leading nonprofit organization concerned with the conservation of wetlands and wetland species. WI has global network of governmental and non-governmental experts working on wetlands and its activities are currently undertaken in more than120 countries.

The World Bank
http://www.worldbank.org

The World Bank's development efforts relating to water resources are organized under four main themes: hydropower; water supply and sanitation; water resources management in rural development (including agricultural irrigation and drainage); and environmental dimensions of water resources management (such as freshwater, coastal, and marine resource management). The Bank utilizes these four areas to address water issues throughout its various sectors and regions of its work.

The World Bank Institute: Water Policy Reform Program
http://www.worldbank.org/wbi/topics.html

The Program contributes to environmentally and socially sustainable development by helping countries prepare and implement policy reforms leading to sustainable water resources management, through capacity building and learning activities. WBI reaches out to a wide range of influential stakeholders, from policymakers to parliamentarians, community representatives, private sector leaders, NGOs, journalists, users associations and the public. The ultimate beneficiaries of the Program's activities are the societies of the concerned countries, as water issues cut across all social and economic activities, and affect mostly the poor.

World Commission on Dams
http://www.dams.org/

The WCD was formed in 1997 to evaluate current thinking and practices worldwide with respect to dams, particularly large-scale dams. WCD's mandate was to (1) review the development effectiveness of large dams and assess alternatives for water resources and energy development; and (2) develop internationally acceptable criteria, guidelines and standards, where appropriate, for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams. Their final report, "Dams and Development: A New Framework for Decision-Making" was issued in 2000 to mixed reviews worldwide sparking international dialogues over the role of dams in development.

The World Conservation Union (IUCN)
http://www.iucn.org/

IUCN is one of the world's oldest international conservation organizations. Originally established as the "International Union for the Protection of Nature," today it is a union of governments, government agencies, and non-governmental organizations working in the field and at policy levels, together with scientists and experts, to protect nature. Its mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. It is a global network of networks with over 8,000 scientists and field practitioners from government and non-governmental organizations. Several of its programs address water-related issues, such as its Marine and Coastal Programme, and the IUCN Water and Nature Initiative with the Wetlands and Water Resources Programme. IUCN participated in the development of the World Water Vision's "Water for Nature" report.

World Health Organization (WHO)
http://www.who.org

WHO serves to improve global understanding of health problems and to lead the efforts to solve them. WHO functions include the direction and coordination of international health work; promotion of technical cooperation; assisting governments in strengthening health services; furnishing technical assistance and emergency aid; promotion of improvements in nutrition, housing, sanitation, recreation, economic and working conditions and other related aspects of environmental hygiene. Thus, WHO deals with water-related diseases and health problems. Their *Water and Sanitation Program* (at http://www.who.int/water_sanitation_health/index.html) brings together much of WHO's work in this area. Their Third Ministerial Conference on Environment and Health, June 1999 adopted a *Protocol on Water and Health* to the UN ECE 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

World Meteorological Organization (WMO)
http://www.wmo.ch

WMO is a specialized agency within the UN system that coordinates global scientific activity to increase prompt delivery of accurate weather information. WMO's *Hydrology and Water Resources Programme* (*HWRP*) (at http://www.wmo.ch/web/homs/hwrphome.html) seeks to apply hydrology to meet the needs for sustainable development and use of water and related resources; to mitigate water-related disasters; and to effectively manage the environment at national and international levels. Included in the programme are planning, design, operation, and management of water projects, including forecasting and control; promotion of the development of the capacity in developing countries, to respond to threats of floods and droughts and thus to meet all requirements for water and its use and management for a range of purposes.

This is done through technology transfer and technical cooperation. The *Global Runoff Data Centre* (*GRDC*) (at http://www.bafg.de/grdc.htm) is operated under the auspices of WMO and closely cooperates with other U.N. agencies, international organizations, and research institutes. The major activities of the GRDC include the collection and dissemination of river discharge data on global scale. WMO, with the support of the World Bank, promotes the development of a *World Hydrological Cycle Observing System* (*WHYCOS*) (at http://www.wmo.ch/web/homs/whycos.html).

