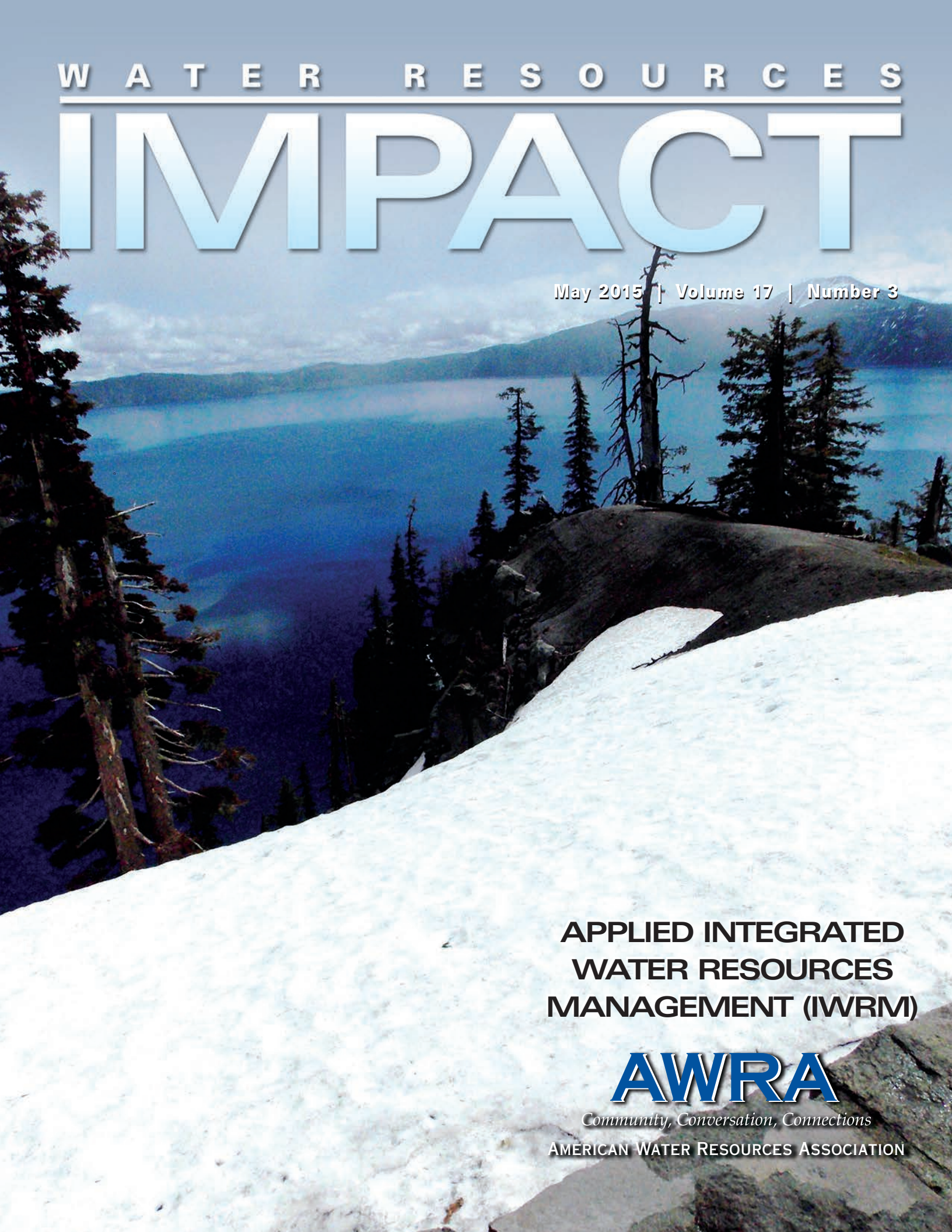
WATER RESOURCES

# IMPACT

May 2015 | Volume 17 | Number 3



## APPLIED INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)

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# APPLIED INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)

**Guest Editors**
**RICHARD A. ENGBERG ~ dick@awra.org**
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Integrated Water Resources Management (IWRM) was defined in 2000 by the Global Water Partnership as "A process which promotes the coordinated development and management of water, land, and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." In 2012, the American Water Resources Association initiated a yearly award to recognize an outstanding water resources project in the United States that was conducted using IWRM. In 2014, 12 projects were nominated for the award. This issue of *IMPACT* highlights nine of these projects all of which were excellent. The project described in the lead article written by Ian Achimore of the Santa Ana Watershed Project Authority was judged the winner of the 2014 award. The guest editors for this issue congratulate the winner and the eight runners up in a contest almost too close to call.

## FEATURE IWRM ARTICLES



## IN ADDITION



WATER RESOURCES
# IMPACT

VOLUME 17 • NUMBER 3 • MAY 2015

## Other features in this issue ...



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*A Bi-Monthly Publication of the*
**AMERICAN WATER RESOURCES ASSOCIATION**

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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, Virginia 20118-1626, USA. The yearly subscription rate is $80.00 domestic and $95.00 for international subscribers. For the International Priority Shipping Option, add $50.00 to the international subscription rate. Single copies of *IMPACT* are available for $15.00/each (domestic) and $20.00/each (international). For bulk purchases, contact the AWRA Headquarters (HQ) office.

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**• VOL. 17 • NO. 3 • MAY 2015 •**
**ISSN 1522-3175**

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**Cover Photo: Crater Lake, Oregon, late May 2014. Courtesy of Richard A. Engberg.**

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WATER RESOURCES IMPACT

# ONE WATER, ONE WATERSHED

IAN ACHIMORE

## INTRODUCTION

Water managers of the 21st Century can no longer conduct business as usual and operate in their own silos because there are immediate and long term water supply and demand challenges that affect the entire surrounding region. These challenges will ultimately affect the constituents of each agency that the water manager serves. The One Water One Watershed (OWOW) 2.0 Plan is the Santa Ana River Watershed's Integrated Regional Water Management Plan (IRWMP) and provides the foundation for collaborative, strategic partnerships and builds upon other successful planning efforts in the region. The OWOW 2.0 Plan encompasses the efforts of planning done among over 100 large and small water districts, local, regional, State and Federal agencies, and public/private stakeholder groups that exist in the 2,840 square mile Santa Ana River Watershed in Southern California.

## CHALLENGES TO THE WATERSHED

The Santa Ana River Watershed, which includes parts of San Bernardino, Orange, and Riverside Counties and a sliver of Los Angeles County, faces enormous challenges as it strives to adapt to changing conditions, many of which are at an unprecedented scale in its modern history. The Santa Ana River Watershed, already one of the most densely populated areas in California, continues to grow and urbanize, increasing demands on water supply, water quality, and flood management. According to the U.S. Census Bureau, the watershed had a population of 5.9 million in 2010 and is expected to reach 9.9 million by 2050, or an average annual growth rate of 1.3 percent. Even with the watershed's plentiful groundwater resources, several subwatersheds now are experiencing declining groundwater levels and overdraft conditions. With the uncertainties of climate change and its impacts, environmental concerns are taking even greater precedence than ever, affecting how water is managed for the future.

As part of the OWOW 2.0 Plan, the Santa Ana River Watershed labeled its challenges and threats as the "Six Horsemen of the Apocalypse." The Horsemen are:

1. Climate Change resulting in reduced water supplies combined with increased water needs in the region.
2. Colorado River Basin drought conditions resulting in pressures on imported supply due to upper basin entitlements and continued long-term drought.
3. San Joaquin-Bay Delta Vulnerability resulting in loss of supply due to catastrophic levee failure or changing management practices of the Delta.
4. Population Growth and Development resulting in interruptions in hydrology and groundwater recharge while increasing water needs.
5. Energy Crises resulting in recent energy developments such as the closure of the San Onofre Nuclear Generating Station, have forced the recognition of the water-energy nexus.
6. Fiscal Crises resulting in the impacts of the Great Recession commonly marked by a global economic decline that began in December 2007. Some say an epicenter was the Inland Empire.

## GENESIS OF THE WATERSHED'S PLAN

The genesis of the "One Water One Watershed" name is the recognition of the need for stakeholders across the watershed to develop an integrated water resource plan, where all types of water (local surface and groundwater, imported water, stormwater, and treated wastewater effluent) are viewed in a comprehensive, integrated manner as a single water resource. Historically, water activities were organized into different silos, and managers worked to achieve separate and individual goals that were thought to be unrelated. The water supplier's goal was to deliver water for a growing population and economy. The flood control manager's goal was to channelize stormwater away from the community before it could harm people and property. The wastewater manager's goal was to highly treat wastewater before it is discharged into the river or ocean to be carried away. Managing the watershed and water resources as done in the past achieved narrow singular goals, but did so with tremendous unintended consequences. The list of endangered species only grew longer, as did the list of impaired water bodies. Societal values have changed, water and funds are scarcer, and together agencies and stakeholders have realized that the old way is no longer viable.

The OWOW 2.0 Plan was developed over two years. Over that time, water resource managers from every sector worked together, through workgroups of experts and stakeholders referred to as "Pillars" organized generally based on water resource management strategies, to write the OWOW 2.0 Plan. The strategies of the OWOW 2.0 Plan, which are cemented in the Plan's strategies were distilled from that work and will serve to guide future planning and management in the Santa Ana River Watershed.

To deal with the six horsemen, most agree that the water management approaches of the past several decades are no longer sustainable in today's environment and economic climate. And most agree that a more integrated and collaborative approach to water resource management will show tremendous promise to water resources everywhere. But in the Santa Ana River Watershed, this approach is not new; it has been the watershed's practice and legacy since the first integrated plan was approved in 1998.

## MEASURING PROGRESS

In order to track progress, the Santa Ana Watershed Project Authority (SAWPA) which serves as the watershed's Regional Water Management Group, developed a system to monitor the implementation of the OWOW 2.0 Plan and projects implemented under OWOW. The monitoring takes place at two levels, the plan level and project level, to:

- Ensure progress is being made toward meeting objectives of the Plan.
- Ensure specific projects identified in the Plan are being implemented as planned in terms of schedule, budget, and technical specifications.
- Identify potential necessary modifications to the Plan or to specific projects, to more efficiently and effectively accomplish the goals and objectives of the Plan.
- Provide transparency and accountability regarding the disbursement and use of funds for project implementation.

To tie the Plan and project monitoring together, SAWPA recognized the need for an interface process of measuring progress on meeting the goals and objectives, as well as the health of the Santa Ana River Watershed. SAWPA engaged the services of the Council for Watershed Health, a nonprofit organization, and Dr. Fraser Shilling of the University of California, Davis, to develop a watershed assessment framework for the Santa Ana River Watershed. The Council and Dr. Shilling worked with the OWOW Pillars to update the watershed management goals, establish planning targets, and utilize data indicators from existing datasets to track progress. With the input of SAWPA staff, a new tracking computer tool was created, incorporating this work that will allow managers to evaluate and assess progress, and assure actionable results for implementation.

## ACHIEVING SOLUTIONS

With the development of the OWOW 2.0 Plan, there have been many multibeneficial projects and programs that have been proposed and funded for the improvement of communities and water agencies alike. These projects have been financed by state bond funds, through the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84), and local funding sources. Implementation of these projects and programs has begun to provide both regional and interregional benefits. These benefits include:

- Reducing landscape irrigation demand by 9,000 acre feet per year (AFY).
- Capturing 42,000 AFY of stormwater for recharge.
- Producing 18,000 AFY of desalted groundwater.
- Removing 25,000 tons of salt from groundwater each year.
- Creating 9,000 AFY of additional recycled water.
- Restoring 3,000 acres of environmental habitat.
- Creating about 6,700 construction related jobs.
- In total, the reduced demand of water imported from the Sacramento Bay Delta is 78,000 AFY. This is the equivalent of water used by about 156,000 households.

## DEALING WITH DROUGHT

One of the immediate challenges to the watershed is the unprecedented and ongoing drought. California's Governor, Edmund Gerald "Jerry" Brown, Jr., declared a drought state of emergency on January 17, 2014. Through OWOW 2.0, agencies throughout the Santa Ana River Watershed developed a $22 million Emergency Drought Grant Program that focuses on water use efficiency across the region. The Program includes several components such as watershed aerial imagery, tools and support for retail water agencies to develop conservation-based water rates, web-based and informational tools to encourage conservation at the customer level, and funding to create market incentives for commercial entities to retrofit turf grass to drought tolerant landscaping. The Program will be implemented over a three year time period and the estimated water savings are 8,725 AFY.

## FUTURE PROGRAMS AND PROJECTS TO DEAL WITH CHALLENGES

SAWPA has initiated the 2015 OWOW Implementation in order to engender projects and programs that are multibenefit, multijurisdictional and watershed wide. Projects and programs will be eligible to be a part of the OWOW 2.0 Plan and/or receive state bond funds if they follow a hydrological system approach and benefit the environment and people living across the Santa Ana River Watershed. Developing system based programs or projects means that the proposal follows the natural hydrology and pre-existing infrastructure to identify where the water flows, how it is put in the river system (such as stormwater capture), who takes it out and where they return it after treatment, and how it is used both upstream and downstream by people and the environment; and then develops solutions driven by the natural hydrology, not political or jurisdiction boundaries. Through ongoing workshops focused on the OWOW 2015 Implementation held at SAWPA, speakers will describe their system wide projects similar to the Inland Empire Brine Line and the Colorado River Basin Salinity Forum, and will coordinate with agencies across the watershed to find linkages between their projects and programs. The Santa Ana River Watershed is fortunate that a lot of its natural hydrology is intact, but recognition is given to the importance of taking steps where possible to preserve that natural hydrology. That is, the natural movement, distribution and properties of water as it passes through the watershed, because it maximizes the use of the water drop most efficiently before being lost to the sea.

## LOOKING FORWARD

OWOW 2.0 has also created relationships and synergies between the water purveyors, conservationists,

remediators, the energy community, etc., within the watershed. The OWOW "bottom-up" approach of vetting solutions and implementation actions by Pillar groups has allowed for an effective method for identifying an acceptable path forward for the watershed.

