



# GO WITH THE FLOW: A WAVE OF WATER-RELATED OPPORTUNITIES

By Carol Milano 14 May 2010

"Water supply is where climate change hits the

ground," declares a Natural Resources Defense Council policy analyst. The imminent crisis of Earth's shrinking freshwater supply is rapidly attaining the wide awareness

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of global climate change. Proliferating water problems are building a wave of opportunities for scientific expertise, knowledge, and innovative solution. Here's a look at the growing pool of diverse needs. **By Carol Milano** 

Population surges, melting glaciers, aging infrastructures, rainfall changes, pollution, and waterfront overdevelopment are just a few causes of water shortage. **Deborah Swackhamer**, codirector of the University of Minnesota Water Resources Center, sees "a top-down and bottom-up groundswell of concern. With use growing faster than supply, people everywhere are starting to appreciate the scope of the water problem."

**Timothy Worley,** Director of Technical Programs for the American Water Works Association (AWWA), concurs. "More businesses and investors now recognize that water is a key element in their success, but dwindling resources may [bring] much stronger clashes among competing uses. Allocation questions will surely arise. In arid regions, climate change



Deborah Swackhamer

and population growth will exacerbate long-time challenges between environmental issues and domestic or agricultural needs."



Photo: Courtesy of American Water Works Association

**Timothy Worley** 

#### Who's Concerned about Water?

International awareness is strong. A new Water Stewardship Certification was introduced at the 2009 World Water Forum in Istanbul, attended by 33,000 decision makers. Dow Chemical, Calvert Asset Management, PepsiCo, PriceWaterhouse-Coopers, and United Technologies were early signers of the UN'S CEO Water Mandate. The UN Global Compact is another recent example of pressure to improve water management.

Research institutions and nonprofit organizations are increasingly involved. Already, 50 large water resource centers have been funded at US universities. Thousands of nongovernmental organizations (NGOs)—from the huge World Wildlife Fund to Brooklyn's tiny Friends of the Gowanus Canal—are aggressively educating consumers and lobbying public officials about water issues.

Government agencies at all levels are extremely concerned about providing enough safe water for residents and businesses. Public health departments are now realizing the huge impacts of pollution, drought, stormwater runoff, and other negative fac-

tors. Actually, "the federal government is looking at our water policy, realizing we have none, and wants to position itself as doing something," contends Swackhamer, chair of the US Environmental Protection Agency's Scientific Advisory Board.

Consumers are becoming aware of water pollution caused by emerging contaminants. "They're unregulated and suddenly being noticed, because they come not only from industry but from consumer products used every day, like pharmaceuticals and fragrances," says Swackhamer. Many states are now passing laws about disposal of prescription drugs.

#### **New Developments**

Since Egyptians built the first known dam around 2500 BCE, water managers have expected rivers to continue behaving as they have in the past. It's a mistaken approach, according to **Barry Nelson**, senior water policy analyst for the Natural Resources Defense Council. "Our methods have relied on traditional, rain-based hydrology: storing water, then moving it to where Mother Nature hasn't provided it. That's wrong." Some new, technology-driven approaches, he believes, could become cost-effective:

- Groundwater management, including cleaning contaminated basins to allow active water storage.
- Wastewater recycling, especially to store it in winter after treatment.
- Low-impact green infrastructure development, such as redesign that captures urban stormwater, a major pollutant. Rather than massive infrastructure projects, Nelson predicts smart retrofits allowing new water supplies from existing sources.
- Desalination. "Though very expensive, we'll see investment increasing. Saudi Arabia, for example, uses desalination because it has so few choices," Nelson notes.

For desalinating ocean water or brackish groundwater, new filtration technologies can make a real difference, Worley anticipates, citing "continual advancements in membrane materials and energy recovery systems. In the changing product landscape, manufacturers are making significant investments in R&D."

With growing recognition of serious pollutants in America's water supply, Swackhamer sees a new trend toward green manufacturing, supported by "green chemistry." "Companies are getting smarter about how they make their products and recycle their waste. We do need smarter pharmaceuticals, which will cause less pollution. Wastewater pollutants might soon be regulated by the EPA, which means that ibuprofen, for instance, could be on the list of contaminants to measure in drinking water."

The burgeoning green infrastructure movement, spearheaded by the Clean Water Network, a large government/NGO consortium, seeks to defend US waterways and water supplies against ill effects of climate change and urbanization. They're exploring a huge range of techniques including evapotransportation, decentralized rainwater harvesting, and revegetation/reforestation. Not surprisingly, the consortium is promoting green infrastructure training for wastewater professionals.