World Resources Institute (WRI)
http://www.wri.org/

WRI's mission is to move human society to live in ways that protect the Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. WRI helps other institutions provide, objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development. WRI conducts policy research, publicizes policy options, encourages adoption of innovative approaches, and provides strong technical support to governments, corporations, international institutions, and environmental NGOs. WRI's areas of work include oceans and coasts and water resources (as well as economics, forests, biodiversity, climate change, governance, sustainable agriculture, world resources, business; and health. WRI publishes "World Resources 2000-2001" as a definitive guide to the global environment. This latest edition, focusing on "People and Ecosystems: The Fraying Web of Life " can be found at http://www.wri.org/wr2000/page.html. The *Pilot Analysis of Global Ecosystems* (*PAGE*) (at http://www.wri.org/wr2000/page.html) provides a "big picture" view of agricultural, coastal, forest, freshwater, and grassland ecosystems using indicators and maps at global and continental scales.

World Water Council (WWC)
http://www.worldwatercouncil.org

Established in 1996, the WWC is a nonprofit, nongovernmental umbrella organization "devoted to the critical issues of long-term global water policy and to advocating solutions to problems of water resource management." WWC was created to address the proliferation of water organizations and their lack of integrated effort to address international water issues. Towards these ends, the World Water Council sponsors the triennial *World Water Forum* and publish the *Water Policy* journal.

World Water Forum (WWF)
http://www.worldwaterforum.org

This is the triennial meeting sponsored by the *World Water Council* (*WWC*). It is always conducted in March in conjunction with World Water Day. The first WWF was held in 1997 in Marrakech, Morocco; the Second WWF was in 2000 in The Hague, The Netherlands; and the Third WWF will be held in Kyoto, Japan, in 2003 (see http://www.worldwaterforum.org for ongoing information). The Ministerial Declaration from The Hague was titled "Water Security in the 21st Century." The Second WWF culminated in the report, "World Water Vision: Making Water Everybody's Business" (both are available from the Vision Library at http://www.worldwatercouncil.org/Vision/library.htm).

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UWIN EXPERTISE DIRECTORY
LIST YOURSELF FOR FREE!!

The Universities Water Information Network (UWIN) is a not-for-profit organization that disseminates information of interest to the water resources community via the Internet (http://www.uwin.siu.edu). UWIN's mission is envisioned as helping to bring water resources to the information superhighway. UWIN is housed at the Headquarters of the Universities Council on Water Resources (UCOWR) at Southern Illinois University in Carbondale, Illinois, and is part of their outreach efforts to the water resources community.

UWIN's services include maintaining an expertise directory, an annotated bibliography for water resources related articles from 1967 to 1993, job advertisements, and list of events. These services are currently offered for free.

UWIN is currently in the process of updating its directory of water resources experts. If you would like to be included in this directory, we would encourage you to visit the following location and submit the requested information: http://www.uwin.siu.edu/dir_directory/expert/submit.html

If you have previously submitted your information to this directory, note that records submitted prior to 1995 will be deleted shortly. In such a case, you should receive an email from the UWIN system administrator requesting you to re-enter your most recent information at the above-specified location.

We look forward to your submission to our directory. If you have any further questions, you may email us at admin@uwin.siu.edu.

INTERNATIONAL NOTES

UPDATE FROM 3rd WWF "KICK-OFF' MEETING

Submitted by Faye Anderson
Member AWRA International Committee

The Third World Water Forum will be held in Japan in 2003 during the week of World Water Day – March 16-23. WWF3 will take place at several sites in the Yodo River Basin and near Lake Biwa, the largest freshwater body in Japan. The main meeting will be held at the International Conference Center in Kyoto, the site of the 'famous' UNFCCC COP-3 climate change meeting.

The World Water Forum meetings are an activity of the World Water Council, which is headquartered in Marseilles, France (see http://www.worldwatercouncil.org/). The first WWF was held in 1997 in Marrakech, Morocco, and the second in 2000 at The Hague in The Netherlands. These two meetings conceived and carried out the World Water Vision Process by which the water community created a global vision of what water management should look like in 2025. The results of this Vision process were presented to some 5,700 participants last year in The Hague. The Forum's parallel Ministerial Conference developed the Declaration of The Hague on Water Security in the 21st Century. All of the documents from the vision process, including the report, "World Water Vision: Making Water Everybody's Business," can be found in the Vision Library at http://www.worldwatercouncil.org/Vision/library.htm.

The Japanese government was selected to organize the Third WWF and a Secretariat has been established in Tokyo to plan this event. A "Kick-Off" Meeting was held on June 3-5, 2001, at the conference site in Kyoto. Approximately 140 international and over 300 Japanese participants attended this meeting, including AWRA Executive Vice President Ken Reid. The theme for the 3rd WWF centers on translating vision into action, and the Kyoto Forum will focus on identifying concrete programs that are successfully implementing integrated water resources management around the world.

