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Conjunctive Use and Public Involvement Create Unique Water Solution in Southern Arkansas

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The Sparta aquifer in Arkansas and neighboring states is a deep, sandy, confined aquifer known for its high-quality water. Located in a temperate region well suited for agriculture and industry, there have been significant demands on its resources, and for decades, unsustainable withdrawals from the Sparta aquifer have threatened regional water supplies.

Approximate extents of Sparta aquifer.

Union County in southern Arkansas has been particularly affected. Discovery of oil in 1921 and post-WWII industrial expansion drove growth and water demand. As Union County's only viable water source, the Sparta aquifer was tapped for industry, poultry production, and municipal supply. Groundwater levels declined consistently since 1940, forming a deep cone of depression under El Dorado, the county's largest city.

The severity of the problem led the Arkansas Natural Resources Commission (ANRC) in 1996 to declare Union and four contiguous counties the state's first Critical Groundwater Area. At then-current pumping rates, the aquifer would encounter irreparable damage within five years. An investigation by the U.S. Geological Survey (USGS) showed that a reduction to 28% of previous pumping rates—from 21 MGD (million gallons per day) to 6 MGD—would be required in order to preserve the Sparta aquifer.

In 1997 concerned citizens responded with a coordinated, countywide effort to address Union County's most serious economic-development problem—the declining Sparta aquifer. As a result, in June 1999 the Union County Water Conservation Board (UCWCB), the first entity of its kind in Arkansas, was formed to address the Sparta situation in its jurisdiction. Authorized by Arkansas Act 1050 of 1999 with unprecedented authority over groundwater, the UCWCB *(continued on pg. 4)*

Editor's Corner

John Weiland
Communications
Council Chair

In the last few years, extraction of oil and natural gas has greatly increased by means of hydraulic fracturing of deep shale deposits such as the Marcellus deposit in Pennsylvania, New York, and Ohio and the Bakken deposit in North Dakota, among others. Hydraulic fracturing, or "fracking," involves injecting water and chemical additives at high pressure through vertical and horizontally drilled wells into shale formations to break up the shale and extract the oil or natural gas. Recent advances in horizontal drilling technology, as well as ideal oil and gas prices have made this practice profitable and prevalent. Natural gas production in the U.S. reached record levels in 2012 and oil production is at 20-year highs. Some speculate that surpluses in untapped reserves could move the U.S. in the direction of energy independence.

However, concerns with the unknown effects on groundwater quality by the chemical additives used in fracking have led many to be skeptical and, in many cases, opposed to the practice of hydraulic fracturing. For example, the State of New York enacted a two-year moratorium on hydraulic fracturing in May 2013. ASCE has taken a position of leadership in the debate over the merits and risks of hydraulic fracturing, having issued ASCE Policy Statement 539 on this topic, adopted by the Board of Directors in July 2012. This policy can be found at **http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-539---Hydraulic-Fracturing/**.

This policy states, in part: "[ASCE] supports the exploration and production of oil and natural gas energy resources by means of hydraulic fracturing when based upon sound engineering and industry practices that protect public health, safety, and the environment. ASCE strongly recommends that current regulations be reviewed, revised or enhanced, as needed, to: mandate full public disclosure of all chemicals and other propping agents in the fracturing fluid; control the handling, use, and disposal of chemicals in the hydraulic fracturing process; establish well construction and decommissioning standards to protect underground sources of drinking water and to prevent methane loss; establish site closure and restoration standards; reduce the freshwater footprint for each fracturing operation by reuse of the flowback fluid; assure the safe treatment and disposal of used fracturing fluids, flowback fluid and producer well waters; ensure adequate controls over stormwater runoff or overflow from the well site; ensure that there is no surface infiltration of waste and production fluids into near-surface aquifers and recharge zones; promote research on hydraulic fracturing, including the effects of multiple drilling operations in a single watershed; and protect in-stream water flows and determine the cumulative impact of multiple drilling operations within a single groundwater basin or watershed."

This issue details ASCE's Shale Energy Engineering Conference (pg. 13), and ASCE is continuing its leadership role in this debate, with EWRI playing a major role regarding water resources. EWRI also seeks members for a new hydraulic fracturing committee, as detailed in this article.

If you have articles to share on water and environment topics, or other announcements, please contact me at **weilandjl@cdmsmith.com** as well as **ewri@asce.org** with your articles, announcements, and other content you would like to share in Currents or through EWRI monthly e-Updates. We look forward to hearing from you!

President's Column

Peggy A. Johnson, Ph.D.
EWRI President
2012-2013

Hello EWRI members and friends! I hope you are having a wonderful summer. Since my last column, our first group of EWRI Fellows was announced at the Congress in Cincinnati. I was so pleased to see such a diverse group being honored in this way.

EWRI is currently involved with a number of ASCE initiatives and programs that I think you will find interesting. First, ASCE-EWRI is considering a new partnership with UNESCO's World Water Assessment Program (WWAP). The partnership is aimed at delivering a series of training programs on water and sustainable development with a focus on: (1) understanding what sustainable development means, (2) getting the most from existing water resources, (3) improving water quality and hygiene, (4) adapting to the impacts of extreme conditions (floods and droughts), (5) planning for the future – identification of future challenges in both urban and rural water planning, and (6) building human capacity for the future. Although the WWAP partnership is in development, there is another EWRI ongoing effort focused on capacity building. The 7th International Perspectives on Water Resources and The Environment Conference sponsored by ASCE-EWRI will be held for the first time in Latin America. It will be held January 8-10, 2014, in the Hotel Colon Hilton Quito, Ecuador. You can find more details at **www.ipwe2014.org**. The abstract submittal deadline is July 26, 2014. Please consider attending and participating in this first regional conference in the Americas.

Another interesting initiative is a new journal that will be jointly published between ASCE and ASME. The new journal, titled the ASCE-ASME Journal of Risk and Uncertainty Analysis, is intended to meet the needs of researchers and engineers to address risk, disaster, and failure-related challenges due to many sources and types of uncertainty. Articles will include a wide range of issues, including risk quantification, scenario development, consequence assessment, valuations, perception, communication, risk-informed decision making, and uncertainty analysis and modeling. I am one of six Associate Editors for this new journal, with responsibility for papers dealing with water and the environment. Bilal Ayyub, from the University of Maryland, is the Editor in Chief. The manuscript management system is not quite ready yet, although ASCE and ASME are working on it and the details of their agreement. In the meantime, please contact me (paj6@psu.edu) if you are interested in submitting a paper.