Managing the Santa Ana River Watershed has required actors at multiple scales of management and with vastly different authorities and responsibilities to provide their judgment and expertise. It is a dynamic process, especially in light of the long term challenges the watershed faces with climate change, population growth and the drought, but the OWOW 2.0 Plan is equipping the region with the tools and programs to adapt.

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## HIGHLIGHTS OF JAWRA TECHNICAL PAPERS • APRIL 2015 • VOL. 51 • NO. 2

**EDITORIAL: Editor Jim Wigington discusses the nature of JAWRA multidisciplinary water resources journal articles.**

**FEATURED COLLECTION: CONSERVATION EFFECTS ASSESSMENT PROJECTS**

- **Rittenberg *et al.,*** present a conceptual framework that relates agricultural Best Management Practice (BMP) effectiveness with dominant hydrological flow paths to improve nonpoint source pollution management.
- **Boll *et al.,*** modify the Water Erosion Prediction Project Model (WEPP) to simulate subsurface flow and associated hydrologic processes.
- **Brooks *et al.,*** present an approach, based on the WEPP model and a pesticide transport model, to identify dominant hydrologic flowpaths and critical source areas for a variety of pollution types. The approach is used to assess BMP effectiveness.
- **Kurkalova** reviews the cost-effective placement of best management practices in a watershed.

**OTHER TECHNICAL PAPERS:**

- **Lisle *et al.,*** discuss whether or not rapid assessment protocols should be used to judge sediment impairment in gravel-bed streams.
- **Lackey and Stein** evaluate alternative statistical survey designs for monitoring wetland area and detecting changes over time in California.
- **Mateus *et al.,*** examine the hydrologic sensitivity of a Pacific Northwest river drainage basin to climate and land use changes.
- In the first of two papers, **Flynn *et al.,*** present a model-based approach for developing large river nitrogen and phosphorus criteria. In the second paper, **Suplee *et al.,*** describe criteria development processes using the approach.
- In companion papers, **VanLandeghem *et al.,*** evaluate associations of physicochemistry and nutrient attributes of Texas Upper Colorado River basin reservoirs with invasive, harmful alga *Prymnesium parvum*.
- **Fleming *et al.,*** develop and test a super-ensemble artificial intelligence flood-forecast model for a Pacific Northwest river.
- **Lyon *et al.,*** evaluate the ability of the Catchment SIMulation (CSIM) hydrologic model to describe seasonal and regional variations in river discharge over the entire Baltic Sea drainage basin.

**A full Table of Contents may be viewed at**
**http://www.onlinelibrary.wiley.com/doi/10.1111/jawr.2015.51.issue-2/issuetoc**

**JAWRA ~ Journal of the American Water Resources Association**

WATER RESOURCES IMPACT

# VOLUNTARY INCENTIVES PROGRAM PROTECTS FORESTS AND FLOODPLAINS FOR DRINKING WATER

DANIELLE DUMONT AND KARL MORGENSTERN

The McKenzie River is the sole source of drinking water for more than 200,000 residents of the Eugene, Oregon, area, as well as being the last stronghold for native Upper Willamette River Spring Chinook and Columbia River Bull Trout (Figure 1). The McKenzie River also has high scenic, recreational, residential property, agricultural and forestry value. The river is fed by a large spring system in the upper watershed that provides an excellent source of clean and abundant water throughout the year.

The Eugene Water & Electric Board (EWEB), the region's oldest publicly-owned utility, developed a source water protection program in 2000 to address threats to the McKenzie River. Integrating input from a variety of watershed stakeholders, EWEB designed a comprehensive program to protect the McKenzie River as a reliable source of excellent drinking water.

Specific objectives of the EWEB source water protection plan include:

- Prevent, minimize, and mitigate activities that have known or potentially harmful impacts on source water quality.
- Promote public awareness and stewardship of a healthy watershed in partnership with others.
- Protect against future expenses such as increased treatment costs, increased disinfection by-product formation, taste and odor problems, and dealing with the effects of hazardous material spills

## SOURCE WATER PROTECTION SOLUTION

The main goal of EWEB's source protection program is to manage the balance between watershed health and human use over time. Approximately 4% of the McKenzie watershed's 832,000 acres is in agricultural use and 1% is in residential and industrial use. The majority of the remaining acres is in forest uses, including private and public land and wilderness areas.

Assessed threats to water quality from human use include:

- Use of pesticides and fertilizers.
- Contamination from septic systems.
- Contamination from chemicals or hazardous material spills and during flood events.
- Increased erosion and sediment from development.
- Removal of native streamside vegetation.

One area of focus is maintaining healthy riparian (streamside) forests while also restoring degraded riparian areas. Healthy riparian forests provide a suite of benefits for downstream water users including flood mitigation, erosion control, pollutant filtration, and water cooling shade.

Protecting drinking water sources frequently involves collaboration between utilities; natural resource agencies; local, state, and federal government; industry; farmers; residents and other stakeholders. This is especially true in the McKenzie watershed, where EWEB owns very little land and has no jurisdictional authority over how the watershed is managed.

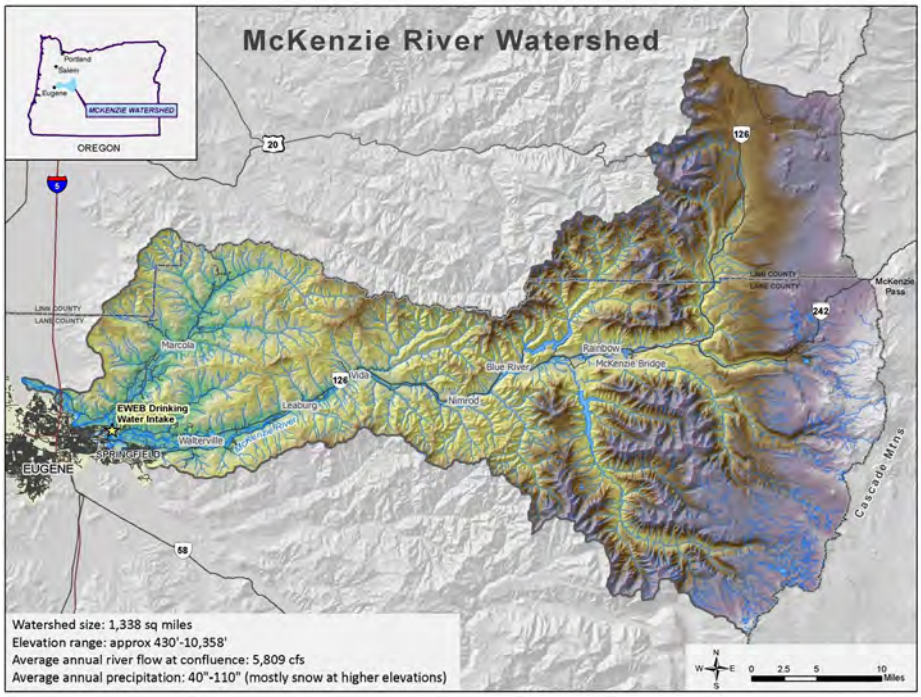


Figure 1. The McKenzie River and its Tributaries, Primarily Forested, is the Sole Source of Drinking Water for the Cities of Eugene and Springfield, OR.

### Voluntary Incentives Program

In 2011, EWEB began working with a number of partners and landowners on a Voluntary Incentives Program (VIP) that compensates landowners for protecting healthy riparian forests while also encouraging restoration of degraded areas. In 2014, EWEB and its partners began implementing a pilot project with 15 landowners to test drive this concept;

the results of the pilot will inform the feasibility of full implementation in 2016.

### Participatory Decision Making: Landowner Involvement

EWEB sought feedback on the VIP by hosting several public meetings for landowners and then forming a Landowner Advisory Committee, which met monthly to provide feedback on the design of the program as it was developed.

Additionally, the University of Oregon and Oregon State University conducted surveys with EWEB customers and McKenzie watershed landowners. The surveys measured the understanding of valuing natural processes and the acceptance for using customer rates to reward rural landowners who maintain healthy riparian forests. The results indicated that approximately 75% of EWEB ratepayers were supportive or very supportive of a line item assessment fee that would assist in funding a VIP that benefits water quality. Landowner survey results indicated 47% support protecting healthy streamside forests. Approximately 25% of landowners responded "Don't Know," which indicates proper program design, messaging, and roll out may move these landowners into a more supportive position.

### Collaboration on Scientific Design of Source Water Program

EWEB also partnered with The Freshwater Trust (The Trust), a local nonprofit river restoration organization, to develop and lead a field survey of functional riparian areas in the watershed. The Trust along with local partners collected and analyzed data to define the subbasin specific characteristics and plant communities that constitute a healthy riparian system.

To improve data collection efforts, The Trust used its tablet application called StreamBank Monitoring that allows for more efficient field work and data analysis (Figure 2). The Trust then built a field protocol and metrics for the VIP and applied the protocol to private landowner pilot sites. Landowner riparian conditions were compared to reference site conditions to determine landowner eligibility for protection incentives or to recommend restoration pathways. Additional analysis using LiDAR allowed the team to focus resources on landowner sites that have highest value for protection or restoration across the watershed.

### Addressing Water and Land Resources and Program Eligibility

The VIP focuses on approximately 8,200 acres of riparian forest lands and floodplains (more than 2,700 tax lots) along the McKenzie River and its tributaries. Participation is open to private landowners and nonprofit organizations that own land within this designated stewardship boundary.

Land within the boundary needs to meet a threshold in order to qualify to receive annual payments and other incentives in return for long-term protection agreements. This threshold was determined by adapting existing riparian forest and wetland habitat standards and definitions from the National Resources Conservation Service, U.S. Forest Service, Defenders of Wildlife, and other entities. Landowners who do not meet the threshold for compensation can still enter the VIP in order to implement restoration projects of riparian areas and potentially become eligible for future protection incentives.

### LONG-TERM MANAGEMENT AND FUNDING

EWEB rate payer funds and grants from the Oregon Watershed Enhancement Board (OWEB) provided funding for the VIP pilot project. EWEB plans to set up a fund with sustainable financing to support payments for landowners as well as restoration costs. Financing may come from a variety of sources including existing rates, corporate sponsorship, development impact fees, state and federal mitigation programs, and grants from foundations. A business sponsorship program is being developed as part of the pilot to increase incentives for landowners to enter the VIP and provide economic opportunities for businesses to grow the protection and restoration economy.

### RESULTS FROM INTEGRATED APPROACH

Taking an integrated water resource management approach that involves a wide range of partners and stakeholders in the design of the VIP has helped to create a robust pilot program that is both scientifically sound and reflective of the needs and interests of all parties. Engaging landowners and customers in the process will increase the level of buy-in as EWEB moves forward with this program.

Figure 2. A Project Partner Uses the StreamBank Monitoring App to Record Habitat Features in the McKenzie River Watershed to Build a Field Protocol for Healthy Riparian Systems.

Successful early outcomes from the pilot project include:

- Local partners hired new staff.
- Landowners signed agreements to participate.
- Detailed riparian assessments collected.
- Diverse funding and resources aligned and focused
- Business sponsors recruited with outreach messages around the value of water and natural systems.

EWEB expects the effectiveness of this integrated approach will provide watershed resiliency for both the impacts of a changing climate and increasing development pressure along the river.

Additionally, the VIP leverages restoration work already underway in the McKenzie watershed. The Trust is also working with the Metropolitan Wastewater Management Commission of Eugene/Springfield, whose restoration program is working to address temperature and water quality issues by increasing streamside vegetation. Together, these programs begin to build the framework for a holistic source water protection approach including multiple stakeholders.

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**VIP DEVELOPMENT PARTNERS**

- **Eugene Water & Electric Board**
- **Cascade Pacific Resource Conservation & Development**
- **Lane Council of Governments**
- **McKenzie Watershed Council**
- **Oregon State University Department of Forestry**
- **Oregon Watershed Enhancement Board**
- **The Freshwater Trust**
- **University of Oregon Community Planning Workshop**
- **Upper Willamette Soil & Water Conservation District**

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## ▲ SCHEDULED FUTURE TOPICS FOR 2015 ISSUES OF WATER RESOURCES IMPACT

**JULY 2015**
**FIRST PEOPLES AND WATER: WATER RESOURCE ISSUES FOR NATIVE AMERICANS**
**Lisa Beutler ~ Associate Editor ~ lisa-beutler@comcast.net**

**SEPTEMBER 2015**
**URBAN WATERSHEDS AND WATERFRONTS**
**Joe Berg ~ Associate Editor ~ jberg@biohabitats.com**

**NOVEMBER 2015**
**HYDROPHILANTHROPY**
**Mae Davenport ~ Associate Editor ~ mdaven@umn.edu**

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WATER RESOURCES
IMPACT

# THE SEVERE STORM PREDICTION, EDUCATION, AND EVACUATION FROM DISASTER (SSPEED) CENTER AT RICE UNIVERSITY

PHILIP B. BEDIENT

In 2008, Hurricane Ike hit landfall on the Gulf Coast, exposing the region's vulnerabilities. The hurricane caused $25 billion in damages and took 20 lives. The Severe Storm Prediction, Education, and Evacuation from Disaster (SSPEED) Center at Rice University was in its early years of operation with the goal to protect the region from severe storms and hurricanes through research and proposed storm mitigation strategies. Funding was largely provided by a grant from the Houston Endowment. The Ike event provided the SSPEED Center tangible data points on the Gulf Coast's exposures to severe storms in our region's neighborhoods, industries, and ecosystems.

## EARLY WORK OF SSPEED CENTER

The SSPEED Center uncovered the specificities of our region's vulnerable areas and began outlining protection strategies for the Gulf Coast by evaluating how "multiple lines of defense" could be used through structural and nonstructural alternatives to protect both residential and industrial development. Moreover, we had to rely on the recommendations that are designed to protect the community's larger resources, such as industry in the Houston Ship Channel, as well as the city's neighborhoods and communities. Detailed analysis within geographic information systems (GIS) allowed for the most accurate damage estimates possible for the region.