The first day of the "Kick-Of" Meeting discussed the activities of the World Water Council (WWC), lessons learned from the 2nd WWF, and the organization of the Japanese 3rd WWF Secretariat. The second day participants joined a series of small group brainstorming activities to identify goals for the 3rd WWF and to provide constructive inputs into the thematic schema of its program. Public participation is a primary theme of the 3rd Forum. The third day summarized these small group activities and developed the framework for the 3rd WWF. Reports from these discussions are available on their website (see below).

This "Kick-Off" Meeting also introduced the Virtual Water Forum and the Water Messengers programs. The Virtual Water Forum is an online discussion tool the Secretariat created to facilitate discussions and activities leading up to the Forum (available from the WWF3 website). It is hoped that many more people can participate in these online discussions than just those who will be able to attend the actual meeting in 2003. The BBC had a film crew at the meeting covering the Virtual Water Forum and the role of the Internet in water management for a future program of Earth Reports (see http://www.tve.org).

Also unveiled at the meeting was the Water Messenger's program. This program is designed to capture the ideas and opinions of those without Internet access. Volunteer messengers will collect the 'water voices' of peoples around the world and submit these comments to the Secretariat and the Virtual Water Forum. The 2003 Forum will also incorporate water fairs and festivals in the cities of Shiga and Osaka. These festivals will focus on cultural and social events and will include the general public.

Regional conferences will be held around the world leading up to WWF3 in Kyoto. News of ongoing events and activities related to the 3rd World Water Forum can be found on the Secretariat's website at http://www.worldwaterforum.org/.

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WATERSHEDS OF CHANGE
2001 ANNUAL MEETING OF THE
CANADIAN WATER RESOURCES ASSOCIATION

Submitted by David W. Moody
Chairperson AWRA International Committee

The Canadian Water Resources Association (CWRA) held its 54th annual conference in Guelph, Ontario, on June 6-8, 2001, with watershed management as the theme of the conference. Prof. John J. Pigram, President (2001-2002) of the International Water Resources Association (IWRA), gave the keynote address (co-authored by Bruce P. Hooper) with the title, "International Perspectives on Watershed Management: From Vision to Reality." In his address, Dr. Pigram traced the evolution of integrated water resources management (IWRM) and integrated catchment (watershed) management (ICM) in Australia, with particular attention to the Murray-Darling basin experience. In 2000, the Federal government launched an inquiry into how best to achieve a nationally coordinated watershed management program. The resulting report recommended that the Federal government take a lead role in implementing watershed management by establishing a National Catchment Management Authority, an approach that Dr. Pigram perceives as too top down and that may generate Federal-State tensions. He went on to review some of the international activities promoting an integrated approach for both watershed management and the broader management of water and land resources, such as the World Water Council's World Water Vision for 2025; the Global Water Partnership's Framework for Action; and the International Network of Basin Organizations (INBO) efforts to promote IWRM at the river basin level. Dr. Pigram concluded by offering seven principles that should be used when reviewing watershed management initiatives. These include: improved watershed management design; ownership of the design by decision-makers; clear definition of the role and structure of the management organization; strong watershed advocacy; establishing priorities for action (especially those that will achieve measurable results in the short term); and accountability.

The technical program consisted of 60 technical papers and 30 poster papers on climate change, hydrology, water quality management, watershed management, wetlands and aquatic habitats, urban water use and management, and rural and agricultural water use and management. A special session on Great Lakes Water Quantity Management and several other sessions discussed recent low lake levels, competing demands for water, impacts of climate variability, and water export and trade issues.

Of specific interest to me, was a special three-part session on Ontario Conservation Authorities that were created by the Conservation Authorities Act of 1946. The Act was passed because the provincial government believed that a new approach was needed to better manage renewable natural resources and that the experiences of the Tennessee Valley Authority (TVA), the Muskingum Watershed Conservancy District, and the Grand River Conservation Commission (Ontario) provided a guide to the implementation of river valley development in Ontario. The six principles upon which the conservation authorities were created are the adoption of the watershed as the management unit, the importance of local initiative, provincial-municipal partnership, the concept that a healthy environment is required for a healthy economy, the development of a comprehensive approach to renewable land and water resources management, and the need for cooperation and coordination of activities. A very readable history of the conservation authorities has been written by Bruce Mitchell and Dan Shrubsole ("Myth and Reality, 1992; Ontario Conservation Authorities, University of Waterloo, Dept. of Geography, Publication Series, No. 35, 366 pp.). The Grand River Conservation Authority won the $100,000 International "Riverprize" for 2000 which rewards demonstrated achievement for river management (http://www.riverfestival.com.au/).

