WATER RESOURCES

IMPACT

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MANAGING WATER ETHICALLY

AMERICAN WATER RESOURCES ASSOCIATION

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Giving credit where credit is due is a very rewarding habit to form. Its rewards are inestimable.

~Loretta Young

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Ethical considerations are becoming increasingly important to water resources governance and management. This issue presents an overview of the important questions as well as some answers. David Groenfeldt provides a brief overview of the birth and growth of water ethics and presents an ethical framework by focusing on categories of water and values. While celebrating the innovation so lauded today, Glenn Schrader poses the question rarely asked: should this gizmo be unleashed in the human marketplace and environment? Where do ethics come into play? Neelke Doorn argues that there is more to flood risk management than simply efficiency or optimization. Ethical issues arise from the distribution of risks and responsibilities and value conflicts. Susan Lea Smith tackles the human right to safe drinking water in the United States and provides solutions to making this right a guiding light of water resources management. Ethical unsustainable groundwater extraction? Oxymorons aside, Michael Campana suggests that stakeholders can get MAD (Managed Aquifer Depletion) and plan for future generations while simultaneously depleting the aquifer supplying them. Mona Polacca and Darlene Sanderson conclude this seminal issue by invoking the voices of indigenous peoples whose innate beliefs espouse ecosystem needs, clean water and sanitation.

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Getting Involved in the Ethics of Water

Brenda Bateman
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WHEN I BEGAN my professional career in 1993, I had the privilege of working for a group of institutional investors (pension funds, university endowments, trusts, estates, etc.) who were interested in using the weight of their financial resources to shape the ethical behavior of U.S. corporations. As part of this work, I had the opportunity to audit the governance, labor and environmental performance of U.S. factories all over southeast Asia. In and amongst all of these activities, it was the appropriation, use and discharge of water that caught my eye. The answers to the questions "who gets the water?," "how is it used?," and "how clean is it?" say a lot about who we are as a society.

My next assignment was with a partnership of the U.S. Commerce Department, U.S. Environmental Protection Agency and U.S. Agency for International Development. Through a mix of technology transfer, professional exchanges and policy training, U.S. officials were paired with overseas counterparts to help modernize environmental protections and water supplies in locations throughout Asia.

With the March 2018 edition of *IMPACT* magazine focusing on water ethics, it is fitting that several of us from AWRA are headed to the 8th World Water Forum in Brasilia, Brazil. Under the theme "Sharing Water," discussions will focus on the topic areas that still need a lot of work and investment, particularly the U.N. Sustainable Development Goals, the Paris Climate Agreement and the Sendai Framework for Disaster Risk Reduction. A two-day side discussion will explore management of water resources and the provision of water sanitation service.

While attending the World Water Forum, we will observe World Water Day—held on March 22 each year. World Water Day is about taking action to solve the water crisis for 1.8 billion people around the globe—people whose source of water is contaminated, putting them at risk of cholera, dysentery, typhoid and other diseases.

There are a number of ways you can get involved professionally, by ensuring that your customers and communities have the information they need to make informed choices about their drinking water and water infrastructure. Create opportunities so that they have a voice in these issues. Continue to invest in professional training and modern communication tools for your staff and your organization.

There are also ways to make a positive contribution on the personal level. To improve rural drinking water and irrigation systems, you can support the efforts of Heifer International, Engineers without Borders, Water.org, or Green Empowerment. To improve kids' abilities to swim and to handle themselves around water, you can seek out Swim Tayka. To donate time or supplies to make emergency and personal hygiene kits, contact local relief organizations. And there are always opportunities to remind students and their families of the importance of having clean, reliable sources of water by contributing to AWRA's Richard A. Herbert Memorial Scholarship or volunteering in the classroom, after-school programs and outdoor camps. Project Wet offers a helpful, hands-on curriculum for all ages.

Please visit conversations.awra.org to describe your experiences and ideas about how we can all get involved in the ethics of water. Because the answers to the questions: "Who gets the water?" "How is it used?" and "How clean is it?" say a lot about who we are as a society. ■

Brenda O. Bateman can be reached at president@awra.org.