The first few years of our work was focused primarily on identifying the impact of Hurricane Ike on the region and engaging with Houston and Galveston area leaders in various fields related to storm protection. During this time, the SSPEED Center released a book, "Lessons from Hurricane Ike," which was designed as a resource of the general public and contained detailed chapters on related topics and proposals for future protection, as well as photography of the storm's impact on the Gulf Coast community. We also began hosting several conferences, symposia, workshops, and other events each year to engage with the local community, gather their input and implement them into our proposals for protection. We conducted dozens of meetings with local leaders and stakeholders to keep them abreast of the direction of our current projects.

## THE FORMATION OF HOUSTON-GALVESTON AREA PROTECTION SYSTEM

In late 2014, the SSPEED Center introduced the development of the Houston-Galveston Area Protection System (HGAPS). This system is specifically designed to protect industries along the ship channel and the Bayport area and surge prone residential development in the Clear Lake and Galveston Island communities. This comprehensive protection strategy includes the SSPEED Center's proposed Centennial Gate, the Lone Star Coastal Recreation Area, and the Texas Coastal Exchange. A number of other levees along road corridors on Galveston and Bolivar, oyster reefs, and surge gate barriers are also included in the overll proposal for study (see Figure 1 for details on HGAPS).

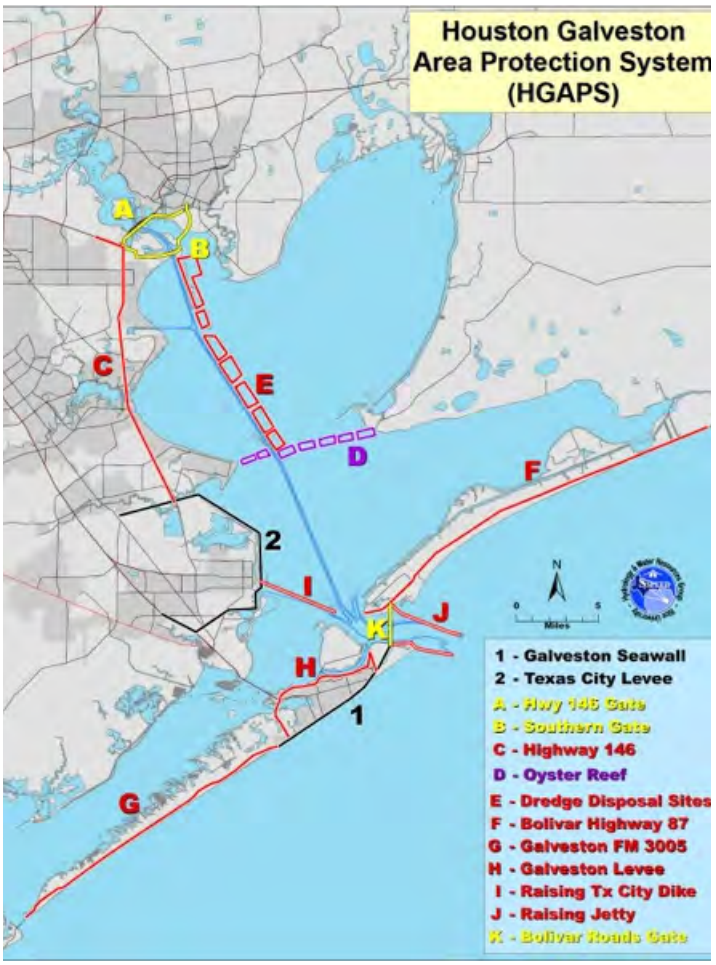


Figure 1. Houston Galveston Area Protection System (HGAPS).

The proposed Centennial Gate is a Rotterdam-style floodgate near the Fred Hartman Bridge and is designed to protect the region's core industries along the Houston Ship Channel. This gate design has been coordinated with experts at Delft University of Technology (TU-Delft). The SSPEED Center has received strong support on this project from the City of Houston and the Port of Houston Authority. Advanced hydrologic models combined with excellent coastal science, and modern hydrologic/GIS

distributed models, are being used to help address the complex problem of heavy Gulf Coast rainfall as it interacts with hurricane storm surge. In this way, a sustainable group of solutions can emerge for the region.

The SSPEED Center has also proposed the Lone Star Coastal National Recreation Area (LSCNRA). This is a nonstructural alternative that could serve as a natural buffer for a tremendous amount of storm surge tide, reducing flooding and property damage further inland. Assembling underdeveloped lands along the Upper Texas Coast into a National Recreation Area could preserve critical flood control capacity while generating signifiant economic advantages for local communities. Former Secretary of State James Baker is supporting this proposal and the project is being packaged for delivery to the U.S. Congress for approval this year.

The SSPEED Center's proposed Texas Coastal Exchange is another nonstructural alternative distinct from the LSCNRA and involves creating a supplemental farm and ranch economy associated with restoring the ecosystem service value of natural coastal ecosystems and allowing for the buying and selling of these services. We are currently evaluating metrics and values of services provided by coastal ecosystems.

## BUILDING CONSENSUS ON PROTECTION STRATEGIES

One of the most challenging parts of the work of the SSPEED Center is encouraging the greater Gulf Coast community to adopt our proposals. We continue to host several conferences, symposia, workshops, and other events each year to engage with the local community, gather their input and implement them into our proposals for protection. We have dozens of meetings with local leaders and stakeholders to keep them abreast of the direction of our current projects.

We have worked alongside the Houston Mayor's office and other political figures in the region, as well as the Army Corps of Engineers, industry representatives and residential associations to ensure that our proposed solutions include input from the diverse viewpoints of the region, as well as help us build a consensus on protection strategies.

At our annual SSPEED Conference in 2012, the SSPEED Center hosted a workshop for the Clear Lake area. This workshop provided a platform for discussion among local stakeholders about the mitigation strategies presented at the conference and an opportunity for citizens to provide feedback and recommendations that affect their community. SSPEED has also hosted short courses on emergency management preparations for hurricane response and severe storm modeling for engineers and decison makers.

The effectiveness and efficiency of our proposed solutions for mitigating severe storms and hurricanes can be proven through our advanced modeling and research. We are still building our data to share with the industry, political representatives, and people groups along the Gulf Coast to ensure that we have the acceptability needed to begin our implementation phase.

## OUR NEXT STEP

With the next phase of funding from the Houston Endowment (will continue through 2017), the SSPEED Center will begin to conduct regional evaluatons of the various alternative proposals that have been put forward for regional storm protection. The SSPEED Center and Texas A&M University-Galveston, with their respective reserch teams, have been studying strategies for surge suppression for the Galveston Bay Region and are the only ongoing efforts at this time. SSPEED had been concentrating its eforts on suppressing surge using barriers internal to the Bay system and nonstructural alternatives, while Texas A&M-Galveston has cenentrated on methods to stop the surge at the coast using a continuous coastal barrier – the "Ike Dike" concept. Both Texas A&M-Galveston and the SSPEED Center are now coordinating their research efforts with an eye towards ultimately combining their various strategies into a single surge reduction plan having "Multiple Lines of Defense" to achieve the best overall solution for the region from an economic, environmental, and social perspective. In combination with the LSCNRA, these solutions provide a sustainable future for the Houston-Galveston region. A single direct hit from a major hurricane surge in the HSC event could easily generate 60 to 100 billion impacts to the national economy.

The SSPEED Center has helped in the improvement of institutional capacity at all levels, as university researchers present their results to both concerned stakeholders and the general public in numerous forums where ideas are exchanged. We look forward to seeing our proposals transition from an exchange of ideas to implemented solutions that protect our neighborhoods and industries from severe storms and hurricanes.

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WATER RESOURCES IMPACT

# CALIFORNIA DEPARTMENT OF WATER RESOURCES: CALIFORNIA'S FLOOD FUTURE

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Flood disasters are an unfortunate reality in California. While agencies such as the U.S. Army Corps of Engineers (USACE) have worked on statewide efforts, historically, the California Department of Water Resources (DWR) focused its flood management efforts on the Central Valley, due to a legislative mandate. However, understanding the impacts of and issues related to flood management throughout California is important because of the state's significant flood risk and the variability of the type and severity of flooding across the state.

Realizing this, DWR in 2013 teamed up with the USACE to develop a comprehensive look at statewide flood risk in California. The result was *California's Flood Future: Recommendations for Managing the State's Flood Risk*, which assesses the state's flood risk to determine actions that can help reduce the impacts of flooding. The report includes seven recommendations to reduce flood risk and improve flood management. Information and technical data for the report were received from 142 public agencies throughout California.

*California's Flood Future* revealed a sobering truth: California is at serious risk of flooding. In fact, over the last six decades, California has experienced more than 30 major flood events, resulting in more than 300 lives lost and billions of dollars in disaster claims. One in five Californians lives within a floodplain and more than $580 billion in assets including crops, buildings, and public infrastructure are exposed to the hazards of flooding in the state. In addition to tragic loss of life, catastrophic flooding could have unprecedented impacts on the state's economy and environmental resources. When California floods, critical infrastructure can be damaged, vital services can become isolated or closed, vast areas of agricultural lands become unproductive, and water supplies and water quality can be affected – the extent of the damage depends on the nature and severity of the flooding.

*California's Flood Future* was developed using a stakeholder-driven process that gathered information from local agencies and utilized a County Engineers Association of California flood committee as a sounding board for draft findings. All three USACE districts in California (Los Angeles, Sacramento, and San Francisco) as well as the South Pacific Division collaborated with DWR on this project. This was an unprecedented effort in terms of collaboration internally within DWR and USACE, with each other, and with local agencies statewide.

To develop *California's Flood Future*, the project team first conducted an extensive statewide information-gathering effort to learn about flood risk, as well as planning and implementation challenges and opportunities at the local level. After meeting with 142 agencies representing every county in California, the project team consolidated information to develop a comprehensive report. The report consists of a *Highlights* document, main report, and seven technical attachments, which include a mapbook for each of California's 58 counties. The mapbook contains information on each county's flood risk, flood infrastructure, types of flooding, and historic flood events. The seven technical attachments focus on how an integrated water management approach can be used on flood related projects, the information gathering process and results, flood exposure in California, the history of flooding in the state, flood risk understanding and assessments in California, financing of flood management, and other flood management issues.

*California's Flood Future* identifieds seven recommendations with accompanying goals and strategies to achieve improved flood management using an integrated approach:

### 1. Conduct Regional Flood Risk Assessments to Better Understand Statewide Flood Risk

**Goal:** Consistent and locally appropriate assessments of flood risk to help local governments make informed decisions about priorities for land use, emergency response, ecosystem functions, and flood management projects throughout the state.

### 2. Increase Public and Policy Maker Awareness About Flood Risks to Facilitate Informed Decisions

**Goals:** Local, State, and Federal officials support policies, programs, and financing strategies to re= duce flood risk in California. California voters support for funding mechanisms to reduce flood risk. California residents in flood-prone regions support local flood preparedness efforts and develop personal preparedness plans.

### 3. Increase Support for Flood Emergency Preparedness, Response, and Recovery Programs to Reduce Flood Impacts

**Goal:** Effective and comprehensive flood emergency preparedness, response, and recovery at all levels of government.

### 4. Encourage Land Use Planning Practices That Reduce the Consequences of Flooding

**Goal:** Reduced risk to people, property, and economies in floodplains.

**5. Implement Flood Management From Regional, Systemwide, and Statewide Perspectives to Provide Multiple Benefits**

**Goal:** Agencies at all levels of government use an Integrated Water Management (IWM) approach to flood management.

**6. Increase Collaboration Among Public Agencies to Improve Flood Management Planning, Policies, and Investments.**

**Goal:** Improved coordination and alignment between Local, State, and Federal public agencies, providing increased effectiveness and efficiency in all aspects of flood management.

**7. Establish Sufficient and Stable Funding Mechanisms to Reduce Flood Risk.**

**Goal:** Funding to implement planned and future flood management programs and projects in California.

The report also notes that flood management is a shared responsibility. Efforts to reduce future flood risk will require cooperation among public agencies, landowners, and other stakeholders to improve public safety, ensure reliable water supplies and healthy ecosystems, and foster economic stability.

In addition, flood management should be approached from an integrated water management perspective. IWM combines flood management, water supply, and ecosystem actions to deliver multiple benefits for a project and across a region. The approach leverages resources and promotes system flexibility to adapt to changing conditions such as financing capabilities, regional preferences, climate change, and flood or drought events. Improved information and understanding will lead to enhanced public safety and other IWM benefits.

The recommendations outlined in *California's Flood Future* are designed to deliver measurable results to achieve public safety, environmental stewardship and economic stability. These results include:

- Reduced risk and consequences of flooding.
- Informed decisions for flood risk made by policy leaders and the public.
- Protected ecosystems and preserved floodplain functions.
- Multiple benefits delivered for projects funded by State and Federal agencies.
- Improved flood management governance and policies.

DWR is now embarking on a follow-up effort to the successful *California's Flood Future*, focusing primarily on the seventh recommendation in the report: **Establish Sufficient and Stable Funding Mechanisms to Reduce Flood Risk.** The Phase-Two Report will identify investment strategies and finance options to address the State's ongoing flood and water management challenges. This new report will specifically respond to Action 8 of the *California Water Action Plan*, which calls for investment in flood risk reduction in the next five years. A draft of the Phase-Two Strategy Report is expected to be released in 2015.