Finally, I would like to bring your attention to our participation in a hot area of research and practice – Hydraulic Fracturing. One year from now, In July, 2014, ASCE-EWRI will collaborate with the ASCE Energy division and several other ASCE Institutes to host a new ASCE conference entitled, "Shale Energy Engineering: Technical Challenges, Environmental Issues, and Public Policy". This conference will highlight the engineering issued related to shale oil and gas production, provide a platform to review the current status of regulatory requirements in this area, and identify and promote the most cost effective and environmentally sound ideas, innovative solutions and emerging technologies related to water resources management, geological and geotechnical aspects of shale gas development, and broader infrastructure components of the shale oil and gas exploitation cycle. The Conference will be organized into the following four tracks:

- Water Resources Management in Shale Oil and Gas Development
- Geological and Geotechnical Aspects of Shale Oil and Gas Well Development
- Environmental, Regulatory, and Public Policy Issues
- Supporting Infrastructure Development for Shale Oil and Gas production

The new formed ASCE-EWRI Hydraulic Fracturing Committee will lead the EWRI contribution to this joint event. If you are interested in becoming a member of this new committee contact ASCE-EWRI staff (**ewri@asce.org**). For more information about the new conference, I invite you to visit the website at **http://content.asce.org/conferences/shale2014/**.

Peggy A Johnson

Peggy A. Johnson, PhD, F. EWRI
President, EWRI
Penn State University

(continued from pg. 1, "Conjunctive Use and Public Involvement Create Unique Water Solution in Southern Arkansas."

Intake facility on Ouachita River (photo by John Czarnecki, used with permission).

continued encouraging conservation, raising funds, maintaining public support, and exploring alternatives.

Voluntary conservation between 1997 and 2003 contributed to a 15–20% demand reduction. Act 1050 also authorized a conservation fee of $0.24 per 1000 gallons of Sparta groundwater used. In addition, Union County residents, recognizing the importance of an investment in their water resources and economic future, voted nearly two to one in February 2002 in favor of a temporary one-cent countywide sales tax to fund a solution. With the help of engineering consultants Burns & McDonnell of Kansas City, Missouri, the UCWCB developed a water-system master plan and determined that the fastest, most cost-effective solution involved conjunctive use of surface water and groundwater.

Recognizing the role of surface water in the county's long-term supply, the UCWCB looked to the Ouachita River, the area's largest river which forms Union County's northern and eastern borders. They then undertook the Ouachita River Alternative Water Supply Project to supply three local industries with lightly treated water from the Ouachita River. The system would replace groundwater withdrawals for some of the largest users and allow water levels in the aquifer to recover.

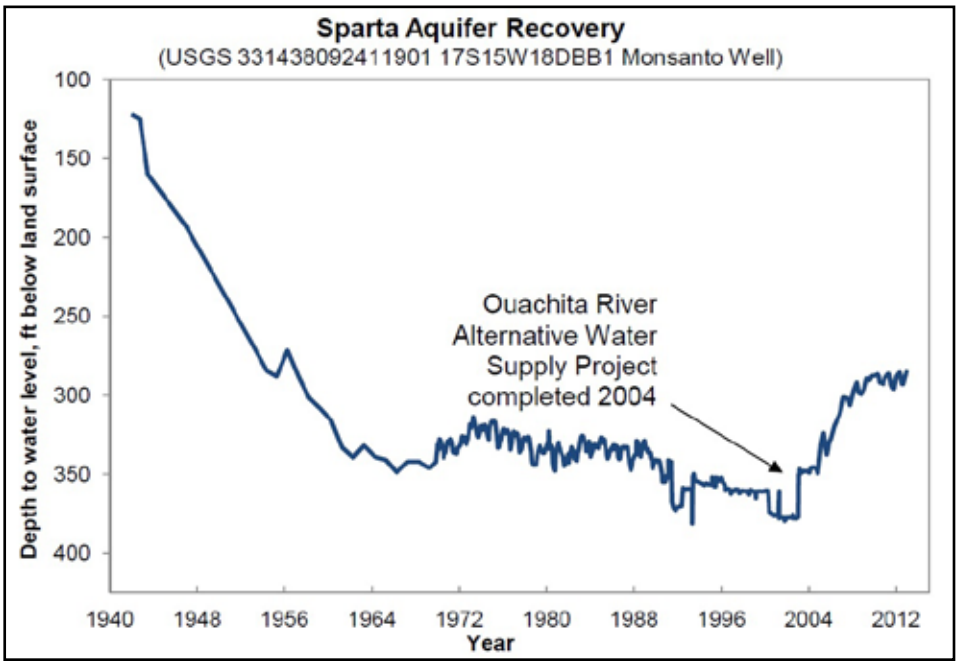
Simultaneously, Entegra (Union Power Station) needed a reliable source of cooling water before building a new power plant in the area. They offered to build and oversize the Ouachita River infrastructure to accommodate both the power plant's and Union County's current and future needs, and to deed the entire $52-million infrastructure to the UCWCB upon completion. In return the UCWCB would pay only for the incremental cost of oversizing, or $14 million, resulting in the power plant making the largest single investment in the project. UCWCB president Robert M. Reynolds called the timing a "rare combination of fortunate circumstances."

Sherrel F. Johnson, UCWCB grants administrator, who was chamber of commerce president during these years, observed that "building public support and raising funds were interwoven, symbiotic efforts occurring on parallel paths." During 1998, public meetings were held from one end of the county to the other. "Meeting sizes varied from a couple of hundred to a handful of folks," Johnson said, "and we took every possible opportunity to communicate the project and its importance to Union County residents and businesses." In the end, 88% of the estimated $65-million project was funded locally, while the remainder was funded by federal and state agencies. With sufficient revenue and lower-than-expected construction costs, the board paid off the bond more than three years early. The project remains debt free.

Completed in 2004, the project includes an intake, clarification facility, pump station, storage tank, and 23 miles of pipeline. The intake is located on the south bank of the Ouachita River near Calion, Arkansas. The intake's hydraulic capacity is 65 MGD, with a non-riparian permit rate of 50 MGD (65 MGD peak day). Sodium hypochlorite is applied at the intake for disinfection. The nearby water-clarification facility currently has a capacity of 32 MGD, with room to expand to 64 MGD. The finished water is then delivered to industrial clients and a new golf course and residential development in Union County. Where possible, distribution pipelines were constructed in existing power-line and roadway corridors to minimize land disturbance and reduce costs.

Since Sparta groundwater has natural high quality—it is "potable straight out of the ground," Johnson said—Union County residents prefer to use it for domestic rather than industrial applications, so the alternative-supply concept was ideal. Reynolds noted that Ouachita River water is in fact better for industrial use due to its lower mineral content. That was a bonus, he said. "We didn't know that when we started."

The effects of the Ouachita River Alternative Water Supply Project to date have been positive. The three major industrial users in Union County have converted to the alternative supply, reducing groundwater



Historic water levels in Monsanto well.

withdrawals by 6 MGD in 2007 and by 10.7 MGD in 2012. With less reliance on groundwater, the Sparta aquifer has rebounded. Water levels in eight monitoring wells in southern Arkansas and northern Louisiana rose from 2004 to 2012—one more than 60 feet near El Dorado, Arkansas; and 11 feet in Spencer, Louisiana, about 50 miles away. Storage and transmissivity tests conducted by the USGS and ANRC in 2012 showed that the aquifer had not sustained permanent damage.