The next annual meeting of the CWRA will be held in Winnipeg, Manitoba, on June 11-14, 2002 (http:// www.cwra.org).

GLOBAL WATER PARTNERSHIP
MEETS IN COSTA RICA

Submitted by Bernhard Griesinger
Organization of American States, Washington, D.C.

The Global Water Partnership's Technical Committee (GWP/TEC) met in San Jose, Costa Rica, on June 7-10, 2001, during which joint meetings were held with the GWP's Central American Technical Committee (GWP/CATAC) and the South American Technical Committee (GWP/SAMTAC). GWP is a network of organizations and institutions interested in water resources management and is committed to the "Dublin-Rio Principles." Its objectives are to clearly establish the principles of sustainable water resources management, identify gaps and stimulate partners to meet these needs, support action at the local, national, and regional levels, and to help match needs to available resources (http://www.gwpforum.org/). The GWP Secretariat hosted by the Swedish International Development Cooperation Agency (Sida) in Stockholm. The Technical Committee (TEC) provides professional and scientific advice to the Consulting Partners, organizations that contribute to, or use, services of the GWP and maintains the technical quality of GWP programs. The Regional Technical Advisory Committees advise on regional priorities for water resources development, the planning of needed action programs, and referrals of clients to service providers within the region. The GPW is funded by contributions from the World Bank, the U.N. Development Program, The Ford Foundation, and 11 countries. The GWP meeting in Costa Rica concentrated on discussion of the GWP work program, questions of how to implement integrated water resources management (IWRM) in Latin America and small group discussions of water pricing and private sector participation, water for food and environmental security, capacity building, ground water, water and risk, and strengthening developing river basins.

President's Message

RUNNING WATER . . . At sunrise I stretch. The air is heavy, humid. The first few steps are tenuous as I slip on the mist-covered asphalt. My stomach sloshes full of sports drink. I turn onto the highway. The grit and debris collected around the inlets crunch under my feet. After a few miles I reach the dam. Water is crashing on the rocks and blocks below and gliding over the ogee above. I turn on a gravel service road and trip on the washouts and rivulets eating away at its surface. I run past the hum and groan of the intake station pumping raw water to a treatment plant miles away. I leave the road to a trail by the lake. A grebe dives and hides. Frogs chirp and jump into the shallows as I approach. Were there more when I was young? I look for the four-posted stacks of the coal fire plant through the canopy. No smoke but a distorted shimmer above one. I reach a rest area and drink from the stainless fountain. A breeze washes over me causing a chill as the sweat evaporates. The salt stings my eyes. I walk to a pier and see a boat trolling across the lake. I cut my finger on a discarded lure and suck the blood from the wound. It too is salty. One last look as I start the trek home completing the loop. A gentle rain starts to fall. I stomp, splash, and play in the ditches. Back home my clothes are soaked and my mind cleansed. I have time to shower and make coffee before my daughter awakes.

Water resources. Everywhere, Everyday, Everyone.

John S. Grounds III, AWRA President, 2001

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FUTURE AWRA MEETINGS

2001

AUGUST 6-8, 2001 / DUNDEE, SCOTLAND
INTERNATIONAL SPECIALTY CONFERENCE
GLOBALIZATION AND WATER MANAGEMENT: THE CHANGING VALUES OF WATER

NOVEMBER 12-15, 2001 / ALBUQUERQUE, NEW MEXICO
ANNUAL WATER RESOURCES CONFERENCE

2002

MAY 13-15, 2002 / NEW ORLEANS, LOUISIANA
SPRING SPECIALTY CONFERENCE
COASTAL WATER RESOURCES

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GROUND WATER/SURFACE WATER INTERACTIONS

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PAPERS APPEARING IN THE JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION JUNE 2001 • VOL. 37 • NO. 3