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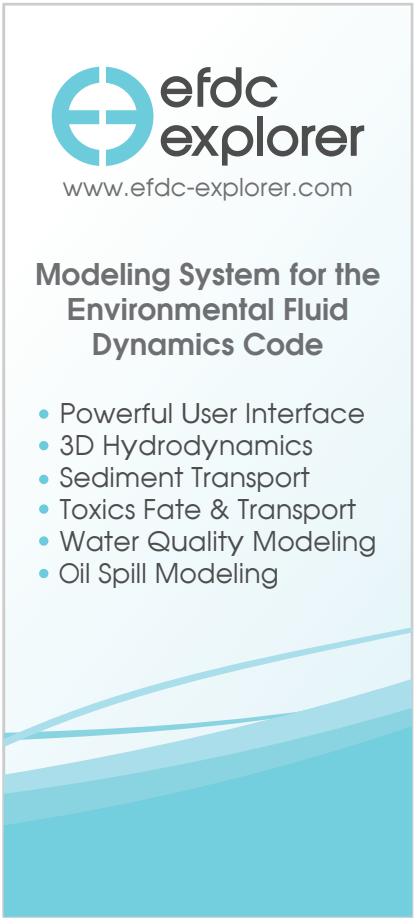

WATER RESOURCES IMPACT

# WORKING TOGETHER TO PROTECT SIGNIFICANT WATER RESOURCES AND ENCOURAGE STAKEHOLDER INVOLVEMENT AS GROWTH OCCURS

JACOB CALLISTER AND DENISE KALAKAY

## INTRODUCTION

The Multi-City/County Water Resources Assessment Project (MCWRAP) is a partnership of eight cities; three counties; five state, federal and regional agencies; and five watershed councils in Oregon's Southern Willamette Valley. Prior to 2009, the local jurisdictions had limited, dated, and often inaccurate water resources information leading to minimal resource protections. Once established, the MCWRAP partnership recognized that understanding water resource opportunities and threats, and working together to mitigate those threats, benefitted the jurisdictions and agencies involved. The three project phases – inventory and assessment, inventory reporting and approval, and local policy development and adoption – culminated in a progressive political climate for resource protection and a strong foundation for healthy ecosystems that cross jurisdictional, agency, and political boundaries.

## ISSUES AND THREATS IN OREGON'S SOUTHERN WILLAMETTE VALLEY

The Willamette Valley once contained extensive wetlands linked to the Willamette River. Settlers drained and filled wetlands, and channelized and diverted streams for agricultural and urban purposes. Less than one-half of one percent of native Willamette Valley wet prairie remains. Today, the Willamette River Basin is a water resource assessment and protection priority due to remaining abundant ecological diversity including threatened and endangered species, documented nonpoint source pollution, and rapid population growth and associated adverse impacts.

Despite Oregon's statewide planning program support for infill and redevelopment, increasing population inevitably results in farm and forest land conversion to urban uses. These pressures will increase with climate change since the Basin is located in a climate refuge area where people relocate from drought stricken regions.

Small Oregon cities often lack tools and resources to identify and protect water resources. Conversely, appropriate information can help property owners know how and where to minimize impacts. Without local knowledge of the location, extent, and value of resources, development often occurs in sensitive or high value resource lands and irreparably damages vital ecosystem functions. With knowledge about natural systems and their functions, a city or county can better integrate those systems with public values and necessary infrastructure.

## WORKING TOGETHER TO INTEGRATE WATER RESOURCE PROTECTION

Working within Oregon's statewide planning program framework, and with the combined financial backing of the U.S. Environmental Protection Agency, Oregon Department of Land Conservation and Development, and local funds, the Partnership set out to identify, assess and protect wetland and riparian resources. Lane Council of Governments, a regional public planning agency, coordinated tasks, facilitated information exchange, and provided customized assistance to each community. Federal and state partners provided technical assistance and helped integrate cross-program benefits. Local staff and public officials ensured that results have community value, practical use, and balance ecological with economic and social needs.

A major benefit of the collaborative model is the coordination and integration across a number of federal and state resource agencies complementing numerous ongoing and often parallel programs. The MCWRAP draws upon and integrates the strengths of wetland scientists, hydrologists, land use planners, natural resource planners, policy analysts, social scientists, and watershed councils. Partners worked as a regional team with common interests while maintaining their individual needs.


Owing to engaged resource agencies, the MCWRAP realized rare and valuable insights. The collective and coordinated approach to resource protection also reduced local staff and policy maker confusion, resulting in less controversial policy development and protections that considered cumulative impacts to each ecosystem. For example, the Oregon Department of Environmental Quality's participation meant policies included Total Maximum Daily Loads (TMDLs), drinking water, groundwater, and stormwater programs.

## TOOLS AND RESOURCES

A Water Resource Action Kit provides a number of practical tools and resources for local staff. The Kit includes a "cross-program" map for each jurisdiction and an outline detailing cross-program benefits and relationships. The "integrated water resource program analysis" provided critical context for local and agency staff, decision making bodies, and the public informing decision making. Other key resources in the Kit include model

code language, citizen outreach resources (including FAQs and explanations of resource functions and values), inventory maps and reports, and a summary of Oregon's regulatory framework for water resources.

## KEY BENEFITS TO PARTNERS

All partners benefitted from the project. Local jurisdictions met state requirements and gained understanding of vital water resources. Centralized project management, outreach, and mapping increased clarity and synergy for local jurisdictions while also providing agency partners with consistent data and useful products. Customized partner support meant more local solutions, transparency, and better resource protections. The MCWRAP created a political climate that will support future resource protection efforts.

Ultimately the MCWRAP built a better foundation for sustained economic and social prosperity through a healthier natural infrastructure. Without this coordinated and collaborative project, constrained local governments would have achieved little natural resource protection.

## KEY LESSONS LEARNED

Many lessons learned over the past five years may prove useful for regional water resource protection.

### Partner Coordination

- Build collaboration that balances efficiency and economies of scale with autonomy and recognition of each partner's uniqueness.
- Ensure agencies understand how proposed programs relate to their agency's mission and coordinate a common strategy that reduces confusion while achieving maximum resource benefits.
- Partner agency representatives may not fully understand the nuances of rules and missions of other partner agencies. Dedicate time upfront to develop mutual understanding and a joint message.
- Partner staff may weigh project costs or time commitment with the perceived benefits of participation. Respect that staff have other priorities.
- Staff willingness and project commitment is the strongest indicator of project success or failure. Even those local staff with relatively little experience and/or passion for water resources realized positive outcomes.

### Program and Policy Development

- Outline a suite of policy development processes that consider the local and regional context. More process may not be the answer in every situation.
- Develop programs that combine regulatory and nonregulatory approaches.
- Develop multiple regulatory approaches that are specific to the needs being addressed rather than incorporating all protections within one ordinance.
- Leverage funding and support opportunities by identifying shared objectives across programs.
- Large and small projects often reveal opportunities for spin-off or parallel projects.

### Outreach

- Highlight the water resources connection and value to people. Water resource protection = clean drinking water.
- Involve agency and jurisdictional decision makers early and foster their understanding of the whole picture so they can be champions making balanced and informed decisions.

Connect water resource protection and clean drinking water

- Regulations will be unpopular with some and potentially many regardless of outreach.
- Local decision-makers benefit from public support, or heightened visibility of public support, to reduce anxieties in making bold policy decisions.
- Local decision-makers prefer to convey to the public that protections are associated with a state or federal regulatory requirement.

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WATER RESOURCES IMPACT

# WATER: A POWERFUL SOURCE OF HUMAN DEVELOPMENT ONE DROP'S PROJECT BURKINA FASO

MARIE-ANNE CHAMPOUX-GUIMOND

Burkina Faso in west Africa is one of the poorest countries in the world. The vast majority of the population live off agriculture and survive on less than $2.00 a day. Of all the factors that contribute to this vicious cycle of poverty, lack of clean drinking water and sanitation is a major hindrance to the region's human and socioeconomic development. The situation is particularly dire in rural areas, where 24% of the population lack access to clean water and 93% lack access to adequate sanitation (WHO and UNICEF, 2014). "This situation is partly due to environmental conditions, such as low rainfall and drought. However, it is also the consequence of inadequate water resource management, conflicts regarding water use, limited capacity of local stakeholders – and a sheer lack of cooperation between them," explains Jacques Rajotte, Chief Operating and International Programs Officer at ONE DROP.

Leveraging water as a creative force for sustainable development, ONE DROP, an international NGO, started Project Burkina Faso in 2012 in the region of Cascades and Hauts-Bassins. Developed using a systematic approach called *The ABCs for Sustainability*, the project uses three complementary components: access to safe drinking water and sanitation ("A"), behavior change using social art ("B"), and access to capital and economic opportunities through microloans ("C"). Deployed over five years, this project will sustainably improve the living conditions of 100,000 people.

## A COMMUNITY APPROACH

ONE DROP's approach focuses on involving communities and leveraging local culture and know how. ONE DROP has partnered with several local organizations to implement the project's three components. Their knowledge of and experience with local culture and practices are assets that facilitate targeted interventions for local needs. This endogenous approach favors community ownership and impacts' sustainability. "Each partner organization enriches the project through its expertise and complementary skills, allowing it to be deeply rooted in communities," explaineds Diane Bachand, ONE DROP's Africa Project Manager. Along with local stakeholders, ONE DROP works with renowned national and international partners to ensure coordination, deployment, and followup. These include: Oxfam-Québec, Mise au Jeu, and Espace Culturel Gambidi. As a member of the international family of Oxfam, Oxfam-Québec has been working in Burkina Faso since 1973. Mise au Jeu uses theatre intervention to encourage local communities to participate in the change they wish to see and train agents of change. Espace Culturel Gambidi is a center focused on creating, producing, and carrying out artistic endeavours that promote and develop live performing arts in Africa

Cooperation between local stakeholders is another core element, in alignment with the principles of Integrated Water Resources Management (IWRM). Project Burkina Faso was developed using a participatory approach that values the contribution of all stakeholders (local authorities, women's organizations, farmers, etc.) in the design process and the implementation. "This approach has helped to create ties with decentralized technical services and strengthened our relationships with local communities," says Hébié Aristide, Mayor of Bérégadougou. Furthermore, the strengthening of the technical and institutional capacities of local stakeholders and partners is an integral part of the project objectives, and they are provided with training programs to improve their work.

A Community Meeting Held in February 2014.

## THREE COMPLEMENTARY COMPONENTS

"Access to clean drinking water and sanitation is, for ONE DROP, the first step in improving the lives of people," states Jacques Rajotte. In Burkina Faso, this intervention component consists primarily of investments in infrastructure and different technical solutions. Thanks to new wells and standpipes, the rehabilitation of existing wells and the expansion of the potable water system, over 45,000 individuals now have access to safe water, which positively impacted their health. Moreover, the distance to the source and the wait times at the pump have been significantly reduced, enabling women and girls to dedicate more time to productive and educational activities. In order to ensure appropriate governance and durability of hydraulic infrastructure, several interest groups have been formed and their capacity to engage all stakeholders in the implementation of IWRM was reinforced. For example, 147 water point committees (CPEs) were established to manage the maintenance and ade-

quate use of water installations. Access to water for agricultural production has also been improved. Project Burkina Faso enabled the connection of five food processing units to the local network as well as the development of nurseries, vegetable gardens, and composting units. All had a positive impact on the local economy and increased the livelihood and food security of communities. "The diversification of agricultural production greatly increases the availability of vegetables, which, in turn, has positive repercussions on our diet. Whereas before, we had to wait for the rainy season to cultivate the land, we now can farm all year round," said Diao Ladji, President of a group of local farmers.

The construction of family and public latrines enabled over 13,000 people to access vital sanitation facilities to maintain their health, dignity, and safety. Soakaways and wash houses were also built and domestic waste collection services were installed in four districts. Thanks to the active participation and dedication of several women's groups, these initiatives greatly improved the sanitary conditions of public areas. "Our work environment has greatly improved thanks to the cleanliness of the market and the importance villagers now place on hygiene," stated Fatoumata Ouattara, an owner of a cosmetics shop in Péni's local market.

Finally, the project also focused on the protection and sustainable management of natural resources. Several initiatives were deployed to restore and improve the banks of the Bérega and Yanon Rivers. River dwellers and local authorities were very active in these initiatives. Their contributions were reinforced by training sessions, IWRM workshops, and environmental education activities in schools.

## BEHAVIORAL CHANGE THROUGH SOCIAL ARTS

Local populations play a critical role in ensuring long-lasting solutions to water, sanitation, and hygiene (WASH) issues. ONE DROP uses the arts and culture to raise awareness and foster the adoption of responsible behavior which, in turn, ensures the long-term sustainability of the project. Multidisciplinary shows, educational and artistic workshops for youth, and educational activities in schools are the primary strategies deployed. By addressing such themes as the protection of natural resources, fair distribution of water, public sanitation, and the management of water points, these activities generated awareness among the population and mobilized them towards change. Approximately 100,000 people were reached and a new sense of collective awareness around responsible water management and local issues was fostered. Significant positive behavioral changes were also observed, as well as improved cohesion among local communities.

## ECONOMIC DEVELOPMENT AND MICROFINANCE

Offering local populations economic opportunities inspires them to improve their living conditions. Microfinance and financial and entrepreneurial education helps to stimulate the local economy, (supports livelihood, reduces seasonal migration, etc.), increases the financial inclusion of participants, and maximizes their revenues. Several microloans were granted to encourage the start-up of small businesses, and over 800 people benefited from various financial training sessions. Starting in 2015, the consolidation phase will support many more local enterprises in the expansion and diversification of their activities.

ONE DROP's integrated approach in Burkina Faso has already benefited other communities around the world: Nicaragua, Honduras, El Salvador, Haiti, and India. The fact that the approach can be reproduced in other countries has clearly demonstrated the relevance of intervening simultaneously on various fronts to ensure long lasting impact. In 2015, a new project in Mali will consolidate the benefits generated by Project Burkina Faso, creating further opportunities for exchange between stakeholders, and new development prospects in the region.

## ACKNOWLEDGMENT

Pictures used in this article are courtesy of Terry Hughes Images ©.

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WATER RESOURCES IMPACT

# WISCONSIN RUNOFF RISK ADVISORY FORECAST HELPS FARMERS MAKE REAL-TIME MANURE SPREADING DECISIONS

SARA WALLING

It was just one sentence in the Wisconsin Legislature's 2007-09 budget, directing the state's Agriculture Department to create an online system to help farmers and manure applicators decide when and where to spread manure while avoiding runoff. It followed calls for action from the public after a series of well publicized manure contamination and fish kill events.

This was a mandate to do what no single agency could do on its own. It called for hydrologists, soil scientists, computer and web programmers, water quality experts, researchers, and farmers themselves. It called for state, federal, and university resources. After two years of meetings and phase-in, the Runoff Risk Advisory Forecast (RRAF) was launched in 2011.