Protecting and restoring damaged wetlands or freshwater sources is now recognized as urgent. America's largest freshwater rescue, The Comprehensive Everglades Restoration Plan (CERP),



Photo: MIT Archives

Dara Entekhabi

aims to improve water supply for South Florida farms and residents, by returning water flow to its natural state. "Our underlying assumption: if we get the hydrology right, the ecosystem will conform to where it was a century ago," says **Tommy Strowd**, South Florida Water Management District deputy executive director of Everglades restoration.

Hydropower is drawing greater attention. It takes so much water to produce energy, and vice versa, that the US Department of Energy has a new water-energy nexus. The large website (http://water-energy.lbl.gov) includes new projects and grants.

#### **Where Jobs May Surface**

Water touches countless day-to-day activities, from local residents and small businesses to international megacompanies and government agencies. "The [employment] opportunities are endless—it's almost a frontier mentality," asserts **Dara Entekhabi**, water foundations professor in civil/environmental engineering at MIT, and member of the National Academy of Sciences committee on Opportunities in Hydrologic Sciences.

Strowd, too, sees growing job potential. CERP, the 20-year Everglades project, is budgeted at over \$8 billion from state and federal sources including the national Water Restoration Development Act. Despite ample funds, Strowd's agency prefers "maintaining only a core capacity, rather than growing a big bureaucracy we'd have when we're done." CERP uses outside lab analysts and water monitoring firms, as well as civil engineers for design work. To build a big reservoir, for example, they'll hire private experts for a short time.

The federal stimulus package (American Recovery and Reinvestment Act) allocated about \$6 billion for water projects. Last July, the Senate passed a \$34 billion allocation for water and energy. Yet more of the action is local and regional. "States are broke, so many are deciding to spend less on

water issues, but municipalities have no choice," Nelson explains. "Urban systems are on the front line. Every water district spends money on water, and then sells it. Payers may object to increasing rates, but shortages will make people realize that water has been underpriced. In California the transition has largely happened—without new water strategies, more shortages will surely result in rate increases."

Any recently funded government project may bring both job and consulting possibilities. Since water problems are universal, look beyond drought-prone areas, Strowd advises, to wherever you're interested in locating. "In comparison to Nevada's eight inches, Florida gets 50 inches of rain annually, but discharges too much into the ocean. In dry seasons, we wish we'd held on to it. We want to fix rain utilization." The variable has become, simply, "how it plays into the local ecology," says Strowd. "You don't necessarily need to work on a big restoration problem, like Chesapeake Bay." Some of the biggest investments are for regional restoration, so check individual federal and state websites for water initiatives.

For new developments in filtration techniques, end users will be water and wastewater treatment agencies and utilities, says Worley. Each individual water utility already has a number of positions, like lab analyst and water quality researchers, and he expects additional openings.

Swackhamer predicts more public sector openings. Many environmental agenices, like the EPA, were created in the 1970s, after the Clean Air Act; one-third of the work force handling water-related issues is likely to retire in the next five years. She anticipates "a need for people to work at the federal and state levels because of the regulatory framework. Consultants will be needed to fill the gaps of insufficient government personnel." (However, Nelson suspects, "With the federal budget suffering, some agencies may downsize" by not filling vacancies.)

Partly in response to public pressure over proposed production sites in controversial locations, big business is developing better water usage and strategies, including cost-effective conservation. Whirlpool, Wal-Mart, and American Standard are charter sponsors of the nonprofit Alliance for Water Efficiency. Corporations or developers entering a new area, often facing local water regulations for wetlands protection, for instance, may need professional assistance to meet requirements, says Strowd.

Environmental management departments, often expanding, are one locus for designing and implementing water-related programs. Swackhamer is impressed by some ways that corporations now acknowledge and tackle water-related issues, although it initially costs more to use "smarter" technology for manufacturing products and recycling waste. "3M created a sustainability office, exploring green chemistry so that starter materials are synthesized more environmentally correctly. They'll produce their own starter materials which can make greener, better products. This easily expands to water awareness, including contamination by things like bisphenol A, which was added to plastic in bottles and cans," Swackhamer expects.

Universities are very much involved in water-related research. "Nations and groups come to scientists asking, 'how much will the sea rise in my city?' There's so much work to be done," reports Entekhabi. He's struck by cross-disciplinary approaches to water's complex issues, exemplified by the skills mix at MIT's Ralph Parsons Lab for Environmental Science. "They're ecologists, chemists, biologists, geologists, and engineers—what your degree is in no longer matters."

"The research side feeds the regulatory side," Swackhamer notes. "The fastest-growing toxicology area is computational models at the molecular, cellular, and organismal level. EPA is investing because it needs this kind of information for regulation."

