

W A T E R R E S O U R C E S

IMPACT

September 2006 | Volume 8 | Number 5

**DECISION SUPPORT
FOR ADAPTING TO
CLIMATE CHANGE**

AWRA

Community, Conversation, Connections

AMERICAN WATER RESOURCES ASSOCIATION



Easy-to-use water level equipment,
because nature doesn't make anything easy.



Pressure Sensor

Bubbler

Shaft Encoder

Radar Level

© 2005 Hach Company

Turn to Hach Environmental to get the total solution for water level monitoring.

Nobody ever claimed measuring water level is a walk in the park. So Hach Environmental offers a complete line of OTT water level monitoring instruments to meet a full range of needs. Our autonomous bubbler and shaft encoder, as well as our radar level and pressure sensors are easy to install, easy to maintain and provide accurate results in unpredictable conditions. Plus, we're backing you with the superior service and support of Hach Environmental. To learn more about how we can help make your job easier, call your local sales representative or toll-free at 1-800-949-3766 ext. 1 today.



Environmental
Be Right. The Environment is Worth it.™

DECISION SUPPORT FOR ADAPTING TO CLIMATE CHANGE

Guest Associate Editors

JOHN FURLOW • jfurlow@usaid.gov

THOMAS JOHNSON • johnson.thomas@epa.gov

Climate has a profound influence on the quantity, quality, and timing of water resources available to support human needs. The impacts of climate change on water and watershed systems may present significant additional risk associated with the provision of safe, reliable water supplies, compliance with water quality regulations, and the protection of aquatic ecosystems. Coping with climate change will require tools and information that allow water and watershed managers to explicitly address the implications of climate variability and change in their decision making process. This issue of *Water Resources IMPACT* presents a series of articles addressing the need for, and examples of recently developed approaches for providing decision support to guide adaptation to climate change.

INTRODUCTION

- 4 Decision Support for Adapting to Climate Change**
Thomas Johnson and John Furlow

FEATURE ARTICLES

- 5 "The Future Ain't What It Used To Be:" Climate Change and Water Resources Management**
John Furlow (jfurlow@usaid.gov)

Infrastructure and management systems designed to deal with climatic variability are often based on the assumption that hydrologic variables do not change over time. However, several examples show that this assumption is not always valid and can lead to costly planning and design flaws. Consideration of climatic change can lead to better, more resilient design.

- 8 Elements of Effective Decision Support for Water Resource Management Under a Changing Climate**
Christopher R. Pyke (pyke.chris@epa.gov) and Roger S. Pulwarty

Effective decision support requires more than just software and hydrologic models. It requires an enabling environment for incorporating decision support as a part of an organization's learning process. Effective applications of decision support address these issues early and often, and, these considerations can make the difference between meaningful decision support and unrealized expectations for decision makers, information providers, and stakeholders.

- 11 Converting Research into Action: A Framework for Identifying Opportunities to Provide Practical Decision Support for Climate Change Adaptation**
J. Randall Freed (rfreed@icfi.com) and Frances Sussman

Despite the likelihood of significant impacts of climate change and variability, information on future climate conditions is rarely integrated into water resource decision making. This paper provides practical advice on how researchers can best assist water resource managers in adapting to future climate change.

- 15 Sensitivity Analysis as a Guide for Assessing and Managing the Impacts of Climate Change on Water Resources**
Thomas Johnson (johnson.thomas@epa.gov) and John Kittle, Jr.

Water and watershed managers can assess their exposure to climate-related risks by understanding the hydrologic sensitivity of key management goals to a wide range of plausible climatic conditions and events. This understanding can also guide the development of management strategies to reduce the likelihood of future harm. New computational tools make such analyses easier by automating modeling tasks and providing easier access to relevant information.

- 18 Implications of Climate Warming on Local Water Management in the South Fork of the American River, California**
David Yates (Yates@ucar.edu), David Purkey, Melissa Gunter, and Elizabeth Mansfield

Regional climate change could have profound impacts on drinking water utilities such as the El Dorado Irrigation District of Northern California. A new water planning tool, the Water Evaluation and Planning Decision Support System, shows how shifts in the timing of snowmelt, along with strict environmental requirements and customer needs will challenge future water needs.

- 22 A New Approach to Reducing the Vulnerability of Water Supplies to Climate Change in the U.S.-Mexico Border Area**
William A. Nitze (wnitze@gridpoint.com)

Climate change will make existing water management challenges in the U.S.-Mexico border region more severe. A new approach based on the creation of a watershed-by-watershed, bottom-up planning process led by the existing bi-national institutions responsible for water is necessary to meet those challenges and reduce the vulnerability of water supplies to climate change in the U.S.-Mexico border area.

W A T E R R E S O U R C E S

IMPACT

VOLUME 8 • NUMBER 5 • SEPTEMBER 2006

Editorial Staff

EDITOR-IN-CHIEF

N. EARL SPANGENBERG

(espangen@uwsp.edu)

University of Wisconsin-Stevens Point
Stevens Point, Wisconsin

ASSOCIATE EDITORS

FAYE ANDERSON

(faye_anderson@comcast.net)

Graduate School, USDA • Washington, D.C.