The RRAF is part of a larger online toolbox called the Wisconsin Manure Management System (http://www.manureadvisorysystem.wi.gov). The system started with the 590 nutrient application restriction maps that address chronic runoff risk due to slope, soil type, proximity to surface water, and other features of individual fields. But the RRAF was the real innovation, addressing in real time the acute runoff risk that comes from heavy rains, soaked or frozen soil, and snowmelt. It assesses day-to-day risk in individual watershed basins, modeling predicted precipitation, forecast temperatures, soil moisture content, snow accumulations, and basin characteristics. Using GIS mapping, the RRAF forecasts runoff risk 5-10 days out, depending on the season, and is updated three times a day.

Manure runoff is not an insignificant issue in Wisconsin. The state is proud of its agricultural heritage and reputation. Agriculture pumps $88 billion into the state's economy annually and provides 10 percent of its jobs. Wisconsin has 9 million acres of cropland, including 4 million acres of corn and 1.6 million acres of soybeans that need fertilizer. There are 3.35 million cattle, 300,000 swine, and 6.8 million chickens, all producing manure.

Wisconsin sits at the western end of the Niagara Escarpment, with its fractured limestone karst topography. It is where the glaciers stopped 12,000 years ago, leaving the glaciated central part of the state with sandy soils and the unglaciated southwest part of the state etched with ridges and valleys. It has 15,000 lakes and is surrounded by Lake Michigan, Lake Superior, and the Mississippi River.

Put agriculture and geography together, and the risk is clear. Algal blooms, hypoxia, and water degradation threaten humans and wildlife. It is not only the state's inland waters and coastal waters that are threatened; runoff from the Upper Midwest has been implicated in the Gulf of Mexico dead zone that appears periodically.

That's not to mention the cost to farmers of losing soil they need and buying fertilizer they do not need. Unfortunately, high-risk times for spreading often coincide with the very times when farmers most need to spread manure – in fall, so they can go into winter with empty manure pits, and in spring, when they need to empty the pits again. Nutrient management planning and best management practices help farmers know how and where to spread manure, but there was little guidance about when to spread until the RRAF came along.

From the beginning, this was a collaborative effort with many partners. Shortly after the Legislature issued that directive to the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP), some staff members attended a presentation by the National Weather Service North Central River Forecast Center (NCRFC) about the Center's soil and runoff modeling capabilities. After some initial discussions of the two agencies' common interests, DATCP formed a working group bringing together all the various areas of expertise the project would demand. Other partners in this group, still functioning, are:

- U.S. National Oceanic and Atmospheric Administration-National Weather Service-NCRFC
- University of Wisconsin-Madison-Soil Science Department and College of Agricultural and Life Sciences
- University of Wisconsin-Extension - Discovery Farms
- USDA Natural Resources Conservation Service
- U.S. Geological Survey
- Wisconsin Department of Natural Resources

DATCP publicly owns the RRAF, managing and funding it, and conducting outreach to promote it. University participants developed the RRAF website, and host and maintain it. Discovery Farms and the University of Wisconsin-Platteville's Pioneer Farm provided locations where USGS collected edge-of-field runoff data to validate forecasts. The NCRFC provided real-time modeling that is the innovative heart of the RRAF, using outputs from existing NWS models including the Sacramento Soil Moisture Accounting (SAC-SMA) model.

The working group met from 2008 to 2010, with the goal of creating a reliable, nonregulatory tool that would result in behavior change and water quality improvement. Members gathered perspectives and ideas from all sides, including users. They considered not only the technical aspects, but the social aspects of presenting the risk to the public. Scientific knowledge, public policy and agency priorities coalesced to produce the RRAF.

The next step was a two-year phase-in at agricultural conferences, trade shows, and on-farm events, along

with blogs to build user buy-in. Along the way, the RRAF has been fine tuned, including making it more mobile device friendly. By late winter of 2012, the RRAF was ready for a public rollout. DATCP coordinated with the Wisconsin Department of Natural Resources to issue press releases. Beginning that year, the two agencies have shared radio campaigns in the spring, buying time on an agricultural radio network and major ag broadcasters' programs. The two agencies often issue joint press releases reminding farmers to check the RRAF when forecasts suggest that spreading might be particularly risky. Outreach materials have included "Plan to spread? Look ahead" business cards, magnets, and a tabletop exhibit.

This is a tool that no one else in the nation had attempted to develop. It could not have happened without the partnership that came together. Now neighboring states and other Great Lakes states with similar water quality concerns are working to develop RRAFs. Minnesota is setting up a project to develop its version of a runoff risk tool, and NCRFC is working with the Great Lakes Restoration Initiative to expand the new model into Michigan and Ohio. In fact, the success of the partnership and the product have encouraged the NCRFC to expand and improve the modeling backbone of the tool.

The RRAF has not only garnered regional interest. The federal Government Accountability Office highlighted the RRAF, and the Manure Management Advisory System, as innovative tools to address freshwater management in its 2014 report, *Freshwater: Supply Concerns Continue, and Uncertainties Complicate Planning*.

But the true test of the partnership's work is this: Do farmers use it? Page view statistics for the site suggest that, during average weeks, 100-150 users check the forecasts. But usage spikes up to hundreds of views during thaws and heavy rains. During a 2013 January thaw, there were almost 1,100 hits. These times also coincide with publicity generated by press release reminders from DATCP and DNR.

So yes, farmers are using it. As nutrient management planning continues to expand in Wisconsin, logic suggests that use of the RRAF will also expand. It is a brand new tool in the toolbox, but one that may well become indispensable to farmers as the spotlight shines increasingly bright on farmers' environmental stewardship.

It all began with one sentence, and many partners.

**ACKNOWLEDGMENTS**

The author would like to thank Dustin Goering (NWS-NCRFC), Rick Wayne (UW-Madison), Laura Ward Good (UW-Madison), Mark Jenks (DATCP), and Donna Gilson (DATCP) for their assistance in preparing this article.

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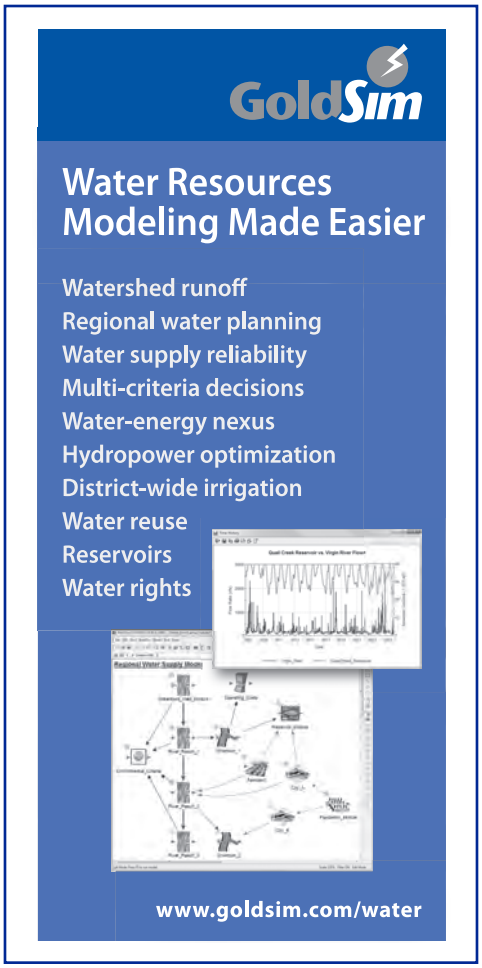

WATER RESOURCES IMPACT

# OREGON'S FIRST INTEGRATED WATER RESOURCES STRATEGY

ALYSSA MUCKEN

With leadership, support, and direction from the Oregon Legislature and the Water Resources Commission, Oregon's natural resource agencies set out in 2009 to develop a statewide Integrated Water Resources Strategy. The Oregon Water Resources Department, the agency responsible for water quantity in the state, took the lead to develop the Strategy. The Department worked closely with the Oregon Department of Environmental Quality and the Department of Fish and Wildlife to ensure that water quality needs and ecological needs were directly addressed as well. The Oregon Department of Agriculture, which oversees the safety and promotion of the state's agricultural sector, also played a key role in the development of Oregon's Integrated Water Resources Strategy.

Unlike traditional water supply plans, this Strategy considers instream needs (where water remains in the environment) along with out-of-stream needs (where water is diverted for use), including water quality, water quantity, and ecosystem needs.

The state's first Integrated Water Resources Strategy, although led by state agencies, was built from the ground up. Early on, the four state agencies actively sought input from the public, hosting discussions in 11 Oregon communities across the state. Stakeholders and water-related-organizations also participated in these discussions and hosted individual workshops with state agency staff.

2010 Open House Discussion in Ontario, Oregon.

The public input gathered resulted in an extensive list of water-related challenges that Oregonians care passionately about and wanted to see addressed in the Strategy. Oregonians also offered up a variety of solutions and ways the state could move forward to improve water resources management in Oregon.

Conversations continued with formal advisory groups that offered advice on the most critical issues to address and the most promising solutions. More than 15 natural resource and economic development state agencies, along with 10 federal agencies with diverse responsibilities in the areas of water supply, water quality, land management, and fish and wildlife management in Oregon provided assistance and feedback in developing the Strategy. These agencies were instrumental in helping to identify the successful tools, plans, and programs already in place today that can be built upon, further integrated, and improved under the umbrella of the Integrated Water Resources Strategy.

In any public outreach effort, it is impossible to reach every citizen of the state. An 18-member advisory group of citizens and stakeholders from across the state provided a diverse range of perspectives and interests. Like the state and federal agencies, their feedback and recommendations were invaluable to developing the structure and content of the Strategy.

The comments, feedback, and input received throughout the development of the Strategy were shared regularly with the Water Resources Commission, other boards and commissions, the Oregon State Legislature, and the Governor's office. After more than three years of engagement with Oregon's citizens, the Water Resources Commission received formal endorsements from its sister commissions and boards, and formally adopted Oregon's first Integrated Water Resources Strategy in August of 2012.

## IMPLEMENTATION OF OREGON'S STRATEGY

The Integrated Water Resources Strategy is a long overdue assessment that reflects how we value water here in the state of Oregon. The Strategy reflects Oregon's diverse opinions and interests, while providing a blueprint of opportunities both instream and out – from our agricultural sector to our municipal water supply to healthy fish and other aquatic life.

This Strategy places an emphasis on collaboration and voluntary efforts. It identifies areas where incentives, whether financial, technical, or policy in nature, could serve as powerful tools for progress. It also identifies where public and private partnerships could stretch our dollars and further our instream and out-of-stream goals. Just as importantly, the Strategy is not intended to remove or jeopardize existing water rights or other local, state, and federal authorizations. The Strategy does not relinquish any existing authorities.

The Integrated Water Resources Strategy calls for a dedicated investment in groundwater and surface water data. Oregon needs a more robust network to track the health of Oregon's water in each basin – to monitor groundwater levels, streamflow, water use, and water quality. Further, professional personnel that are able to collect data, process, and share the results are a critical part of Oregon's water strategy.

The Integrated Water Resources Strategy is ambitious and there are not currently enough resources to fully implement all of the recommended actions. The intent of the Strategy is to provide a blueprint for future actions. The 2013 Oregon Legislature recognized the need to invest in the state's first water strategy, providing resources to implement more than a dozen recommended

actions. Many of the Legislature's investments support the improvement of monitoring capabilities and technical needs across state agencies.

The investment in our scientific capacity has given the Department of Forestry, Department of Agriculture, and the Department of Environmental Quality greater capacity to evaluate whether current practices are improving water quality on agricultural and forested lands. The Oregon Water Resources Department is expanding the state's network of streamflow measurement sites, observation wells, and installing real-time telemetry at new and existing stations. Conducting cooperative groundwater investigations with the U.S. Geological Survey has been a long-standing program in Oregon; the Strategy highlighted the importance of continuing this collaborative partnership and helped bring additional resources to study groundwater issues and update existing models. Agencies have been able to work together in a number of ways, such as developing and documenting methodologies for establishing new scenic waterway flows, protecting seasonally varying flows for state-funded storage projects, and keeping toxics from entering Oregon's waterways through innovative partnership programs.

The Integrated Water Resources Strategy represents a statewide approach for meeting Oregon's instream and out-of-streams needs, while recognizing the value of locally initiated and collaborative water resources planning processes. Oregon will be piloting a place-based approach to integrated water resources management in the coming years, while gathering lessons learned from neighboring states and planning efforts already underway. Oregon is currently investing in a two-year study in the Upper Deschutes River Basin where local partners and other interests are leading efforts to evaluate climate change risks and define a suite of solutions for meeting future water needs of agriculture, municipalities, and instream flows. Similar efforts are occurring in the Willamette Basin where a diverse group of stakeholders are exploring alternative ways to allocate existing storage to meet a full range of instream and out-of-stream needs. Historic efforts are underway to implement the Klamath Basin adjudication, completed by the Department in 2013 after decades of working with multiple parties.

The next iteration of the Integrated Water Resources Strategy is due in 2017. To prepare, Oregon will update its 50-year water demand forecast and assess its existing tools for monitoring and responding to droughts, floods, seismic, and other pressures. Keeping an open and transparent process with meaningful public involvement will continue to be a key principle for developing Oregon's next water strategy. The state's first Integrated Water Resources Strategy has provided resource managers and practitioners a greater degree of flexibility and space to communicate and cooperate on emerging issues or projects of mutual interest. For more information about Oregon's Integrated Water Resources Strategy, consider joining the **Mailing List** at http://listsmart.osl.state.or.us/mailman/listinfo/iwrs, or visit the **Project Website** at http://www.oregon.gov/OWRD/pages/law/integrated_water_supply_strategy.aspx.

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## IN MEMORIAM ... REUBEN J. JOHNSON (AWRA PRESIDENT, 1975)

AWRA Past President Reuben Joseph Johnson (age 100), Falls Church, Virginia, died peacefully at his home on February 21, 2015.

Reuben was born in Orland, California, on November 29, 1914. After earning a B.S. in Civil Engineering at the University of California at Berkeley and serving as a naval officer in World War II, he began a career with the Army Corps of Engineers, working on a variety of water projects around the United States. In 1966 he moved to Washington, D.C., where he served as Deputy Director of the Water Resources Council. After his retirement in 1974, he continued to work as a consultant on water projects around the world.