TECHNICAL PAPERS

- Towards Characterizing and Planning for Drought in Vermont – Part I: A Climatological Perspective
- Towards Characterizing and Planning for Drought in Vermont – Part II: Policy Implications
- Multiple Criteria Screening of a Large Water Policy Subset Selection Problem
- Soil Moisture Sensors for Urban Landscape Irrigation: Effectiveness and Reliability
- A Tree-Ring Reconstruction of Streamflow for the Colorado Front Range
- A Spatial Linear Program for Optimally Scheduling Forest Management to Meet Stormflow Objectives
- Protecting Beijing's Municipal Water Supply Through Watershed Management: An Economic Assessment
- Floodplains and Housing Values: Implications for Flood Mitigation Projects
- Characteristics of a Long-Term Freshwater Transport in Apalachicola Bay
- Stratification of Variability in Runoff and Sediment Yield Based on Vegetation Characteristics
- Impact of a Turfgrass System on Nutrient Loadings to Surface Water
- Evaluation of the Rosgen Stream Classification System in Chequamegon-Nicolet National Forest, Wisconsin
- Simulating Flow in Regional Wetlands With the MODFLOW Wetlands Package
- Reservoir Operation and Evaluation of Downstream Flow Augmentation
- Temporal Responses of Surface-Water and Ground-Water to Precipitation in Illinois
- Stochastic Water Quality Analysis Using Reliability Method
- Macroscale Hydrologic Modeling for Regional Climate Assessment Studies in the Southeastern United States
- A Scale-Invariant Gauss-Markov Model for Design Storm Hyetographs
- On-Farm Water Conservation Practices in Southern Alberta

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Journal of the American Water Resources Association

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JT8	Retired
JT9	Computer Scientist (GIS, modeling, data mgmt., etc.)
JT10	Elected/Appointed Official
JT11	Volunteer/Interested Citizen
JT12	Non-Profit
JT13	Other _____

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CF	Consulting Firm	IN	Industry
EI	Educational Institution (faculty/staff)	LF	Law Firm
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LR	Local/Regional Gov't. Agency	RE	Retired
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		OT	Other _____

WATER RESOURCES DISCIPLINE CODES

AG	Agronomy	HY	Hydrology
BI	Biology	JR	Journalism
CH	Chemistry	LA	Law
EC	Economics	LM	Limnology
ED	Education	OE	Oceanography
EG	Engineering	PH	Physics
FO	Forestry	PS	Political Science
GR	Geography	PB	Public Health
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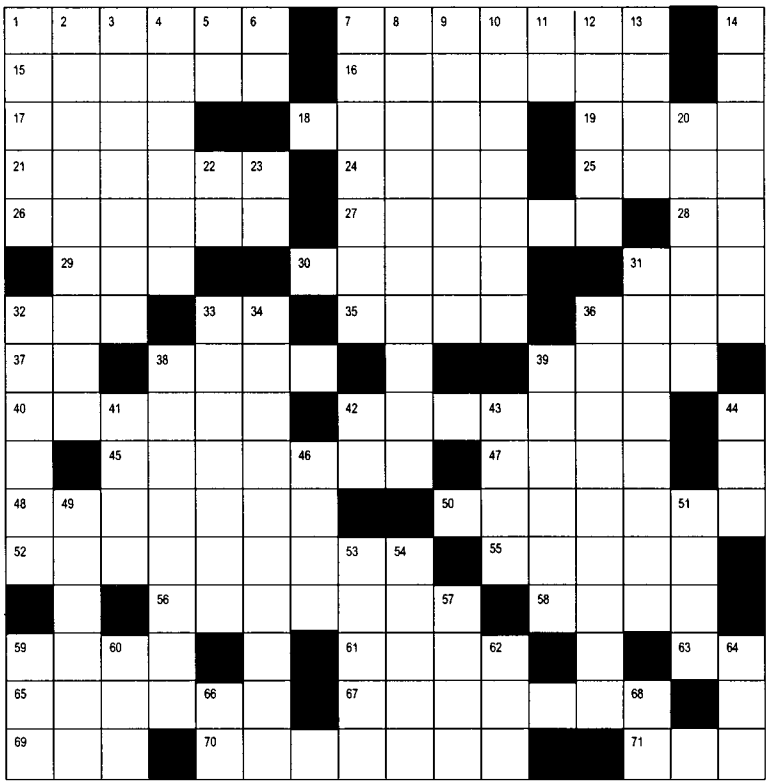
▲ Water Resources Puzzler (answers on pg. 45)