The Sparta aquifer in southern Arkansas and northern Louisiana is recovering. In this case, conjunctive use of surface water and groundwater has proved to be a successful water-management strategy, and still has considerable public approval. The project is as much a social success as a technical one.

Today, as government funding for such projects shrinks, the ability to identify, design, fund, and execute infrastructure projects locally becomes more important than ever. Union County has shown how it can be done. "There is no aquifer-recovery project in the state, the region, and perhaps the country comparable to the Ouachita River Alternative Water Supply Project," said Johnson. "The Union County Water Conservation Board; the citizens it serves; and local, state, and national public and private resource partners have created a national economic-development model for application of public policy and natural-resource conservation."

CH2M HILL Launches 2013 Sustainability Report

CH2M HILL has published its Sustainability Report 2013 External link, the company's sixth sustainability report since 2005.

As one of the first engineering and construction companies to publish a sustainability report and launch an internal environmental management system that follows ISO 14001 guidelines, CH2M HILL has been recognized as a leader by Verdantix, an independent analyst firm focused on sustainable business issues, in sustainability consulting in 2013, environmental services in 2012, sustainable engineering in 2010, and climate change consulting in 2009.

CH2M HILL's report, its third produced entirely online, documents the firm's key measurement and improvement areas:

- Reduced paper consumption by 9 percent as compared to revenue
- Recycled 70,169 pounds of e-waste, 3,436 pounds of batteries, and 6,500 writing instruments
- Purchased $557,000 in recycled-content office products, 38 percent of total office supplies
- Increased teleworkers by 24 percent
- Increased spend with suppliers that have sustainability criteria in place by $16.9 million
- Helped clients treat 74.95 billion gallons of wastewater and reuse 9.9 billion gallons of effluent
- Decreased total overhead air travel by 6 percent while growing our business
- Reduced carbon footprint by 3 percent and offset 22 percent of our emissions by purchasing carbon offsets and renewable energy credits

"Our clients expect us to provide innovative, cost effective, and comprehensive solutions and technologies that will help them become stronger environmental stewards, while our employees are committed to doing the same with our internal operations," says CH2M HILL CEO Lee McIntire. "We are proud of our sustainability leadership in the industry."

Reflecting the company's expanded focus on water, energy, and climate change issues, the report contains the following highlights:

- CH2M HILL's sustainability programs around the world
- Profiles and commitments of some of CH2M HILL's sustainability leaders
- Water conservation strategies for clients
- Carbon emissions and energy use inventory
- Stories about CH2M HILL's partnerships with communities around the world
- Awards received for sustainability leadership, safety, and diversity
- Information about CH2M HILL's supply chain management

By measuring and reporting on its own sustainability metrics, CH2M HILL actively participates in the United Nations Global Compact External link. CH2M HILL's Sustainable Solutions Web site External link offers more information about the company's work to help its clients' organizations to become more sustainable.

Predicting Hurricane-Induced Coastal Change

The probability of hurricane-induced coastal change on sandy beaches from Florida to New York has been assessed for the first time in two U.S. Geological Survey studies released today.

The two reports -- one assessing the coastline from Florida to North Carolina, the other from Virginia to New York -- can function as part of a "virtual toolkit" for U.S. Atlantic coast community planners and emergency managers as they make decisions on how to best address coastline vulnerabilities.

The reports show that even during the weakest hurricane, a category 1 with winds between 74 and 95 miles per hour, 89 percent of the dune-backed beaches from Florida to New York coast are very likely to experience dune erosion during a direct landfall. But scientists involved say the strength of the studies is in their ability to predict coastal change in specific areas.

The online mapping tool, based on a USGS state-of-the-art model, will allow community planners and emergency managers to focus on a specific storm category and see the predicted coastal change in their area. The information may help them with decisions ranging from changes to building codes and locations for new construction, to determining the best evacuation routes for future storms.

"The USGS has been working on identifying storm-driven coastal change hazards for more than a decade," said Hilary Stockdon, a USGS research oceanographer and co-author of the studies. "The data collected and modeling capabilities developed during that period are what's enabled us to complete these regional assessments of predicted coastal change, providing key information to decision makers working to build more resilient communities and take actions to protect lives and property before storms hit."

For the entire study area, the modeling also shows that during a category 1 hurricane, storm waves are expected to increase water levels at the shoreline by approximately 150 percent above storm surge levels. This means in a category 1 storm that waves alone would raise water levels at the shoreline by approximately 2.6 to 3.3 meters (8.5 to 10.8 feet), depending on the region. Results show that waves play a significant role in elevating water levels during lower category storms, while storm surge is the major contributor to high water levels in stronger storms.

In an assessment of dune height from Florida to New York, the researchers found the southeast coasts, because of their lower dune elevations, more likely to experience overwash, or the landward movement of beach sand, than coastlines farther north. Dune heights from Delaware to New York are 1.4 meters (4.6 feet) higher, on average, than the dunes from Maryland south to Florida. The South Carolina coast, where average dune elevations are only 2.9 meters (9.5 feet), is the most vulnerable to overwash of the beaches studied. Ninety-six percent of coastal locations in the state are likely to overwash if a category 1 hurricane makes landfall there.

Prior to Hurricane Sandy, dunes on New York's south shore were among the highest on the Atlantic coast, and as such during a category 1 storm only 9 percent of coastal areas were likely to overwash. Still, these high dunes were vulnerable to extreme erosion during a category 1 hurricane, with 76 percent of the dunes very likely to be experience erosion. This was observed during Hurricane Sandy, which made landfall as an extra-tropical cyclone but pounded the beach with hurricane waves and surge. The protective sand dunes along barrier islands in New Jersey and New York were completely eroded in places, increasing vulnerability to more extreme erosion during future storms.

But vulnerability doesn't just come down to dune height; scientists credit the continuity of the dunes as being one of the key reasons coastal vulnerabilities vary greatly along the coast.

"Large areas of the South Carolina coast are very likely to erode during hurricanes due to long, continuous stretches of low dunes. In other areas, such as Delaware and New York, the mix of high and low dune elevations creates a more complex picture of vulnerabilities where relatively safe areas are adjacent to areas that are likely to be inundated," said Stockdon.

"Inundation" is a process by which an entire beach system is submerged and, in extreme cases, can result in island breaching. Only 9 percent of the entire study region is very likely to be inundated in a category 1 storm, although the percent is significantly higher in some regions. If a category 1 storm makes landfall on the South Carolina coast, for example, 34 percent of the beaches and dunes there are very likely to be inundated.