A very active member of AWRA during his water resources career, Reuben served as the South Atlantic District Director from 1970 to 1972, Vice President in 1973, and President in 1975, the year immediately following the AWRA Headquarters move from Urbana, Illinois, to Minneapolis, Minnesota.

He was a lifelong member of the Evangelical Free Church, to which he devoted his time and talents, serving at local, regional, and national levels. He also served on the board of Youth for Christ, and continued as an active member of the Christian Businessmen's Committee until his death. A memorial service was held February 26 in Hanover, Pennsylvania, and a funeral service was held February 27 in Annandale, Virginia.

WATER RESOURCES IMPACT

# AN INDUSTRIAL WATER RESOURCES INVENTORY AND PROJECTIONS FOR ECONOMIC DEVELOPMENT

ANNA LINHOSS AND JEFF BALLWEBER

Water resources play an important role in a state's economy, environment, and overall quality of life. Water provides for a healthy environment; serves industries, commercial operations, and agriculture; and delivers drinking and sanitation services. These may, at first, seem to be competing uses, but when they are analyzed through the lense of integrative water resource management we see that water is also shared through networks, linkages, and feedbacks. As states pursue economic and community development opportunities it is important that we realize how proactive policies and objective economic valuations can transform water from a divisive to a unifying resource. In order to do this we need a transparent and objective inventory methodology that assesses current and projected water resources and demand as well as reviews water resource policy and law issues. Not only is it important to understand these issues at the state level, we must also contextualize the issues at a regional scale.

Inexpensive water supplies may have contributed to the southeastern United State's (U.S.) rapid population and economic growth at the turn of the 21st Century. However a series of fairly widespread, severe droughts between 2005 and 2008 threatened municipal water supplies as well as operations of electrical power plants and other industries. Many southeastern states have taken note of the warning and are turning a more critical eye to water resources.

In order to understand water resources in the southeast there is a need to contextualize each state's water sustainability relative to its peers and neighbors. However, such a comparison is not entirely straightforward. The issue of water sustainability is complex involving dissimilar types of information such as resources, demand, policy, and projected growth that are not easily compared. Analyzing the whole picture is necessary for understanding the condition of the system and its parts.

In response to this need, we have developed the "Water Sustainability through Decision Analysis" (WSDA) index to examine the relative status of water sustainability in the southeastern U.S. (Linhoss and Ballweber, 2015). WSDA uses integrative measures of water resources, demand, and policy and is applied to eight southeastern states (Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina, Tennessee, and Texas). Measures or criteria that were used to describe water resources include average annual rainfall, river length per state area, number of dams per state area, and the percent of the state that is underlain by a groundwater aquifer. Water demand measures include surface water use and groundwater use normalized by the area of each state as well as population growth. Measures used to assess water policy include the existence of water conflicts and litigation, a state water management plan, and a water development fund. The data that was used in this assessment is all freely and easily available at the national or state level.

The southeast is generally blessed with high rainfall rates. Louisiana, Mississippi, and Alabama rank as having the first, second, and third highest average annual rates of rainfall in the continental U.S. Major groundwater aquifers also underlie much of the southeast with some exception in Arkansas and Texas. Combined surface and groundwater use in the study sites ranges between one and five inches per year when normalized over the area of each state with Tennessee using the most water and Mississippi using the least water on a per unit area basis. Of all the water policy issues in the southeast, the Alabama, Florida and Georgia "water war" in the Apalachicola-Chattahoochee-Flint River Basins is perhaps the highest profile example. On the other hand, Texas has proactively engaged in interstate water compacts in six instances. Arkansas, Georgia, South Carolina, and Texas all have comprehensive water management plans. Georgia and Texas both have state water development funds.

The WSDA framework uses Stochastic Multi-Criteria Decision Analysis (SMAA-2) (Lahdelma and Salminen, 2001) to compare the measures of water sustainability across states. This method is explicitly able to account for data uncertainty and the unknown importance (weight) of measures to any decision maker. Within SMAA-2, a probability density function (PDF) is assigned to each measure of water sustainability (i.e., water supply, water use, and water policy) for each state that represents the measures' range of likely values. When the weights of the measures are unknown, SMAA-2 explores the complete weight space of each measure, using a uniform distribution. SMAA-2 outputs include the rank acceptability index which calculates the frequency that each alternative ranks as the most preferred through the least preferred while considering the uncertainty in the measures and varying the weighting schemes.

The study found that generally Georgia, Mississippi, and South Carolina have a competitive water advantage in the southeast (Figure 1). States with the lowest water sustainability were Arkansas, Louisiana, Tennessee, and Texas. Through the application, we showed that the WSDA index is a useful, simple, transparent, and transferable integrative water resource management tool.

Water is a fundamental natural resource. It is renewable and exhaustible. It is judged by both quantity and quality. It is required for agriculture, industry, municipalities, recreation, and the environment. As an economic resource that attracts and retains industry we must understand the limits and value of water and the costs and benefits of its utilization. As droughts increasingly impact the southeast, states must integrate sustainable

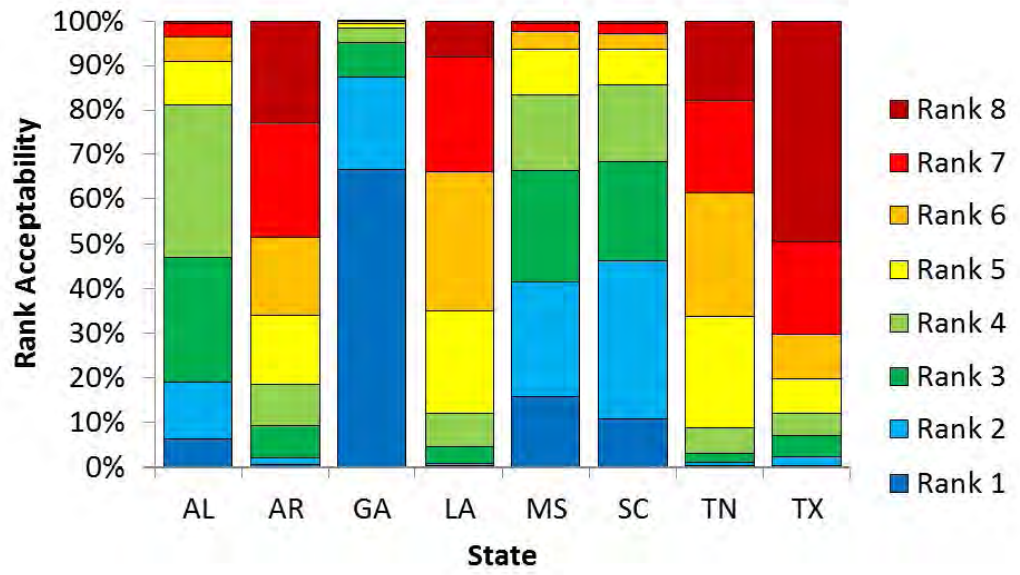


Figure 1. Rank Acceptability Index Results. Rank 1 indicates least water stressed and Rank 8 indicates most water stressed. The figure indicates the proportion of times that each state ranks from least to most water stressed given the uncertainty in the data. AL - Alabama, AR - Arkansas, GA - Georgia, LA - Louisiana, MS - Mississippi, SC - South Carolina, TN - Tennessee, TX - Texas.

water resources development and management into their economic and community development portfolio. Our analysis of integrative water resources throughout the southeast along with the development of the WSDA index supports policy recommendations that will enhance the environment, energy infrastructure, and industry. For more information regarding the details for the measures and the methodology please see Linhoss and Ballweber (2015).


### ACKNOWLEDGMENTS

The authors would like to thank the Mississippi Energy Institute for funding this research.


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WATER RESOURCES IMPACT

# THE DELAWARE RIVER WATERSHED INITIATIVE: BUILT ON SCIENCE, IMPLEMENTED BY 50 NGOs

CAROL R. COLLIER

How do you tackle a goal of "ensuring sufficient clean water through healthy watersheds," in a river basin 13,500 sq. miles in size and covering portions of four states? A new program – the Delaware River Watershed Initiative (DRWI) - was kick started by the William Penn Foundation (WPF), a Philadelphian philanthropic organization, to do just that. Working through NGOs, WPF is providing $35M over a three-year period for on-the-ground restoration and forest protection projects, plus organizational capacity building grants. Even though it sounds like a large amount of money (and it is!), the intended outcome will not be met if it is spread throughout the river basin. The Initiative is a targeted, science-based approach to change.

The WPF larger Watershed Protection Program addresses three areas: (1) Basinwide – science-based policies, development of a research agenda, and tracking change; (2) Constituency Building – enlarging the regional trail network to 750 miles while enhancing environmental centers with water resources educational tools; and (3) Water Quality Improvement – through the DRWI, targeting eight geographic areas critical to watershed health using strategies that, if successful, can be replicated and expanded. This article will focus on the DRWI, which provides a different approach to IWRM.

## KEY FEATURES

### Targeted Geographic Areas

Analyzing the basin's 432 watersheds on a HUC 12 scale, the Academy of Natural Sciences of Drexel University (ANS or the Academy), the DRWI science lead, was tasked with prioritizing the best and worst areas for water quality and aquatic community structure. Then the Open Space Institute (OSI) applied an analysis of potential work capacity (what NGOs were in the area that could lead the work) and areas of friction (areas with increasing development pressure, etc.). From these overlays, eight clusters of subwatersheds were selected, some with poor water quality in need of restoration, some with very high water quality where forested headwaters should be protected, and some "hybrid" sites needing both restoration and protection.

### Targeted Stressors

Funding is targeted to improvements in the areas of agricultural runoff, suburban stormwater runoff, reducing forest fragmentation and loss of headwater forests, and reducing aquifer depletion (primarily in the New Jersey Pinelands). It was felt that these stressors were of most concern and the most difficult for governmental agencies to manage.

### "Grasstops" Organizations

This process involves approximately 50 NGOs that know the issues in their cluster target area. Each cluster can have four to seven organizations working together to develop a plan and prioritize needs. Organizations in

clude local watershed associations and land trusts; regional organizations such as Natural Lands Trust, the Pennsylvania Environment Council, and universities; and national organizations such as The Nature Conservancy. It is not a top-down government driven process, but involves people with feet on the ground and buy-in to the solutions.

### Strong Scientific Backbone

The William Penn Foundation wanted to ensure that decisions were made on a solid scientific basis. The Academy is charged with developing and implementing a monitoring and assessment program to evaluate overall improvement, as well as having a specific focus on the nonpoint source restoration sites and forest protection sites. The Academy, with the Stroud Water Research Center and monitoring leads within the targeted clusters, are assessing algae, macroinvertebrates, fishes, salamanders, water chemistry, and habitat. A total of nearly 300 sampling events at 112 sites have been completed. A data management system using PostGRES is being developed for centralized storage and service of comprehensive data on ecological metrics and water quality.

### Logistics

No one organization can run all aspects of this complex Initiative and, consequently, a Coordinating Committee of key organizations manages significant elements of the project. The National Fish and Wildlife Foundation (NFWF) is the re-granting organization for the restoration work (vegetated stream buffers, retrofitted stormwater basins, green infrastructure, etc.). OSI is the re-granter for the forest preservation work. Each will issue multiple requests for proposals over a three-year time period. The Institute for Conservation Leadership (ICL) is working to build collaboration within each cluster and among the clusters. The Academy is the fourth organization, leading the scientific efforts including development of a basin-wide research agenda. There are meetings with target area cluster teams for different topics and an annual meeting for all cluster teams.

### Evaluation

Belts and suspenders! Because it is such a complex program, the WPF has pulled together a team of outside evaluators to assess the scope, direction, and implementation of the Initiative. They will be reporting back to the DRWI partners periodically with concerns and recommendations.

### Getting the Word Out

It is important to spread the word about this Initiative in order to build partnerships, enlarge its influence (hopefully duplicating efforts in other river basins), and to attract leverage funding. One of my roles is liaison with governmental agencies, federal to local. I have a counterpart who is reaching out to other philanthropic organizations and potential private funders. There is an interactive map, e-newsletter, journal and magazine articles, a monthly science-oriented pub talk – "Tapping Our Watershed," and the usual social network outlets (see www.ansp.org/DRWI for more details).

### Larger Picture and Thoughts for the Future

This is a grand experiment of how targeted on-the-ground projects can improve water quality. But it goes far beyond that. The success will not depend on the completion of 60 or so projects in the river basin, but is dependent on changing the mindset of land owners, municipal officials, natural resource organizations, state governments, and others. It is difficult to change land use practices, especially in local rule states, but that is one of the critical outcomes of this Initiative. It also will depend on eventual expansion of the targeted cluster areas and replication in other areas of the basin. Through the development of the Research Agenda, the team is also looking into the effectiveness and scale of the aspects of the Initiative as well as broader forces affecting the basin such as climate change and population movement.

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# INTEGRATED WATER RESOURCES MANAGEMENT AND THE AMERICAN WATER RESOURCES ASSOCIATION

JOHN WELLS AND CHERYL ULRICH
Co-Chairs, IWRM Committee
American Water Resources Association

The AWRA Integrated Water Resources Management (IWRM) Committee has been charged with taking the lead in "an ongoing conversation about how to make IWRM the standard practice in water resources management across the country." Chartered by the Board in June 2014, the technical committee's formation stems from several years of work following adoption of the AWRA position statement on IWRM in January 2011.

That statement called for water management goals, policies, programs, and plans to be organized around the concept of IWRM. It defined the concept as the "coordinated planning, development, protection and management of water, land and related resources in a manner that fosters sustainable economic activity, improves or sustains environmental quality, ensures public health and safety, and provides for the sustainability of communities and ecosystems." The Board went further, signaling its commitment to "helping organizations throughout the nation further the implementation of Integrated Water Resources Management."

Through this issue of *IMPACT*, the national IWRM award program, specialty conferences, and ongoing IWRM Committee discussions, the Board is engaging members and potential partners outside of AWRA in a conversation about what communities, regions, and the nation might make of the concept.

As part of this initiative, the Board has asked the IWRM Committee to develop a set of strategies to provide a blueprint for effective, coordinated management across sectors and levels of government.