ACROSS

1 rock foundation
7 volume behind a dam
15 connected to a main computer
16 not a departure
17 island of the Marianas group
18 a single-masted vessel
19 diamonds and rubies
21 to free
24 followed by facto or jure
25 Dec. 24 and Dec. 31
26 ancient Urfa
27 New Year's Eves sounds
28 atom No. 22
29 area of 100 sq. meters
30 ruined (slang)
31 Red or Black
32 parts of quarts
33 site of Mt. Olympus
35 mailing instructions
36 an aquatic bird
37 memo heading (abbr.)
38 look intently
39 follows New Jersey or fishing
40 Java or Borneo
42 a true copy
45 show lively interest
47 IMPACT editor
48 "The Origin of _____"
50 dog breed
52 glass enclosed plant display
55 type of undergrowth
56 infuriated
58 let sleeping _____ lie
59 followed by market or collar
61 country in Asia
63 location of Saline River
65 _____, place, or thing
67 emotional
69 type of vacuum tube (abbr.)
70 discharged
71 to take in water with the tongue

DOWN

1 river in Oregon
2 covers with flood waters
3 gamblers and actors
4 full of cracks
5 symbol for actinon
6 letter of the Hebrew alphabet
7 city in West California
8 boundary of lower stratosphere
9 5th Century Spanish historian
10 fencing move
11 type of tax (abbr.)
12 follows stream
13 height (abbrl)
14 river in California
20 follows water and gas
22 location of Neosho River
23 god of wisdom
31 _____ velocity
32 river in Indiana
33 _____ violet
34 a distraction
36 Jackie Wilson's "Lonely _____"
38 insulin producer
39 got closer
41 look suggestively
42 symbol for einsteinium
43 coral strip
44 marsh or swamp
46 federal agency (abbr.)
49 kitchen implement
51 Neisse River (Polish)
53 Jamaican citrus fruits
54 intended
57 to love excessively
59 regulator of electric power (abbr.)
60 reduces chance of osteoporosis (abbr.)
62 settled soil (abbr.)
64 a tidal current
66 an electromagnetic unit (abbr.)
68 map feature (abbr.)

❖ ❖ ❖

▲ Water Resources Continuing Education Opportunities

MEETINGS, WORKSHOPS, SHORT COURSES

AUGUST 2001

23-27/9th National Nonpoint Source Monitoring Workshop. Indianapolis, IN. **Contact** CTIC, Nonpoint Source Workshop, 1220 Potter Dr., Ste 170, West Lafayette, IN 47906 (765/494-9555; f: 765/494-5969; e: ctic@ctic.purdue.edu; w: www.ctic.purdue.edu/CTIC/NPSCall.html)

SEPTEMBER 2001

2-6/IV Inter-American Dialogue 0n Water Management, Foz do Iguacu, Parana, Brazil. **Contact** Executive Secretariat, Av. Brigadeiro Luiz Antonio, 317-conj. 53,01317-901 Sao Paulo, SP, Brazil (+55 11-3104-6412; f: +55 11-3104-6412; e: dialogo@acquacon.com.br; w: www.ivdialogo.com); or Bernard Griesinger, Inter-American Water Resources Network, OAS, 1889 F St., N.W., Washington, DC 20006 (202/458-3570; f: 202/458-3560; e: bgriesinger@oas.org; w: www.iwrn.net)

9-12/Dam Safety 2001. Snowbird, UT. **Contact** ASDSO, 450 Old Vine St., 2nd Floor, Lexington, KY 40507 (859/257-5140; f: 859/323-1958; e: info@damsafety. org)

10-12/Environmental Health Risk 2001. Cardiff, Wales, UK. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK (w: www.wessex.ac.uk/ conferences/2001/envh01)

11-13/River Basin Mgmt. 2001. Cardiff, Wales, UK. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (w: www.wessex.ac.uk/conferences/ 2001/river01/)

11-14/Modflow 2001 & Other Modeling Odysseys – Internat'l. Ground Water Modeling Conf. & Workshops. Golden, CO. **Contact** Internat'l. Ground Water Modeling Ctr., 1500 Illinois St., Colorado School of Mines, Golden, CO 80401; (303/273-3103; fax: 303/384-2037; e: igwmc@mines.edu); submit abstract to: w: www.mines.edu/igwmc/events/modflow2001)

18-19/EPA Region 6 Nonpoint Source Watershed Conf. Dallas, TX. **Contact** Lee Ann Huseman, TIAER, M.S. T-0410, Stephenville, TX 76401 (254/968-9559; w: Region6ConfAnnouncement.html)