Beaches serve as a natural buffer between the ocean and inland communities, ecosystems,

and natural resources. However, these dynamic environments move and change in response to winds, waves, and currents. During extreme storms, changes to beaches can be large, and the results are sometimes catastrophic. Lives may be lost, communities destroyed, and millions of dollars spent on rebuilding.

These reports and the mapping tool can serve as an important resource for coastal planners and emergency managers as they work to protect their communities from future storms.

Both publications and internet mapping services are available online.

National assessment of hurricane-induced coastal erosion hazards: Mid-Atlantic Coast: U.S. Geological Survey Open-File Report 2013–1131, Doran, K.S., Stockdon, H.F., Sopkin, K.L., Thompson, D.M., and Plant, N.G., **http://pubs.usgs.gov/of/2013/1131/**

National assessment of hurricane-induced coastal erosion hazards: Southeast Atlantic Coast: U.S. Geological Survey Open-File Report 2013-1130, Stockdon, H.F., Doran, K.J., Thompson, D.M., Sopkin, K.L., and Plant, N.G., 2013, **http://pubs.usgs.gov/of/2013/1130/**

An assessment of the Gulf Coast vulnerability to hurricanes was released in May 2012 (**http://pubs.usgs.gov/of/2012/1084/**). A news release (**http://www.usgs.gov/newsroom/article.asp?ID=3224#.Ud2B-6zNmxc**) was issued announcing the results.

Where Are California Wetlands and How Are They Doing?

What is the extent of our wetlands? How healthy are they? How are they protected?

These are three of many questions addressed by two new web-based tools, released on June 26, by the Wetland Monitoring Workgroup of the California Water Quality Monitoring Council. Together, these tools are designed to make information about wetlands location, extent and condition more readily available.

The first, EcoAtlas, is targeted toward wetland scientists, managers and regulators. It provides an online resource for compiling maps and data about wetlands produced by numerous local, state and federal agencies and non-governmental organizations. The second, the California Wetlands Portal, is designed to help members of the general public answer fundamental questions about wetlands in their communities and the state as a whole using the data stored in EcoAtlas. By making information more accessible, the Wetland Workgroup and the Monitoring Council hope to better inform agency decision making.

Wetlands play a pivotal role in maintaining healthy ecosystems in California. "The health and cleanliness of California's surface waters remain an important barometer of their availability for beneficial purposes like drinking water, recreational uses, and for the continued sustainability of aquatic life," said State Water Resources Control Board Executive Director Tom Howard.

Formed in 2007 by cooperative agreement between the California Environmental Protection A gency and the Natural Resources Agency, the California Water Quality Monitoring Council brings together water quality and ecosystem health information from a variety of organizations with special expertise in wetland monitoring and assessment, coordinated through the California Wetland Monitoring Workgroup. This collaborative workgroup facilitates dialogue and coordination among twenty-three state, federal, and local agencies and non-governmental organizations that monitor and assess California's wetlands.

The California Wetlands Portal is part of the My Water Quality website at www.MyWaterQuality.ca.gov. Initially launched in 2009 by the Monitoring Council, this website houses the widest collection of water quality and aquatic ecosystem health data ever available about our state's lakes, rivers, streams, wetlands and ocean waters. The goal is to provide timely information in an easy-to-understand manner for the public, environmental organizations, and water resource professionals. The Wetlands Portal and EcoAtlas build upon a suite of other tools already available through the My Water Quality website.

The EcoAtlas tool was developed by the San Francisco Estuary Institute in partnership with U.S. EPA and the State Water Resources Control Board. EcoAtlas gives site visitors access to salient information about the condition and extent of streams, wetlands, lakes, and their surrounding riparian areas while offering a toolbox of advanced features needed for wetlands management. EcoAtlas is on the web at **www.ecoatlas.org**.

"These new online tools will empower Californians to access information about the value and health of their wetlands," said U.S. Environmental Protection Agency Regional Administrator Jared Blumenfeld. "The release of the Wetlands Portal and EcoAtlas represents a multi-agency collaborative effort to inform the public and support better aquatic resource management."

Ubiquitous and Crowdsourced Sensing: A New Paradigm for Environmental Monitoring

David J. Hill, Thompson Rivers University, Kamloops, BC, Canada

Sensors applicable to environmental sensing and monitoring are everywhere. The smartphone in your pocket likely carries a global positioning system (GPS), gyro, accelerometer, proximity sensor, ambient light sensor, and spectral imager.[1] Cars contain GPS, ultrasonic rangers, and thermal imagers.[2] People carry sensors, too, including odor receptors (nose), spectral imagers (eyes), and accelerometers (ears).

Figure 1 illustrates the annual sales of microprocessors (by core),[3] personal computers (PCs),[4] and mobile phones.[5] Although many smartphones and PCs contain multi-core processors, or even multiple processors, it is clear that phones and PCs account for only a small proportion of global microprocessor sales. Thus, a large number of sensors are being embedded into other systems such as cars and infrastructure. Using microprocessor sales as a rough lower bound for the number of sensors deployed annually, we can estimate that 10 billion sensors entered the environment in 2012 and that the number of new sensors will increase quasi-linearly every year. Based on these estimates, if even only the sensors deployed since January 2010 were still in service in 2020, the world would contain over 150 billion sensors in 2020, which is approximately 20 sensors per person.[6]

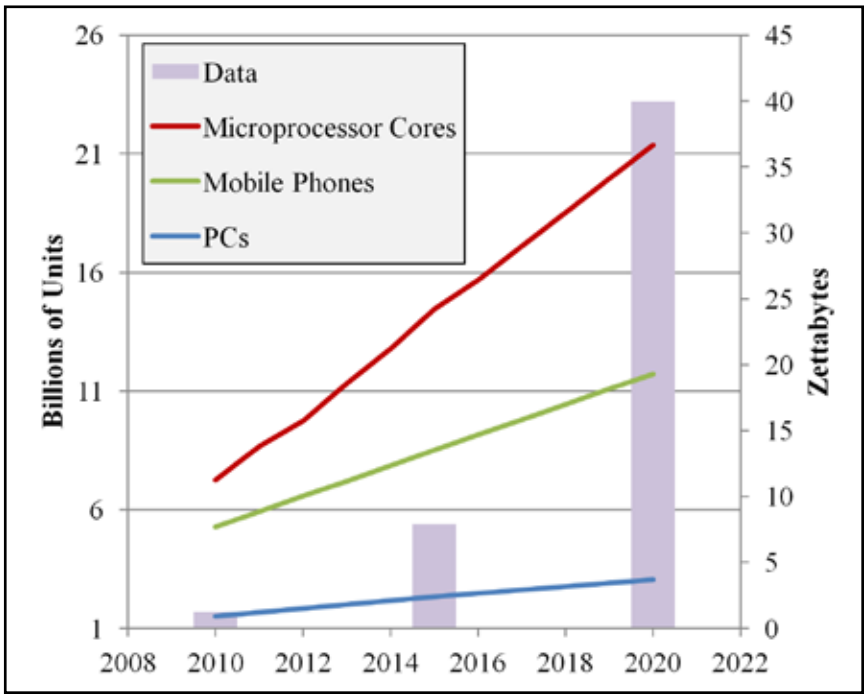


Figure 1: Comparison of the sales of new microprocessor cores (a proxy for sensors), mobile phones and personal computers (left-hand axis) and the creation of new data (right-hand axis) from 2010 to 2020. Microprocessor and "new data" data are from International Data Corporation (IDC), mobile phone data are from the World Bank, and PC data are from eTForecasts.