Corrections to AWRA Board of Directors Call for Nominations

The Board of Directors Call for Nominations form included in the January issue of *IMPACT* had some incorrect information.
Following is the corrected information:

- Nominations should be submitted to Martha Narvaez, Water Resources Center, University of Delaware, DGS Annex, Newark, DE 19716 or mcorrozi@udel.edu.
- Nominations must be received no later than February 28, 2018.
- AWRA is also requesting nominations for Secretary/Treasurer.

For complete details and a corrected nomination form, please go to: http://www.awra.org/about/bod-information.html

An Overview of Water Ethics

David Groenfeldt

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"Water Ethics" is a young and still-emerging field that has mostly grown out of an initiative by UNESCO's Commission on the Ethics of Scientific Knowledge and Technology (COMEST) from 1998 to 2004. An initial report in 2000 was followed in 2004 by a series of 14 reports on various aspects of "Water and Ethics" ranging from gender to groundwater to environment, plus a synthesis report, "Best Ethical Practice in Water Use" (co-authored by C. Brelet and Lord Selborne). The reports are available through UNESCO or on the Water Ethics Network website, waterethics.org.

When the UNESCO-COMEST initiative concluded in 2004, the topic was taken up by the Botin Foundation in Spain, resulting in two important publications: *Water Ethics* (2007), a book of case studies edited by Ramon Llamas and associates, and in 2012 a special issue of *Water Policy* edited by Jerome Delli-Priscoli. Meanwhile, in 2010, a book on water ethics by Peter Brown and Jeremy Schmidt republished key articles related to water ethics and helped frame the topic as a distinct subfield of water management. My own book, *Water Ethics: A Values Approach to Solving the Water Crisis* (2013) spelled out a systematic framework (summarized in my article on page 8). Most recently, COMEST has again taken up the theme of water ethics, including both fresh and marine water, with a new report expected in 2018 or 2019.

Parallel to this evolutionary process has been the emergence of Indigenous Water voices, primarily through the triennial World Water Forums. At the 2003 Forum in Kyoto, Indigenous participants proclaimed the "Indigenous Peoples Kyoto Water Declaration" which, though not using the terminology of ethics, was all about ethical responsibilities to protect water, a theme brought home to the U.S. public through the Standing Rock demonstrations in 2016. Indigenous water values have been indirectly absorbed into the development of water ethics, but there is much potential for more deliberate alliance-building.

The "values space" of water management has become, rather surprisingly, an exciting place to be. In addition to "water ethics," the buzz words include "water integrity," "water stewardship" and "water values" with initiatives and organizations formed around each of these themes. All these concepts and more can be subsumed within a broad definition of "water ethics." In spite of the bad taste that the word "ethics" might leave in some of our mouths(!), the deliberate application of ethics has the potential for fostering truly integrated policies that can guide us to the elusive goal of sustainable, just and hopeful water management ■

David Groenfeldt is an adjunct associate professor of anthropology at the University of New Mexico, Albuquerque. He established the Water-Culture Institute in 2010 to promote the integration of Indigenous and traditional cultural values into water policy and helped establish the Indigenous Water Initiative to coordinate inputs from Indigenous Peoples in the 2003 and 2006 World Water Fora. Contact: dgroenfeldt@waterculture.org.