19-21/Introductory & Advanced Workshops on USEPA, SWMM4.4 & PCSWMM GIS 2000 Stormwater Modeling. Toronto, ON, Canada. **Contact** Dr. Lyn James, CHI, 36 Stuart St. Guelph, ON, Canada N1E 4S5 (519/767-0197; f: 519/767-2770; e: info@chi.on.ca; w: www.chi.on.ca)

22-23/Conf. on Stormwater & Urban Water Systems Modeling. Toronto, ON, Canada. **Contact** Dr. Lyn James, CHI, 36 Stuart St. Guelph, ON, Canada N1E 4S5 (519/767-0197; f: 519/767-2770; e: info@chi.on.ca; w: www.chi.on.ca)

24-26/Water Resources Mgmt. 2001. Halkidiki, Greece. **Contact** Conf. Secretariat WRM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (w: www.wessex.ac.uk/conferences/2001/wrm01/)

OCTOBER 2001

14-17/Hydrologic Science: Challenges for the 21st Century. Bloomington, MN. **Contact** AIH, 2499 Rice St. Ste. 135, St. Paul, MN 55113-3724 (e: AIHydro@aol.com; w: www.aihydro.org)

18-20/Nonstructural Measures for Water Management Problems. London, Ontario, Canada. **Contact** Dr. S.P. Simonovic (e: imonovic@uwo.ca)

25-27/IV Water Information Summit. Panama City, Panamá. **Contact** Lenin Montano, CATHALAC, P.O. Box 873372, Panamá 7, Rep. of Panamá (+507/317-0125; f: +507/317-0127; e: wis4@cathalac.org; w: www.cathalac.org; http://www.waterweb.org); or David W. Moody, Inter-American Water Resources Network (603/835-7900; f: 603/835-6279; e: dwmoody@beaverwood.com); or Terry Dodge, Water Web Consortium (561/961-8557; f: 561/691-8540; e: tdodge@ces.fau.edu; w: www.waterweb.org)

NOVEMBER 2001

5-9/Process Based Channel Design Short Course 2001. Vancouver, WA. **Contact** Lisa Hughes, Inter-Fluve, Inc. (406/586-6926; e: lhughes@interfluve.com; w: www.interfluve.com)

6-7/The Practice of Restoring Native Ecosystems. Nebraska City, NE. **Contact** National Arbor Day Foundation, P.O. Box 81415, Lincoln, NE 68501-1415 (402/474-5655; f: 402/474-0820; e: conferences@arborday.org)

7-9/Bridging the Gaps Between Science, Policy, & Practice – NALMS Sym. Madison, WI. **Contact** T. Thiessen (e: thiessen@nalms.org; w: www.nalms.org)

7-9/Annual Course on "Facilitating and Mediating Effective Environmental Agreements." UC-Berkeley, CA. **Contact** CONCUR (510/649-8008; e: concur@concurinc.net; w: www.concurinc.com)

12-15/AWRA's Annual Water Res. Conf. Albuquerque, NM. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

14-16/ Groundwater Technology Conf. Pittsburgh, PA. **Contact** Groundwater Foundation (402/434-2740; e: cindy@groundwater.org)

26-29/Water for Human Survival – International Regional Sym. New Delhi, India. **Contact** Mr. A.R.G. Rao, Director (Water Resources), Central Board of Irrigation and Power, India (e: cbip@nda.vsnl.net.in)

▲ Water Resources Continuing Education Opportunities . . . cont'd.

FEBRUARY 2002

25-March 1/IECA 33rd Annual Conf. Orlando, FL. **Contact** International Erosion Control Association, P.O. Box 774904, Steamboat Springs, CO 80477-4904 (970/879-3010; f: 970/879-8563; e: ecinfo@ieca.org; w: www.ieca.org)

MAY 2002

29-31/Ninth International Conf. on Hydraulic Information Management – HYDROSOFT 2002. Montreal, Canada. **Contact** Lucy Southcott, Conf. Secretatiat, HYDROSOFT 2002, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Sjouthhampton, SO40 7AA, UK (+44(0)238-029-3223; f: +44(0)238-029-2853; e: lsouthcott@wessex.ac.uk; w:www.wessex.ac.uk/conferences/2002/hy02