UBIQUITOUS AND CROWDSOURCED ENVIRONMENTAL SENSING

While sensors serve the individual device in which they are embedded, they can also be joined together via wired or wireless communication to form ad-hoc sensor networks that can provide spatiotemporal information about the environment surrounding the device. Because the cyberinfrastructure used to create the ad-hoc network and the sensors themselves is ubiquitous in the environment, this type of sensing is called pervasive, or more commonly, **ubiquitous sensing**. When people participate within the sensing network (e.g., to report measurements from sensors that are not directly connected to the network), the term **crowdsourcing** is used to describe the sensing activity.

Ubiquitous and crowdsourced sensing processes have immense potential to improve environmental monitoring, support decision making, and enable "smart" systems because of their extremely high spatiotemporal measurement resolution, as illustrated by the following two examples: (1) during the 2011 earthquake in Mineral, VA, Twitter posts reporting the event started within 40 seconds, one minute and twenty seconds ahead of the United States Geological Survey reports,[7] and (2) in the aftermath of the Fukushima Daiichi event, people throughout the world began streaming radiation measurements from homebrewed Geiger counters,[8] to online networks for sharing and mapping environmental data, including Xively[9] and Safecast.[10]

OUTLOOK

Although studies have illustrated the potential of ubiquitous and crowdsourced environmental sensing in several areas of application (e.g., air quality, toxicology, hydrology, and natural disaster response), there are several practical challenges that must be addressed before the full power of this technology can be realized. First, ubiquitous and crowdsourced sensing requires the aggregation and processing of large volumes of data. Figure 1 shows that the volume of new data produced in 2010 is approximately 1.2 Zettabytes (1 trillion Gigabytes) and that this is expected to increase superlinearly in the near future to approximately 40 Zettabytes by 2020.[11] To

address this **Big Data** challenge, the **Cloud** will become a critical element for data storage and for processing sensor data. Second, ad-hoc networks must be created to include an increasing number of mobile sensors over large geographical areas. Physical/digital abstractions, such as the **Internet-of-Things**, will be important in structuring the data streams from the sensors in the network. Third, the great variety of data types that are available from sensors (e.g., video, audio, text, photos, etc.) will require new approaches for communicating sensor data over the Web, such as the Open Geospatial Consortium Sensor Web Enablement (OGC SWE) framework. This variety of data types will also require new approaches for data fusion to combine heterogeneous sensor data to produce high spatiotemporal resolution measurements of the environment. Finally, to protect privacy and encourage user participation, advancements in data security and privacy for distributed big data must be made.

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This article is one of a regular series of reports on emerging and innovative technologies in the area of environment and water resources produced by EWRI's Emerging and Innovative Technologies Committee (EITC). EITC's mission is to advance the development, knowledge, and application of emerging and innovative technologies for the planning and management of water resources and the protection and enhancement of the environment. If you are interested in contributing an article or becoming a member of this Committee, please contact Walter Grayman at ***grayman@fuse.net****.*

World Bank Funds Water Resource and Sanitation Services in Ghana

In early June, the World Bank's Board of Executive Directors today approved a US$155 million IDA* grant to support the Government of Ghana's efforts to increase access to sanitation and water supply services and to improve the capacity of government agencies to plan and manage natural resources more sustainably.

The funds will support two of the Government of Ghana's priorities: manage natural resources in a sustainable manner and bring improved sanitation and water supply to over 3.6 million people living in and around the Greater Accra Metropolitan Area (GAMA).

The US$5 million IDA grant supports the Natural Resources and Environmental Governance project with Technical Assistance. The project is designed to provide technical assistance to help improve the capacity of government agencies to plan, manage and use natural resources in selected sectors more effectively and sustainably. The project will support the analytical work, policy dialogue, consultations and capacity building to address critical sector challenges identified in the first phase of the NREG Program (2008-2012).

"The high rate of environmental resource degradation exacts a heavy toll on Ghana, an annual cost of about ten percent of GDP," said Jamal Saghir, World Bank Director of Sustainable Development, Africa Region. "These funds will help the Government better manage its natural resources, particularly its forests, and bring more jobs and improved livelihood opportunities to people living in the country's rural and forest areas."

The second IDA grant of $US150 million will support the Greater Accra Metropolitan Area (GAMA) Sanitation and Water Project, a five year program designed to bring sanitation facilities and water supply to residents in the GAMA with emphasis on low income communities and to strengthen management of environmental sanitation.

The services will be identified by each community through a participatory process, with a goal of selecting options that best suit residents' needs, especially women, who have the responsibility to get water in most households. The project selection will take into account the specific physical conditions of each community, such as soil characteristics and space availability.

EPA Announces More Than $3 Million in Grants to Help Facilitate Environmental Stewardship and Cleanup Across the Country

On June 13, the U.S. Environmental Protection Agency (EPA) announced the selection of 16 grantees for a total award of $3.2 million through the agency's Environmental Workforce Development and Job Training (EWDJT) Program. The grants support local work to recruit, train, and place unemployed individuals in jobs that address environmental challenges in their communities. By providing Americans in economically disadvantaged communities with environmental job training, EWDJT grants promote environmental justice by equipping trainees with environmental health and safety certifications while creating a locally skilled workforce that advances local economies. Rather than filling jobs with contractors from distant cities, EWDJT grants provide employment opportunities for local residents to participate in the revitalization of their communities.

"These grants are provided to local community job training organizations that have demonstrated partnerships with employers who have expressed a willingness to interview and hire graduates. I am happy to continue to support this important and tremendously successful EPA program that has successfully placed more than 71 percent of program graduates in environmental careers since the program's inception in 1998," said Mathy Stanislaus, assistant administrator for EPA's Office of Solid Waste and Emergency Response. "Graduates are well respected in their communities and many have secured employment in jobs in environmental firms such as response and cleanup, clean energy installation, wastewater treatment, and environmental health and safety."