One of the first strategies the Committee has tackled is to understand what drives successful IWRM plans and projects. This is an important step considering how little common understanding not only AWRA members, but also the water management community at large, appear to have of what people mean by IWRM.

Working through the Committee, AWRA will create an online catalog of IWRM plans, examples, and projects. The catalog will serve as an annotated bibliography of plans and projects designed to help people understand what drives successful IWRM, including what makes a plan or project legitimately IWRM, how scale and governance may affect the design and function or performance of IWRM, the role of policy and incentives in supporting IWRM, and how and when IWRM pays. We hope this will help everyone who needs it to obtain a shared understanding of IWRM and its implementation.

On a parallel path, the Committee intends to see what it can learn from the national water resource management programs of other countries, like New Zealand, Australia, South Africa, Brazil, and those collectively of the European Union. The results will be published as an international chapter of the online catalog.

With longer run goals in mind, the Committee has also begun asking what steps and partners would be essential to developing a national vision and strategy that embraces the concept. While some might ask whether a national vision on anything having to do with water resources is feasible or desirable, that conversation should begin by asking whether water and land managers can expect continued support of either federal or local resources in the absence of a unified approach to water resources management.

Accordingly, the Committee plans an intense effort to build a network of engaged, collaborative partners, both within and outside the AWRA. We see this as essential to "helping organizations throughout the nation further the implementation of Integrated Water Resources Management."

While AWRA is taking a leadership role, making IWRM the expectation, not merely the exception, requires partners at every level, scale, and focus across the nation. To further this partnership goal, the Committee will prepare an outreach strategy and communication plan working first with AWRA members, committees, and sections, then launching out to other professional associations, agencies, and NGOs.

Instead of working independently, it is time for AWRA and its partners to come together to develop an overarching strategic framework for the nation. This framework will be designed to clarify roles and responsibilities, increase accountability, reduce conflict, improve the integration of resources, provide water security for future generations, and save public funds by more effective use of resources. In short, it will serve as a roadmap for sustainable management of the nation's water resources.

As the foundation for this framework, AWRA recommends a national commitment to the following tenets:

- Clean water is a basic human right and is an economic and ecological necessity.
- Planning should seek long-term sustainability.
- Participatory decision making is essential.
- Management should be based on sound science and hydrologic units.
- Organizations at all levels should establish realistic measurements of outcomes.

- Governments should pursue continuous improvement of their institutional capacities to sustainably manage water.

While there is widespread agreement that water is a critical and strategic natural resource, there is no national policy for water resource management. Particularly given that Americans are the world's largest water consumers, this is surprising. Threats of aging infrastructure, climate change, and population growth are so significant that the nation can no longer afford to postpone action. AWRA believes it is imperative to create and demonstrate strategies to sustain U.S. water resources. The country's future growth and prosperity depend on it.

We believe AWRA as an organization with 50 years of nationwide experience is well suited to advance this issue. AWRA and its IWRM Committee are committed to building a culture of adaptive learning, high-quality connections and the explicit alignment needed to create a national water strategy that enables meaningful, breakthrough change in the management of our nation's water resources. We invite you to join us in making this a reality.

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## Solution to Puzzle (pg. 33)


## ▲ CANDIDATES FOR AWRA OFFICERS AND DIRECTORS ... 2016

The Nominating/Awards Committee of the American Water Resources Association, chaired by Past President Carol R. Collier, announces the following slate of candidates for terms commencing January 1, 2016.

**PRESIDENT-ELECT**
**(1-YEAR TERM)**

**RAFAEL (RAFA) FRIAS**
Black & Veatch
Sunrise, Florida

**SECRETARY/TREASURER**
**(3-YEAR TERM)**

**NOEL GOLLEHON**
USDA-NRCS
Beltsville, Maryland

**DIRECTOR**
**(3-YEAR TERM)**

**BETSY CODY**
Congressional Research Service
Washington, D.C.

**LISA ENGELMAN**
Booz Allen Hamilton
Rockville, Maryland

**CHRIS McENTEE**
Greeley and Hansen
Philadelphia, Pennsylvania

**LAUREL STADJUHAR**
West Sage Consultants
Denver, Colorado

**BEN WITHERELL**
New Jersey Department of
Environmental Protection
Trenton, New Jersey

As set forth in Article III, Section 5D of the American Water Resources Association's Bylaws "members may nominate additional candidates by submitting a written petition to the Association Headquarters signed by not less than 25 association members in good standing. A letter signed by the nominee expressing a willingness to accept the nomination and to serve if elected and a brief biographical sketch must accompany the petition. Such petition with the requisite signatures, the acceptance letter, and the biographical sketch must be received no later than May 26."

# PROPHETS OF OLD, PROPHETS OF NEW, THE RULERS OF US GIVE THE RIGHT TO BE BLUE!

ERIC J. FITCH

*God has cared for these trees, saved them from drought, disease, avalanches, and a thousand tempests and floods. But he cannot save them from fools.* – John Muir

*For most of the history of our species we were helpless to understand how nature works. We took every storm, drought, illness and comet personally. We created myths and spirits in an attempt to explain the patterns of nature.* – Ann Druyan

*O words of love, O words divine! The silver thought, the golden line! Of all men's words, there's none so fine, As these three words: 'I've got mine!'* – Hagar the Horrible ... Dik Browne

In the Hebrew Scriptures/Christian Old Testament, drought is a common feature. In fact, the only reason it isn't listed as one of the Four Horsemen of the Apocalypse is that drought's constant companion Famine fills the space. Drought plagued the Hebrews/Israelites/Jews in the times of Abraham, Isaac, Joseph, Ruth, David, Elijah, Elisha, Haggai, Jeremiah and Nehemiah. Their social response: Prophets, Priest and Kings preached Repentance and Prayer to God. The explanation for the drought was simple: it was obvious the People of God had done wrong and as they turned their backs to God. He then turned away his face and the calamity occurred! Humans lacked understanding on how nature worked and any instrumentality, even long term, to alter the conditions. Jeremiah (14: 20-22) summarized both their level of knowledge and response masterfully:

*We know our wickedness, O Lord,*
*The iniquity of our fathers, for we have sinned against You.*
*Do not despise us, four Your own name's sake; Do not disgrace the throne of your glory; remember and do not annul Your covenant with us.*
*Are there any among the idols of the nations who give rain? Or can the heavens grant showers? Is it not You, O Lord our God? Therefore we hope in You, For You are the one who has done all these things.*

Even for those of faith in the modern world, Science provides humankind with a much better though evolving understanding of the workings of weather and climate. For mainstream Christians, the stewardship of the Earth as Humanity's home is our God given responsibility. We have the gifts and challenges of intellect and free will as our chief tools in these matters. As well as the scientific discoveries and the technological innovations and inventions that are the fruit of these gifts, we also have social structures and organization to help (or harm) this mission. One of these key tools should be our governments; especially in Democracies.

In an idealized model of Public Service in the type of Democratic Republic which the United States of America (U.S.) aspires to be, public officials (elected and appointed) should act in accordance with certain key underlying standards. **First,** the powers that they hold are entrusted to them by the People and that they are fundamentally servant leaders not nobility. **Second,** that their first duties are to the People those living now and to future generations. **Third,** that they should support that belief that we strive to be an equalitarian society recognizing the gifts of all and acknowledging that a key duty is to help create and protect that equality in all its forms. **Fourth,** it is their duty to protect the natural environment for the use and enjoyment of current and future generations as our one and only true home and for itself. **Fifth**, that all knowledge, wisdom and good judgement does not lie within their body since it is made up of human beings who are limited and that they should seek counsel from the best and wisest to guide their decisions.

At this time, the Congress of the U.S. has failed in each and every one of these duties with regard to key issues of environmental governance, especially with regard to climate change. Every day which passes brings us more knowledge and warnings about the State of our World and its Climate. Just in the first quarter of 2015, studies have shown that 2014 set records for mean annual global temperature in the atmosphere, massive warming in the world's Oceans, accelerated melting of the world's polar caps, and more evidence of the warming state of the World. California is experiencing a severe drought on the heels of other recent droughts which have massively decreased available water supplies. Models based on paleoclimatology and future projections indicate the beginning of a massive period of drought encompassing all of the American Southwest and much of the Great Plains. Models show that like past droughts during warming periods it will start sometime by the middle of this century and go on for decades or even centuries making the Dust Bowl look like a passing fad. An extremely intense Tropical Cyclone (hurricane) Pam flattened the nation of Vanuatu attributed in its strength to topical waters in the Southern Pacific reaching average temperatures ~88$^{o}$F. The continuing parade of evidence of the arrival of the Anthropocene, the age where humans are affecting the state of the Earth's climate and not to the good, has made these changes irrefutable.

What was the response of the 113th Congress and the nascent 114th Congress? More of the same...stuff. A majority of Senators and members of the House either profess belief that anthropogenic Climate Change is (a) not real; (b) all natural, not manmade; (c) only could happen if God made it so, but He wouldn't; (d) not important; (e) don't know ("I'm not a Scientist); or (f) don't care enough ("Any proposed solution would be too costly for the Economy"). Their denial has gone beyond inaction into blocking and otherwise attempting to interfere with scientific research on the subject and analysis of the results. The Congress is attempting to forbid well qualified scientists from advising the U.S. Environmental Protection Agency (USEPA) and other agencies because after all "if they have published papers in peer reviewed scientific journals they obviously have a personal bias towards the theories." They are attempting to forbid the CIA, the DoD, and other federal intelligence agencies from analyzing the impacts of climate change on international stability and conflict since of course drought, sea level rise, famines, plagues, pestilence, and other primary and secondary impacts of climate change could not possibly impact regional and global stability. Even where the courts have confirmed that the USEPA has the authority to modestly regulate greenhouse gas emissions, the Congress is attempting to block implementation of those regulations and some of its members are even advising states that they don't have to comply with these regulations when (if) they go into effect. It is my contention that these legislators are not being proper Public Servants. They are putting special interests above the common interest, the profit of the relatively few today over the common good of the people and the environment today and into the future.

There is one way however that the actions of those in power, and unfortunately it is not just those in Congress, are following the ancient models perfectly. Just as the prophets of old were ignored, ridiculed, and persecuted, so too are many of the scientists today who are trying to counsel change of human ways before the environment is irreparably harmed. These deniers in Congress and their backers might as well be quoting from Hagar the Horrible "I got mine and the heck with the rest of you."

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## AWRA SCHEDULED MEETINGS IN 2015 AND 2016

**June 15-17, 2015**
**Hyatt Regency French Quarter ~ New Orleans, Louisiana**
**AWRA's 2015 SUMMER SPECIALTY CONFERENCE ON "CLIMATE CHANGE ADAPTATION"**
**C. Mark Dunning and Carol R. Collier, Conference Co-Chairs**
**(SEE PROGRAM-AT-A-GLANCE ON PG. 32 FOR ADDITIONAL DETAILS)**

**November 16-19, 2015**
**Grand Hyatt Denver ~ Denver, Colorado**
**AWRA's 2015 "ANNUAL WATER RESOURCES CONFERENCE"**
**Laurel Stadjuhar, Conference Chair**

**April 25-27, 2016**
**Sheraton Anchorage Hotel & Spa ~ Anchorage, Alaska**
**AWRA's 2016 SPRING SPECIALTY CONFERENCE ON "HYDROPOWER AND ENVIRONMENTAL FLOWS"**
**Michael R. Lilly, Conference Chair**

**June 27-29, 2016**
**Hilton Sacramento Arden West ~ Sacramento, California**
**AWRA's 2016 SUMMER SPECIALTY CONFERENCE ON "GIS AND WATER RESOURCES IX"**
**Dean Djokic, Conference Chair**

**CHECK OUT AWRA'S WEBSITE FOR ADDITIONAL INFORMATION ON ANY AWRA MEETING ~ www.awra.org**

# COLORADO RIVER SHORTAGES IMPACT BASIN STATES' ECONOMIES

ANTHONY BECKHAM AND CLAY J. LANDRY

Water shortages on the Colorado River will have a significant effect on the economy of Arizona, according to a recent study released by the L. William Seidman Research Institute at Arizona State University's W.P. Carey School of Business. The study found that the Colorado River has an annual economic value of approximately $1.43 trillion in the Colorado River Basin (James *et al.*, 2014).

The report used economic indicators such as Gross State Product (GSP), employment, and labor income to assess the economic impact of decreased Colorado River supplies on Colorado River Basin states. The study assumed a worst case scenario, in which Colorado River supplies are unavailable for one year. Under the scenario, the two largest GSP sectors, Real Estate and Rental and Healthcare and Social Services, would account for a $20 billion decrease in Arizona's GSP. In total, Arizona would risk losing more than 2.1 million job years and $108 billion in labor income if the Colorado River water supply was unavailable for a year.

While it is unlikely that Colorado River water will be completely unavailable in the near term, the increasing likelihood of a shortage declaration is a cause for concern. When Lake Mead's elevation levels drop between 1,050 and 1,075 feet, the Secretary of the Interior determines whether to make an official declaration of shortage that would result in a Tier 1 reduction, affecting Colorado River supplies in Arizona and Nevada. Under Tier 1 shortage conditions, Arizona will lose approximately one ninth of its Colorado River water supplies. If similar reductions are experienced across the region, the economic impacts will be costly. Table 1 shows the total economic impact of different Colorado River reductions in the entire Colorado River Basin. As shown, a 10 percent decline in Colorado River water would cause a $143.4 billion dollar decrease in GSP across Colorado River Basin states. At the same rate, the states would lose 1.6 million job years.

The study concludes that the Colorado River is vital to the economy of the Colorado River Basin states and reduced water supplies would weaken GSP and employment throughout the Basin. Lower Basin states may experience the economic effects of reduced Colorado River water availability as early as 2016, and Arizona's economy will likely bear the brunt of the shortage in the near term.

## REFERENCE

James, T., A. Evans, E. Madly, and C. Kelly, 2014. The Economic Importance of the Colorado River to the Basin Region. L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University. Available at: http://protectflows.com/wp-content/uploads/2015/01/PTF-Final-121814.pdf.