ERIC J. FITCH

(fitch@marietta.edu)

Marietta College • Marietta, Ohio

MICHELLE HENRIE

(MHenrie@BHF-Law.com)

Brownstein, Hyatt & Farber, P.C.
Albuquerque, New Mexico

JONATHAN E. JONES

(jonjones@wrightwater.com)

Wright Water Engineers • Denver, Colorado

CLAY J. LANDRY

(landry@waterexchange.com)

WestWater Research • Laramie, Wyoming

RICHARD H. MCCUEN

(rhmccuen@eng.umd.edu)

University of Maryland
College Park, Maryland

LAUREL E. PHOENIX

(phoenixl@uwgb.edu)

University of Wisconsin
Green Bay, Wisconsin

TECHNICAL DIRECTOR

RICHARD A. ENGBERG

(dick@awra.org)

AWRA • Middleburg, Virginia

BUSINESS CORRESPONDENT

CHRISTINA QUINN

(Quinn@waterexchange.com)

WestWater Research • Laramie, Wyoming

Cover Photo: The Niger River during the rainy season at Niamey, Niger.

Photo by John Furlow, USAID, Washington, D.C.



**AWRA . . . Community,
Conversation,
Connections**

A Bi-Monthly Publication of the
AMERICAN WATER RESOURCES ASSOCIATION

AMERICAN WATER RESOURCES ASSOCIATION
 4 West Federal Street • P.O. Box 1626
 Middleburg, VA 20118-1626
 (540) 687-8390 / Fax: (540) 687-8395
 E-Mail: info@awra.org • Home page: www.awra.org

EDITOR-IN-CHIEF**N. EARL SPANGENBERG**

College of Natural Resources
 University of Wisconsin-Stevens Point
 Stevens Point, WI 54481
 (715) 346-2372 • Fax: (715) 346-3624
 E-Mail: espangen@uwsp.edu
 (Support for Dr. Spangenberg is provided by the
 College of Natural Resources
 University of Wisconsin-Stevens Point)

AWRA DIRECTOR OF PUBLICATIONS PRODUCTION**CHARLENE E. YOUNG**

3077 Leeman Ferry Rd., Suite A3
 Huntsville, AL 35801-5690
 (256) 650-0701 • Fax: (256) 650-0570
 E-Mail: charlene@awra.org

Water Resources IMPACT is owned and published bi-monthly by the American Water Resources Association, 4 West Federal St., P.O. Box 1626, Middleburg, Virginia 20118-1626, USA. The yearly subscription rate is \$80.00 domestic and \$95.00 for International subscribers. For the International Airmail Shipping Option, add \$50.00 to the subscription rate. Single copies of *IMPACT* are available for \$10.00/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.

Mention of any trademark or proprietary product in works published in the *Water Resources IMPACT* does not constitute a guarantee or warranty of the product by the American Water Resources Association and does not imply its approval to the exclusion of other products that may also be suitable.

Contact the AWRA HQ Office if you have any questions pertaining to your membership status. For information on advertising rates and deadlines, contact Charlene Young, AWRA Director of Publications Production, at the address given above.

POSTMASTER: Send address changes to *Water Resources IMPACT*, American Water Resources Association, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626. Copyright © 2006 by the American Water Resources Association.

• VOL. 8 • NO. 5 • SEPTEMBER 2006 •
 ISSN 1522-3175

Other features in this issue ...

- ▲ Student Opportunities24
- ▲ The New Economy of Water25-26
- ▲ What's Up With Water (New Column!)27-28
- ▲ Take Charge of Your Career29-30
- ▲ Water Resources Puzzler31
- ▲ AWRA Business ...

12 Send Us Your "Feedback"**21 Wetlands Restoration Dialogue Announcement****24 August 2006 JAWRA Book Reviews****26 AWRA Future Meetings****28 President's Message****32 Spring Conf. Student Presenter Competition****34 Herbert Scholarship Award Winners****32 2006 Election Results****36 August 2006 JAWRA Papers****36 Water Res. Continuing Education Opportunities****37 AWRA 2006 Membership Application**

A Note From the Editor-In-Chief ... With this issue, we are pleased to welcome a new columnist to the pages of *IMPACT*. Eric Fitch has joined Clay Landry and agreed to put on a different hat – as a regular columnist – to bring ideas, opinions, and a variety of points of view to us in each issue of *IMPACT*. Look for Clay and Eric to be with us on a regular basis. As always, they look forward to your opinions as well. Do not hesitate to contact us with your responses to articles and their opinion columns (see "Feedback" on pg. 12).

Scheduled Topics for Future Issues ...**NOVEMBER 2006****GLOBAL WATER FUTURES**

FAYE ANDERSON (faye_anderson@comcast.net)

JANUARY 2007**ENERGY AND WATER**

ERIC J. FITCH (fitch@marietta.edu)

LAUREL E. PHOENIX (phoenixl@uwgb.edu)

MARCH 2007**WATER RIGHTS AND WRONGS**

MICHELLE HENRIE (MHENRIE@BHF-LAW.COM)

MAY 2007**EMERGING CONTAMINANTS IN WATER RESOURCES**

WILLIAM A. BATTAGLIN (GUEST EDITOR) (WBATTAGL@USGS.GOV)

JONATHAN E. JONES (JONJONES@WRIGHTWATER.COM)

JULY 2007**INSTREAM FLOWS**

CLAY J. LANDRY (LANDRY@WATEREXCHANGE.COM)

All of the topics listed above are subject to change. For information concerning submitting an article to be included in the above issues, contact the designated Associate Editor or the Editor-In-Chief N. Earl Spangenberg at (espangen@uwsp.edu).

**AWRA**

Community
 Conversation
 Connections