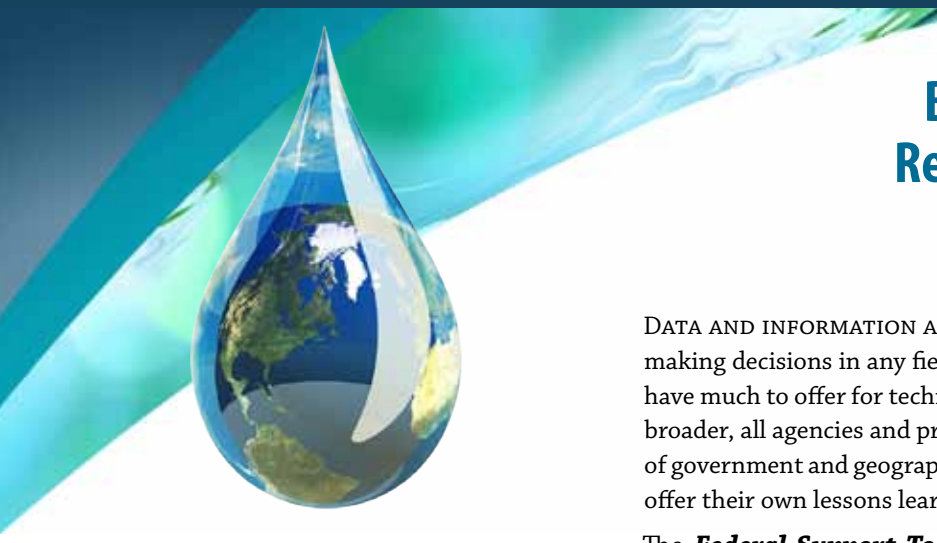
The EWDJT Program is unique because graduates are provided with a wide range of skills and certifications that improve their ability to secure not only short-term work, but full-time careers in the environmental field. The program also underscores President Obama's call to strengthen job training across the United States. Program graduates acquire training and certifications in a variety of areas, such as: Occupational Safety and Health Administration (OSHA) hazardous waste operations (HAZWOPER), CPR and first-aid, confined space entry, chemical safety, lead and asbestos abatement, landfill management, wastewater treatment facility operations and stormwater management, brownfields assessment and cleanup, Superfund site-specific cleanup, leaking underground storage tank removal, electronics recycling, emergency response and disaster site worker certification, clean energy and solar installation, weatherization, native plant revegetation and landscaping, oil spill cleanup, heavy machinery operations and hazardous waste transport (HAZMAT), and uranium mine-tailings cleanup and mine-scarred land remediation.

As of May 2013, more than 11,000 Americans have completed training through the support of the EWDJT Program, of which, more than 8,000 have obtained employment in the environmental field. Individuals who have completed the training include unemployed, low-income and minority residents of all age groups, as well as veterans, single mothers, ex-offenders, dislocated workers who have lost their jobs as a result of manufacturing plant closures, and other individuals with significant barriers to employment.

The 16 grantees for Fiscal Year 2013 are:

- Northwest Regional Workforce Investment Board, Connecticut – Plans to train 42 students, and place 40 graduates in environmental jobs.
- Merrimack Valley Workforce Investment Board, Massachusetts – Plans to train 45 students, and place 31 graduates in environmental jobs.
- The Fortune Society, Inc., New York – Plans to train 45 students and place 33 graduates in environmental jobs.
- Pathways-VA, Inc., Virginia – Plans to train 40 students and place 32 graduates in environmental jobs.
- Florida State College at Jacksonville, Fla. – Plans to train 60 students and place 45 graduates in environmental jobs.
- OAI, Inc., Illinois – Plans to train 45 students and place 40 graduates in environmental jobs.
- EmployIndy, Indiana – Plans to train 48 students and place at least 36 graduates in environmental jobs.
- Mott Community College, Michigan – Plans to train 51 students and place 36 graduates in environmental jobs.
- Southern University at Shreveport, La. – Plans to train 60 students and place 55 graduates in environmental jobs.
- Rose State College, Oklahoma – Plans to train 95 students and place 70 graduates in environmental jobs.
- St. Louis Community College, Missouri - Plans to train 81 students and place 55 graduates in environmental jobs.
- Northern Arizona University, Arizona – Plans to train 36 students and place 35 graduates in environmental jobs.
- City of Oxnard, California - Plans to train 55 students and place 45 graduates in environmental jobs.
- City of Richmond, California – Plans to train 60 students and place 45 graduates in environmental jobs.
- Zender Environmental Health and Research Group, Alaska – Plans to train 32 students and place 28 graduates in environmental jobs.
- City of Tacoma, Washington - Plans to train 54 students and place 39 graduates in environmental jobs.

More information on EPA's Environmental Workforce Development and Job Training Grants Program: **http://www.epa.gov/brownfields/pilot_grants.htm**.



Building Strong Collaborative Relationships for a Sustainable Water Resources Future

MARCH 2013

DATA AND INFORMATION ARE THE foundation for describing, understanding, and making decisions in any field. Federal agencies with a purview in water resources have much to offer for technology transfer and knowledge capacity building. Even broader, all agencies and professionals in the water resources field across all levels of government and geographies can benefit from experiences of others and, in turn, offer their own lessons learned.

The ***Federal Support Toolbox*** is designed to facilitate more effective and efficient sustainable water management by providing easy access to a large amount of information about water resources. The goals of the Toolbox include:

- *Encourage and strengthen communications and connections*
- *Build and enhance capabilities through Integrated Water Resources Management (IWRM)*
- *Promote information sharing through collaboration opportunities*
- *Plan for future water management*
- *Enhance water resources management around a shared vision*
- *Increase management efficiency*
- *Reinforce and foster collaboration, partnerships, and alliances*
- *Solving water challenges through leadership and innovation*
- *Align programs and resources for efficiency gains*

> *"The Toolbox will enable agencies to capitalize on existing knowledge and technology without the need to reinvent the wheel and to bring their resources together to find solutions that might not be achieved otherwise."*
>
> —Steve Stockton, USACE Director of Civil Works

The *Federal Support Toolbox* provides the global water resources community with an on-line portal for access to a wide range of water resources information. The Toolbox aims to support sustainable water management through collaboration, partnerships, capability building, information sharing and technology transfer.

The Toolbox includes water resource information from the US 50 states, federal agencies, river basin commissions, Tribes, nongovernmental organizations, academia, private industry, and from international sources. Information that can be found in the support toolbox includes:

Programs
Initiatives
Legislation
Policies
Regulations
Collaborations
Partnerships
Databases
Tools
Models
Best management practices
Research and development
Education
Leadership
News

Federal Support Toolbox Portal

The *Toolbox* is a one-stop-shop for the water resources community, and is accessible through a single online information portal, the ***watertoolbox.us***. It is not a clearinghouse but rather a centralized portal that links information needs to the information sources, and utilizes an advanced search function either by keyword or geospatially. The Toolbox also provides a forum for partner communication on water resources needs and solutions, as well as industry news and events.

This unique information hub is based upon research, conferences, and contributions of federal agencies, states, river basin commissions, Tribes and nongovernment agencies. Participating agencies and partners can further support this initiative and collaborate to keep the information current and relevant.