#### **Pool of Needed Scientific Specialties**

With "increasing recognition for the value of restoring ecoystems to their natural condition," Strowd sees a need for scientists trained in ecological areas, including biology, zoology, chemistry, and geology as well as environmental, civil, and mechanical engineers. Soil science is especially important, since the interaction of water with soil nutrients spurs changes to nearby plants and animals.

As major manufacturers consider their own water use, and how they can indirectly protect the water supply by using less, and by discharging less harmful waste, Swackhamer sees job potential. "Opportunities for creative, innovative people in chemical engineering, chemistry, synthetic biology, nanotechnology, and systems biology are ballooning. There's so much need to understand how new technologies are affecting the environment."

To Swackhamer, an environmental health professor, water safety encompasses a wide range of human health threats. "It involves toxicology, how chemicals go from air to water, exposure routes of environmental contaminants, and how to measure each one, leading to controls on how chemicals move through the environment. This isn't just epidemiology. It involves technological solutions, chemistry, and environmental engineering for aspects like water treatment plants."

Toxicologists, for example, says Worley, often work for regulatory agencies, focusing on protecting public health with clean water.

Water exists on Earth as a vapor, liquid, and solid. The huge amounts of energy either used or released when a phase changes are elevating the importance of thermodynamics, says Entekhabi. He finds Earth systems science "an emerging field, crossing boundaries, integrating experts from specialties that have had little involvement. Your previous discipline may not be the right set of tools now. Oceanographers, computational scientists, and hydrologists all have to work together on these problems."

Arid western US regions will be up to 7 percent drier in the future, forecasts Nelson, citing increasing need for biologists, hydrologists, and engineers to cope with the challenges. Pinpointing water quality as another crucial arena, he expects epidemiologists, toxicologists, and public health experts to be in increasing demand. "Detecting and decreasing carcinogenic chemicals and endocrine disruptors in our water are growing focuses. Money for water work, especially efficiency, will come from capturing associated energy benefits."

Scarcity will surely raise the value of water—and of scientific skills that might help lessen the insufficiency. How strong will that tide be? "If oil was black gold, water is now blue gold," Swackhamer promises.

#### WHERE TO EXPLORE OPPORTUNITIES

American Water Works Association's annual conference (June 20-24, Chicago) is attended by environmental scientists, engineers, and microbiologists. <a href="www.awwa.org">www.awwa.org</a>

Check federal and state websites for water-related initiatives. Start at US Environmental Protection Agency featuring updates on new grants, partnership projects, a section for scientists on new technologies, and links to state agencies. <a href="https://www.epa.gov/ebtpages/water.html">www.epa.gov/ebtpages/water.html</a>

The Water Environment Federation, for water quality professionals, provides a calendar of national conferences, seminars, and websites as well as Jobs Bank listings, adding 70 positions each month. <a href="https://www.wef.org">www.wef.org</a>

American Geophysical Union conferences deal increasingly with water issues, reports Dara Entekhabi of MIT, describing them as outstanding networking opportunities. <a href="https://www.agu.org">www.agu.org</a>

The Water Utility Climate Alliance "forms partnerships between municipal utilities and the climate change scientific community." Find the latest ones at <a href="https://www.wucaonline.org">www.wucaonline.org</a>

The Water Infrastructure Network is a national coalition of water and wastewater service providers, state environmental and health administrators, engineers, and environmental scientists. Their activities include a December white paper, "Infrastructure Funding and Jobs Creation." <a href="https://www.win-water.org">www.win-water.org</a>

American Society of Limnology and Oceanography has a meetings calendar and international job postings, by specialty areas including hydrology and oceanography/marine science, at <a href="https://www.aslo.org">www.aslo.org</a>

The American Chemical Society's largest division, environmental chemistry, focuses mostly on water, says Deborah Swackhamer of the University of Minnesota, recommending a visit to your nearest chapter or regional meeting. <a href="https://www.acs.org">www.acs.org</a>

National Resources Defense Council's blog has continuous information on newly funded water-related projects, on issues including oceanography and health/environment. <a href="mailto:switchboard.nrdc.org/blogs/issues">switchboard.nrdc.org/blogs/issues</a>

All 50 Water Resources Research Institutes, funded by the Federal Water Resources Research Act, hold an annual state conference. Check the one at your state's land grant institution.

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### **Featured Participants**

Alliance for Water Efficiency - www.allianceforwaterefficiency.org

American Water Works Association - www.awwa.org

Clean Water Network - <u>www.cleanwaternetwork.org</u>

MIT - www.mit.edu

National Academy of Sciences - www.nasonline.org

National Resources Defense Council - www.nrdc.org

South Florida Water Management District - <a href="www.sfwmd.gov">www.sfwmd.gov</a>

University of Minnesota Water Resources Center - www.wrc.umn.edu

US Environmental Protection Agency - <a href="https://www.epa.gov">www.epa.gov</a>

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