## E-MAIL CONNECTION

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Table 1. Estimates of Total Economic Loss for the Colorado River Basin States.

| Decline in Availability of Colorado River Water (percent) | Gross State Product (billions 2014 $) | Employment (millions job years) | Labor Income (billions 2014 $) |
|---|---|---|---|
| 10 | 143.4 | 1.6 | 87.1 |
| 15 | 215.1 | 2.4 | 130.7 |
| 20 | 286.8 | 3.2 | 174.3 |
| 25 | 358.5 | 4.0 | 217.9 |
| 30 | 430.2 | 4.8 | 261.4 |
| 40 | 573.6 | 6.4 | 348.6 |
| 50 | 717.1 | 8.0 | 435.7 |
| 75 | 1,075.6 | 12.0 | 653.6 |

# IF WATER IS OUR MOST VALUABLE RESOURCE, HOW COME WE AREN'T WILLING TO PAY FOR IT?

JOHN C. TRACY, President, AWRA

I think I will make a habit of providing a quote for each of my columns, as other people seem to say what I am thinking much more clearly than I can state it. So I would like to start this column with a quote that I found in an article published by the Stockholm International Water Institute *Water Pricing: How to Value Our Most Elusive Resource* (http://www.siwi.org/publication/water-pricing-how-to-value-our-most-elusive-resource/) that is attributed to Plato (noted philosopher):

> "*Only what is rare is valuable, and water, which is the best of all things … is also the cheapest.*"

I think this quote sums up quite nicely a contradiction I have been seeing in how we have come to regard water resources in this country. On the one hand, the number of articles, books, and web-pages declaring water as our most valuable resource has grown significantly over the last few decades, with a sampling of the articles that I was able to find just by using a simple web-search listed below:

- *The World's Most Valuable Stuff*
  The Economist
  (http://www.economist.com/node/16163366)

- *Water: America's Most Valuable Resource*
  ConservAmerica
  (http://conservamerica.org/2012/03/water-americas-most-valuable-resource/)

- *Water: Teaching About the World's Most Valuable Substance*
  The Learning Network, The New York Times
  (http://learning.blogs.nytimes.com/2014/02/26/water-teaching-about-the-worlds-most-valuable-substance/?_r=0)

- *Planet Water: Investing in the World's Most Valuable Resource*
  Steve Hoffman
  (http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470277408.html)

Reading these articles, and many others like them, would seem to indicate that as a society we are well aware of the value of water, and the absolute necessity to ensure that we develop and maintain reliable, resilient and robust water infrastructure and systems.

However, on the other side of this discussion is the issue the country is now facing, which is an aging, and increasingly unreliable, water infrastructure, which is highlighted by the American Society of Civil Engineers (ASCE) Infrastructure Report Card (http://www.infrastructurereportcard.org/). The Report Card indicates that our drinking water infrastructure rates a D, our dams rate a D, our inland waterways rate a D-, our levees rate a D-, and our wastewater infrastructure rates a D. The overall average grade for our nation's infrastructure is rated at a D+, which means that even if we graded on a curve, the nation's water resource infrastructure would be below average relative to Transportation, Schools, Energy and other Public Services. This situation is particularly acute in portions of my home state (Idaho) where the Infrastructure Report Card estimates that approximately $890 million in drinking water infrastructure and $1.4 billion in wastewater infrastructure is needed over the next 20 years. Many of these expenditures are needed in smaller rural water and wastewater utilities that are facing an aging infrastructure and an aging workforce, both of which need to be replaced within the next decade. For these municipalities, it is quite clear that if they do not maintain reliable water supply and wastewater systems, they will no longer be viable communities.

This leads me to the question: If water is our most valuable resource, how have we gotten to the point where we don't seem to be willing to pay to ensure that we can access it reliably? And of course the follow-up question: How can we convince ourselves to pay more to ensure we have reliable and resilient water systems? I had been wondering about these two questions for a while, and I really did not have any answers. That is, until recently, when I attended an event with a number of people associated with the privatization of water supply, wastewater treatment, and storm water management systems. One thing that struck me about the event was that a large percentage of the attendees were from the business and financial sectors. When I started discussing the problems associated with improving the condition of our nation's water resources infrastructure, especially in rural areas, they all agreed that this was a difficult problem that needed to be solved. They also pointed to some innovative approaches that they had seen work, all of which required a significant marketing effort, and the development of some creative financial models. It is clear that within the water community we engage in many conversations about the physical and biological aspects of the water resource systems, discuss innovative engineering approaches to address water resource challenges, and talk about how to communicate the importance of having

reliable water systems to the general public. However, I realize now that a key voice that is often missing from our conversations about water resources is the perspective that comes from the business sector. This voice can help answer the questions of how the development and operation of our water resource systems can be better marketed and financed to ensure their sustainability. I think this points to an opportunity for AWRA to expand our water community, and increase the diversity of voices included in our conversations on water. So the next time you are working on developing an agenda for a conference, seminar, webinar, or other activity associated with AWRA, think about reaching out to someone you may know in the financial and marketing communities, and ask them if they would be interested in talking about water.

**E-Mail Connection**

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## Earn $5 For Each New Member You Bring To AWRA!

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***For more information and resources to help you get started, go to the AWRA website and click on the M2M logo!***

**www/awra/org**

### HAVE SOME COMMENTS ABOUT THIS ISSUE OF IMPACT? SEND US YOUR FEEDBACK

***Water Resources IMPACT*** is in its 17th year of publication and we have explored a lot of ideas. We hope we have raised some questions for you to contemplate. "Feedback" is your opportunity to reflect and respond. We want to give you an opportunity to let your colleagues know your opinions ... we want to moderate a debate ... we want to know how we are doing.

For this issue send your comments by e-mail to Richard A. Engberg at **dick@awra.org or** IMPACT Editor-in-Chief Eric J. Fitch at **IMPACT-editor@awra.org.**

Please share your opinions and ideas. Limit your comments to approximately 350 to 400 words.

If published, your comments may be edited for length or space requirements.

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# TECHNICAL SESSIONS-AT-A-GLANCE

## • Monday ~ June 15 •

**8:30 AM-10:00 AM**
**Opening Plenary Session**

**Keynote Speaker**
**JEFFREY HEBERT**
New Orleans Redevelopment Authority & "100 Resilient Cities" Program
New Orleans, Louisiana

**10:30 AM-12:00 NOON**
**Panel Plenary Session**

**Federal Agencies: Climate Adaptation Challenges and Progress**
**Panelists**
**KATHLEEN WHITE**
USACE/IWR ~ Hanover, NH
**JERAD D. BALES**
USGS ~ Reston, VA
**KAREN METCHIS**
USEPA ~ Washington, DC

**1:30 PM-3:00 PM**
**Concurrent Sessions 1 & 2**

1 Climate Change Adaptation-1
2 Economics of Adaptation

**3:30 PM-5:00 PM**
**Concurrent Sessions 3 & 4**

3 Climate Change Adaptation-2
4 Engineering and Infrastructure-1

**12:00 NOON-1:30 PM**
**LUNCH BREAK (On Your Own)**

**5:00 PM-6:30 PM**
**OPENING NETWORKING RECEPTION**

## • Tuesday ~ June 16 •

**8:30 AM-10:00 AM**
**Concurrent Sessions 5 & 6**

5 How Do Data, Models, and Tools Aid in Adaptive Actions-1
6 Engineering Infrastructure-2

**10:30 AM-12:00 NOON**
**Concurrent Sessions 7 & 8**

7 How Do Data, Models, and Tools Aid in Adaptive Actions-2
8 Extreme Events

**1:30 PM-3:00 PM**
**Concurrent Sessions 9 & 10**

9 How Do Data, Models, and Tools Aid in Adaptive Actions-3
10 Case Studies: Planning and Adaptation

**3:30 PM-5:00 PM**
**Concurrent Sessions 11 & 12**

11 How Do Data, Models, and Tools Aid in Adaptive Actions-4
12 Drought Preparedness and Adaptation

**12:00 NOON-1:30 PM**
**LUNCH BREAK (On Your Own)**

**5:00 PM**
**DINNER (On Your Own)**

## • Wednesday ~ June 17 •

**8:30 AM-10:00 AM**
**Concurrent Sessions 13,14,15**

13 Planning for Action-1
14 Water Supply and Adaptation-1
15 PANEL: North Atlantic Coast Comprehensive Study: Outcomes and Applications

**10:30 AM-12:00 NOON**
**Concurrent Sessions 16 & 17**

16 Planning for Action-2
17 Water Supply and Adaptation-2

**1:30 PM-3:00 PM**
**Concurrent Sessions 18,19,20**

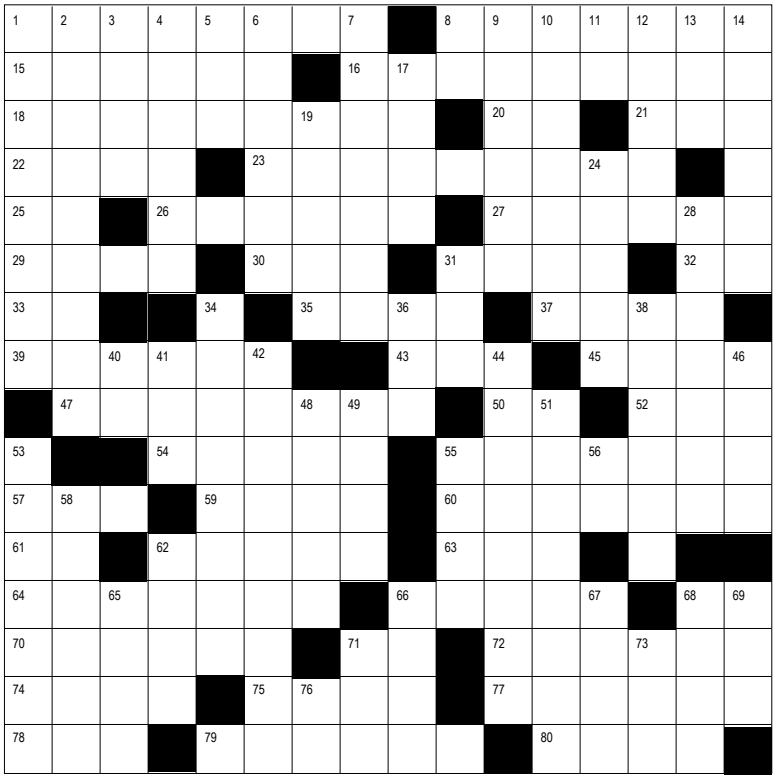
18 Planning for Action-3
19 Resilience and Policy
20 Coastal Adaptation and Resiliency

**3:30 PM-5:00 PM**
**Concurrent Sessions 21,22,23**

21 Dealing With Agriculture and Vegetation Changes
22 Social and Cultural Factors
23 Climate Vulnerability Assessments

**12:00 NOON-1:30 PM ~ SPECIAL EVENT ~ CONFERENCE LUNCHEON**
Guest Speaker ~ BRUCE MOWRY
City of Miami Beach ~ Miami, Florida

## WATER RESOURCES PUZZLER (answers on pg. 26)



### ACROSS

1 house breakers
8 a predicament
15 unsure in manners
16 twisters
18 rambled
20 coastal cops (abbr.)
21 switch positions
22 theatrical role
23 wiry terriers
25 atom. no. 36
26 poems with sound correspondence
27 belly buttons?
29 teeny
30 employment abbreviation
31 ending for neo or holo
32 Royale or Pines (abbr.)
33 one of orig. 13
35 fast flyers
37 follows oil or bongo
39 _____ and diced
43 start of ache or drum
45 a journey
47 became discolored
50 college deg.
52 consumed food
54 pool ball number
55 type of stocking
57 hooked beak bird
59 _____ En-lai
60 violate privacy
61 ancient Iraqi city
62 aboriginal people
63 honest pres.
64 anagram of reunite
66 follows bed time or short
68 atom. no. 26
70 touch gently
71 3.14
72 consisting of sheep's hair
74 Bond's school
75 anagram of near
77 temptresses
78 timid
79 abed
80 an act

### DOWN

1 untutured persons
2 supernatural
3 raise
4 Elmer _____
5 acid
6 a lemur
7 boom boxes
8 HMO employee
9 rash
10 area above Arctic Circle
11 Norton or Asner
12 hoofed animal
13 sign on a door
14 to evaluate
17 lyrical poems
19 ice coatings
24 former tennis great
28 restricted
31 Civil War gp.
34 jowled birds
36 Williams or Turner
38 father of the Cyclopes
40 that is (Lat.)
41 OH airport code
42 shelters for Fido and Lassie
44 arcs of spectral colors
46 Rose or Roselle
48 a prostitute
49 a needle case
51 a celestial body
53 points of origin
55 sanction
56 1 of 24
58 ring of flowers
62 one's bearing
65 site of Trojan war
66 calculator key
67 time long past
68 deflect
69 naval off.
71 start of school or mature
73 Remick or Majors
76 Unser or Gore

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**ISSN 1522-3175**

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WATER RESOURCES IMPACT

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AWRA is still the best multidisciplinary organization in the world and if your interests in water resources are broad like mine, then AWRA is home. Anything you want to do in a water professional organization, you can do in AWRA.
**- Michael Campana, member since 1996**

Through AWRA I am able to network with a broad cross section of professionals working to improve water management. Attending the meetings was a great way to keep up with water management and policy issues and multidisciplinary science. Also, the meetings provided a terrific forum for presenting new directions, policies and programs to an audience of managers from all over the country.
**– Nancy Lopez, member since 1979**

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We're all in this together… and joining AWRA is a great way to meet and get to know others in the water resources community.

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Participating in AWRA allows you to follow your passion while engaging in the vital conversations surrounding water resources management.

**Connection**
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## AWRA Information

Founded in 1964, the American Water Resources Association is a nonprofit professional association dedicated to the advancement of men and women in water resources management, research, and education. AWRA's membership is multidisciplinary; its diversity is its hallmark. It is the professional home of a wide variety of water resources experts including engineers, educators, foresters, biologists, ecologists, geographers, managers, regulators, hydrologists and attorneys.

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