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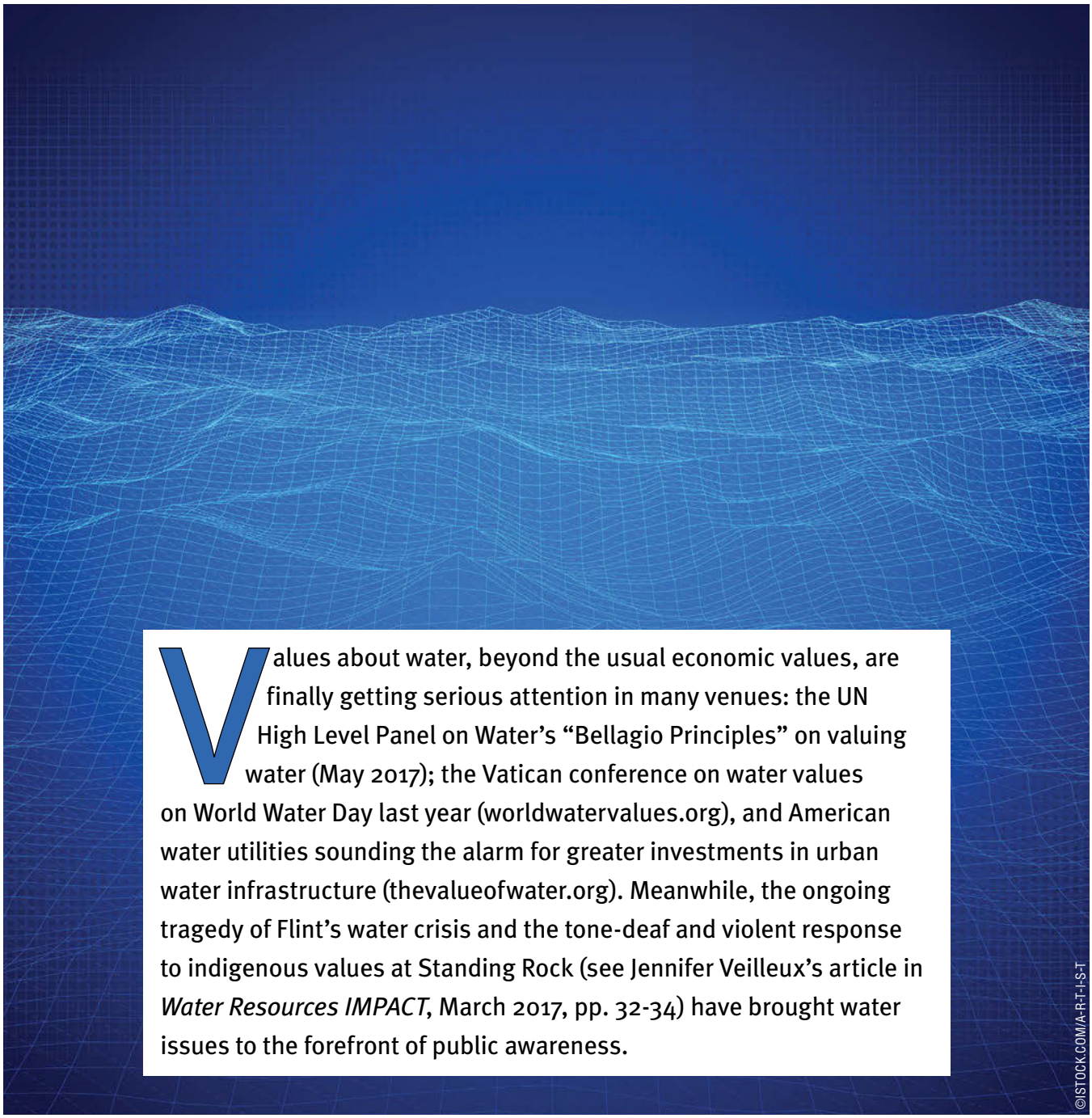
A Conceptual Framework for Water Ethics

David Groenfeldt



Values about water, beyond the usual economic values, are finally getting serious attention in many venues: the UN High Level Panel on Water's "Bellagio Principles" on valuing water (May 2017); the Vatican conference on water values on World Water Day last year (worldwatervalues.org), and American water utilities sounding the alarm for greater investments in urban water infrastructure (thevalueofwater.org). Meanwhile, the ongoing tragedy of Flint's water crisis and the tone-deaf and violent response to indigenous values at Standing Rock (see Jennifer Veilleux's article in *Water Resources IMPACT*, March 2017, pp. 32-34) have brought water issues to the forefront of public awareness.