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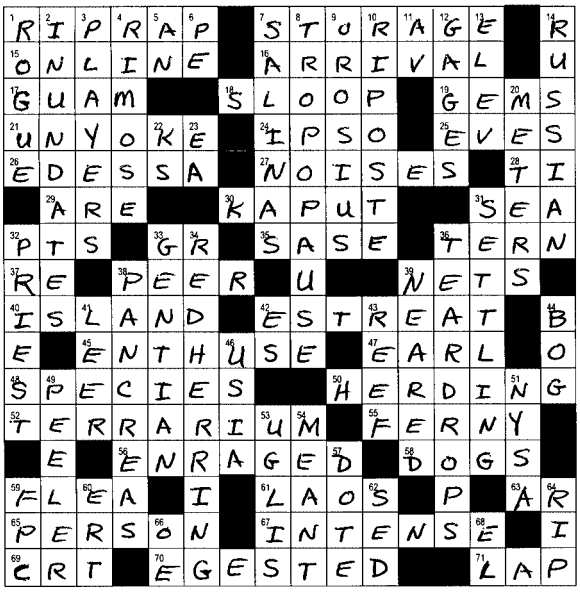
Solution to Puzzle on pg. 43



Water Resources Studies Take a Significant Hit in the Proposed 2002 Federal Budget

REPORTED BY RICHARD A. ENGBERG
AWRA TECHNICAL SPECIALIST, MAY 17, 2001

The fiscal year 2002 federal budget proposed April 9, 2001, by the Bush Administration takes direct aim at water resources in particular the water quality and quantity programs of the U. S. Geological Survey (USGS).

As reported in the April 24, 2001, issue of EOS, USGS programs would suffer a $44 million cut, or a 22 percent decrease overall.

Within the USGS water programs, the flagship National Water Quality Assessment Program (NAWQA) would be reduced by 29 percent. NAWQA, which provides long-term information on water quality conditions and ecosystem health, would be required to shrink its number of study units substantially.

Funding to modernize the nationwide stream gaging network would be eliminated completely, potentially damaging the ability of the USGS to provide critical real time information on flood forecasting and early warning.

Funding also would be eliminated completely for Water Resources Research Institutes, which train water scientists in all states.

Additionally, the Toxic Substances Hydrology Program and the Ground Water Resources Program would be cut by 71 and 40 percent, respectively.

If not revised by Congress the proposed 2002 budget means that USGS will ultimately provide much less information to user groups that have important decisions to make about water quantity and quality.

These potential program reductions should be of great concern to AWRA members and to all who use the outstanding water resources data collected by the USGS. The question must be asked – "Why is the study and analysis of water quality and quantity of such low importance to the administration?"

Submitting Articles for IMPACT . . . Contact the Associate Editor who is working on an issue that addresses a topic about which you wish to write. Associate Editors and their e-mail addresses are listed on pg. 1. You may also contact the Editor-In-Chief Earl Spangenberg and let him know your interests and he can connect you with an appropriate Associate Editor. Our target market is the "water resources professional" – primarily water resources managers and such people as planning and management staffers in local, state, and federal government and those in private practice. We don't pay for articles or departments. Our only recompense is "the rewards of a job well done."

▲ Employment Opportunity

HYDROLOGIST

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Missoula, Montana

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callahan@landandwater.net

or mail to:

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(Ref. PC-M3-01)
Land & Water Consulting, Inc.
P.O. Box 8254
Missoula, MT 59807

▲ Future Issues of IMPACT

September 2001
Richard H. McCuen, Associate Editor
HISTORICAL ASPECTS OF WATER RESOURCES
E-Mail: rhmccuen@eng.umd.edu

November 2001
Jonathan Jones, Associate Editor
URBAN BMPS AND RECEIVING WATER IMPACT
E-Mail: krwright@wrightwater.com

January 2002
Clay J. Landry
THE BUSINESS OF WATER
E-Mail: landry@perc.org

Tentative Subjects For Future Issues

Small Municipalities and Water Supply

Coastal Management Problems

Issues in Water Resources Education

Distance learning in Water Resources

International Transboundary Water Disputes

Post Fire Management

Natural Disasters / Extreme Event Planning

Urban Management Problems

Water Quality Trading

Watershed Councils Revisited

Dam Removal

If you wish to submit an article for any of the above issues, contact the Associate Editor (if listed) or the Editor-In-Chief, N. Earl Spangenberg.

Have Questions??? Contact AWRA HQ

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