If your agency or organization desires to share water resources information or capabilities, we ask you to join this effort as a partner or as a public user. To learn more about the Toolbox, please contact:

Ms. Ada Benavides
U.S. Army Corps of Engineers
(202) 761-0415
Ada.Benavides@usace.army.mil

Nominate a Colleague, Mentor, or Visionary

Teresa Culver, Chair of EWRI Awards Committee

For the last year, I have had the privilege of chairing the Award's Committee of EWRI. Between EWRI and ASCE, a wide range of awards and recognitions are available. This year, we have recognized a wide range of individuals, including professors from Texas A&M to Polytechnic Institute of NYU, to Georgia Tech to Western Ontario. We also recognized professionals from the Bureau of Reclamation, U.S. EPA, and the Army Corps, and consultants from Idaho to Nebraska to Ohio, to name a few.

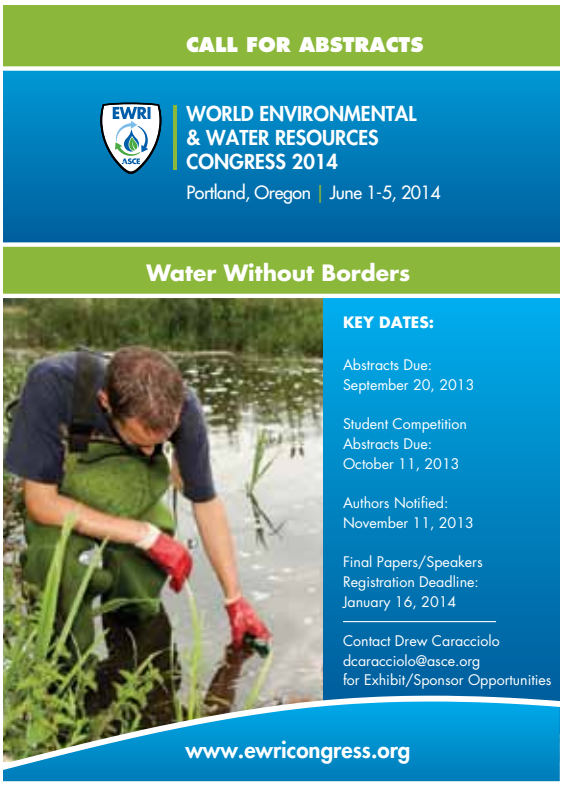
We are seeking nominations for recognitions at our next Congress in Portland, Oregon in 2014. Nominations for all EWRI and ASCE awards are due by October 1, 2013. I am asking your help in recognizing our outstanding colleagues. There are awards for a body of work, including the:

- Arid Lands Hydraulic Engineering Award for contributions related to arid and semi-arid landscapes,
- Ven Te Chow Award for contributions in hydrologic engineering,
- Einstein Award for contributions in erosion control, sedimentation or waterway development,
- Hydraulic Structures Medal,
- Rouse Award for contributions to hydraulics and waterways,
- Tipton Award for contributions in irrigation and drainage, and
- Julian Hinds Award for contributions in water resources planning and management.
- Freese Award for contributions in environmental engineering

Nominations are also needed for the Huber Civil Engineering Research Prize, which recognizes the contributions of younger researchers. You may also nominate individuals for the service they have given to the institute or to profession.

In addition, there are also various recognitions for authors of important papers, for committee chairs, for task committees and for local chapters. The new Margaret Petersen Award recognizes an outstanding woman in environmental and water resources engineering.

We have all been impacted by instructors, mentors, colleagues and visionaries. Please consider leading a nomination for someone who has impacted you or the field. For more details on the respective eligibility requirements and how to submit a nomination, please see www.asce.org/ewri/Awards/EWRI-Awards. I think you will find helping to facilitate the recognition of our deserving very rewarding.



Submit Your Abstracts for the 2014 EWRI Congress!

Water Without Borders: Sustainable Environmental and Water Resources Solutions for a World Without Borders is the theme for EWRI's next World Environmental and Water Resources Congress to be held in Portland, Oregon, June 1-5, 2014. Ray Walton (Congress Chair) and Wayne Huber (Technical Program Chair) invite you to submit abstracts at the EWRI submittal site: **http://submissions.miracd.com/ASCE/EWRI2014/login.asp**. Abstract submittals will be accepted until **September 20, 2013**.

Many track and session options are available, covering all EWRI councils and themes. The overarching Congress theme will be highlighted by sessions dealing with renewal of the Columbia River Treaty with Canada as well as other sessions related to international water issues.

Refresh your professional knowledge and network with your colleagues, both while enjoying the amenities of one of the great cities of the Pacific Northwest.

Additional Congress information, and major conference themes, may be found on the Congress website: **http://content.asce.org/conferences/ewri-congress2014/index.html**.

ASCE to Host First Shale Energy Conference in Pittsburgh in July 2014

Shale energy plays — both gas and oil — are being explored and developed all over the country, and all over the world. Although the production of shale oil and gas offers many benefits, there are questions about the impacts of these developments on the environment.

These production areas — from the Bakken in North Dakota, to the Eagle Ford in Texas, to the Marcellus in the east — are all very different. There is even disagreement over the correct terminology for the fracturing used to recover the gas and oil from the shale. But in every case, there are challenges to overcome, challenges that relate to civil and environmental engineering. These challenges range from impacts on water resource issues, to geotechnical and groundwater questions, to the impacts on existing infrastructure, to the disposal of wastes. Because the widespread development of these shale resources is relatively recent, development of sound, scientifically based information is still on-going.

To help build and expand the engineering body of knowledge on hydraulic fracturing and shale energy development, ASCE will be hosting a three-day conference in Pittsburgh, Pennsylvania, in July 2014. Although the Energy Division of ASCE is the primary sponsor, several of the Society's Institutes, including EWRI, have key roles in developing the Congress and providing the expertise to help develop a better understanding of the issues associated with shale energy development.

Currently, it is anticipated that the Congress will have four main tracks — one of these tracks has been allocated to EWRI, and a workgroup is developing the sessions for the Conference. The various tracks and topics are outlined in the Call For Abstracts (see **www.asce.org/shaleenergy2014**). In addition to the formal technical sessions, it is anticipated that there will be a significant exhibitors area and several keynote and panel discussions which will allow "cutting edge" issues to be considered.

In addition, Teresa Culver, of the University of Virginia, is helping to put together a hydraulic fracturing committee within EWRI. This committee will help develop materials for the 2014 Conference, but will also be responsible for developing additional ideas and products for EWRI. We invite all interested parties to get involved by contacting **ewri@asce.org**.

Distinguished Lecture Series at the 143rd Annual Civil Engineering Conference

Hear Peggy Lane, P.E., discuss her ASCE best-seller Field Guide to Environmental Engineering for Development Workers: Water, Sanitation, and Indoor Air during the Distinguished Lecture Series at the 143rd Annual Civil Engineering Conference.

Register today at **http://content.asce.org/conferences/asce-annual2013/registration.html**! Early-bird savings end July 31st.

9th International Weather Radar and Hydrology Symposium

CALL FOR ABSTRACTS | SUBMISSIONS DUE OCTOBER 14, 2013

The Environmental & Water Resources Institute is proud to announce that the 9th International Weather Radar and Hydrology symposium (WRaH 2014) will commence on April 7th, 2014, in Washington, DC.

The symposium will cover a wide variety of topics related to hydrological, hydrometeorological, hydroclimatological and water management applications of weather radar, its data and its products. The target audience includes hydrologists, meteorologists, academics, water resource engineers and managers, emergency management professionals, government policy makers, natural resource scientists, environmental engineers and managers, researchers, and consultants. An added focus of this symposium will be on promoting and expanding hydrologic applications of weather radar in engineering practices and identifying needs for scientific and technological advances for such engineering applications.

For the latest information about the 2014 Weather Radar and Hydrology Symposium, please visit the official website at **www.WRaH2014.org**.

Bidding EWRI a Fond Farewell

Andy Kropf

EWRI Project Administrator Andy Kropf departs from the EWRI team, after six enjoyable years with the Institute, to pursue his personal career goals.

When I began at ASCE in October 2006, I had no idea what this position would ultimately mean to me. I had graduated from college in May, and after some brief work over the summer, I eagerly accepted a position with EWRI.

Despite attending a university with a large, prestigious school of engineering, I was relatively unfamiliar with the industry, and hoped that I would survive as a layman in an organization filled with knowledgable professionals. I quickly discovered that — in addition to being extremely intelligent and technically gifted — engineers comprise a wonderfully friendly, tight-knit, and supportive community with a strong culture of giving, particularly with their time and talents.

Over my time here, I've taken in a number of irreplicable, irreplacable experiences that have helped me develop as a professional, and as a person. I've visited parts of the country and the world that I had previously only dreamed of seeing. Through various conferences, publications, student and international programs, and other efforts, I have indirectly contributed to a profession that helps make the world as a whole function. Even more, I've interacted with people from different backgrounds, cultures, expertises, and experience levels — many of whom I now consider my friends.

Andy Kropf (left) pictured with (from left to right) EWRI Director Brian Parsons, Visiting International Fellow Kristina Toderich, and Visiting International fellowship committee members, Derick Wride and Laurel Saito.

I leave ASCE with mixed emotions. Although I am excited for the new endeavors and exciting adventures that await me, I will certainly miss the organization that took a chance on me as a young professional, and allowed me to flourish. I can't thank my teammates in EWRI enough; particularly Brian Parsons, who has borne with me as I learned the ropes of ASCE and demonstrated confidence in me to accomplish EWRI's goals. He, along with my current and previous team members — Ann Rountree, Gabrielle Dunkley, Sara Hagan, and Autumn Richter — have supported me, and given me the tools to succeed at ASCE, and beyond.

Thank you. Thank you to the members, non-members, and ASCE and EWRI staff who have made this stage of my career such a positive experience. I will always value everything I gained from my time here.

Experience Ecuador with EWRI!

In 2006 ASCE-EWRI initiated a series of international conferences in developing countries. The primary objective of this conference series is to bring together environmental and water resources professionals from around the world with a focus on the regional issues of the developing country where the conference is hosted. Having hosted registrants from 64 distinct countries since 2006, the Conference Organizing Committee and EWRI Staff look forward to the challenge of continuing to diversify the attendance and increase the value of these events.

The 7th Conference is being organized collaboratively by El Colegió de Ingenieros Civiles del Ecuador (CICE) and ASCE-EWRI (EWRI) and it is scheduled for January 8-10, 2014, in Quito, Ecuador, Colon Hilton Hotel. Quito is the world's first city to be designated as a UNESCO World Cultural Heritage site.

Bathed in rich culture, vibrant landscapes, and tremendous biodiversity, Quito serves as an appropriate landing spot for this international conference series. The Organizing Committee for this conference have planned a technical and social program that will enrich your professional endeavors and offer tremendous networking opportunities.

Organizing Committee

Philip Burgi, H. M. ASCE, Conference Chair
Ing. Bruce V. Rydbeck, Conference Co-Chair
Dr. Rollin Hotchkiss, M. ASCE, Technical Program Chair
Mr. Brian Parsons, EWRI Director

Steering Committee

Ing. Arturo García, Presidente - (CICE)
Ing. Walter Solís, Ministro del Agua
Ing. Jorge Rivera, Presidente, AEISA -Pichincha
Ing. Hugo Landivar, President, ASCE Ecuador Section
Ing. Jorge Merlo, former Secretario Ejecutivo - CICE

Conference Scope

This conference will cover a wide variety of topics related to environmental and water resources. While technical sessions will include topics on both developed and developing countries, much of the focus of this conference will be on water resources and the environment in developing countries, especially in Latin America and the Caribbean. Participants, including paper presenters and attendees, will include engineers, scientists, practitioners and planners from all over the globe. Presentations will be made in both English and Spanish.

The Program

Three keynote speakers and several panelists have been invited for the opening and closing sessions. The remaining program will be formed with papers based on abstract submittal. An informal "networking" lunch will be organized every day. A welcome reception and gala dinner is being organized for participants. Each technical session will have three or four speakers with a seating capacity of about 60 to 100. Abstracts are now open till July 26, 2013. Submit your abstracts at **www.ipwe2014.org**!

ASCE-EWRI has prepared two outstanding Keynote Presentors for IPWE 2014, with additional guests possibly forthcoming! Visit *www.ipwe2014.org* to learn more about Dr. Ron Denham, of the Water & Sanitation Rotarian Action Group, and Ing. Ilya R.E. de Marotta, Executive Vice-President for the Panama Canal Authority.

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Meetings to Watch For...

2013 International Low Impact Development Symposium
August 18-21, 2013, St. Paul, Minnesota
http://www.cce.umn.edu/2013-International-Low-Impact-Development-Symposium/

7th International Perspective on Water Resources & the Environment
January 8-10, 2014, Quito, Ecuador
http://www.ipwe2014.org

Weather Radar and Hydrology International Symposium
April 7-9, 2014, Washington, DC Metro Area
http://content.asce.org/conferences/wrah2014/

World Environmental & Water Resources Congress 2014
June 1-5, 2014, Portland, Oregon
www.ewricongress.org

KNOW SOMEONE NOT RECEIVING CURRENTS?

Do you know someone who is not receiving their quarterly issue of Currents, the EWRI Newsletter? If so, please send an email to ewri@asce.org with the member's mailing and email address. Feel free to invite them to visit www.asce.org/my-profile (or call 800-548-2723) to verify and/or update their contact information today!

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