Clearly, water is more than a factor of economic production and rivers are more than nature's plumbing systems. Managing water reflects a complex range of cultural, social and psychological values underlying water policies, projects and investments. It is high time for the water profession to explore these values systematically and learn how explicit consideration of ethical values can contribute to sustainable water management.

Values are resources that, like water itself, can help us attain our broad social goals. Values operate at a foundational level where we formulate the specific goals and objectives to be achieved through water policies. This relationship was laid out by Ralph Keeney in his 1992 book, *Value-Focused Thinking: A Path to Creative Decision-Making* and later elaborated by management guru, Richard Barrett, in his notion of "values-driven organizations." It is not money, fame or even sex that directly motivates people; rather, people are motivated by their values about the importance of attaining these (and many other) goals. Values are powerful but messy. Our values, goals and specific objectives need to be sorted out carefully and deliberately.

This is where ethics, and specifically "water ethics," comes into play. Ethics is the art and science of deciding what action should be taken in light of one's values, while at the same time holding up the values themselves for critical examination. Are these values the right ones? Will the expression of these values lead to good outcomes? Are these values so important that the utility of the outcome is irrelevant, or should we perhaps reconsider our initial values?

Ethics, in other words, can serve as a decision support tool. Should the proposed dam be approved? Cost-benefit analysis cannot deal with intangible values very well, which is why both the High Level Panel on Water and Pope Francis are so interested in water values. Legal arguments about the dam might invoke moral arguments, but legal decisions are based on existing laws, which usually reflect old ethical assumptions. The current interest in water values is framed as a way of bringing a broader and more contemporary perspective to bear on water decisions. But then what? Where does the path of values-analysis lead us? Are we simply enlarging the chorus of values-driven special interests? How can we promote water decisions that respond to the greater societal good, rather than to the strongest pressure group?

Ethics introduces the integrative reference of "the good" as a decision-making gold standard. It sounds elusive because it necessarily is. If values are the Christmas tree ornaments, ethics is the tree, the principles underlying the values. Some of these ethical principles are couched in the language of rights: the human right to water; the cultural right to traditional spiritual practices; the natural right of a river to flow and the right not to be discriminated against on grounds of gender, race or culture. Other ethical principles are derivative principles articulating specific standards for management of water resources, e.g., the principle of management subsidiarity (1992 Dublin Principles), which derives from the ethical value of democratic governance, and the principle of water as a commons, elaborated by Nobel-laureate Elinor Ostrom and others.

Water ethics framework

Analyzing or "reflecting" on water values can be facilitated by a framework that focuses our reflection on particular domains or categories, and on the interactions across value categories. This process of ethical reflection helps in sorting out the values and deciding which are most or least important. But ethical reflection aims higher than merely establishing value hierarchies; it aims towards action: How can we express our values through the ways we use water?

The water ethics framework presented here is taken from my 2013 book, *Water Ethics: A Values Approach to Solving the Water Crisis*. The framework is built around two categories of water and five categories of values (Figure 1). The two kinds of water are (1) Water that is in natural ecosystems, in a river or aquifer, in clouds, or in the soil (including both blue and green water, using Malin Falkenmark's color terms) and (2) The water that we take out of nature to use for some purpose. We divert water for urban water supply and for irrigating crops, or we pump water from aquifers to use in manufacturing, or to

Figure 1. Two categories of water context (left) and five categories of values (top).

	Environmental values	Economic values	Social values	Cultural values	Governance values
Water in Ecosystems (rivers, lakes, wetlands, aquifers, green water, etc.)	X	X	X	X	X
Water Use (agriculture, urban, domestic, industrial, or other use)	X	X	X	X	X

> Ethics is fundamental to good decision-making and also to innovation. It is by holding fast to ethical principles that we are motivated to find new solutions to old problems.

wash coal, or to mix with fracking fluid. Those two kinds of water—nature's water and people's water—cycle back and forth, as water is diverted, used and returned to the rivers, oceans and aquifers over and over again.

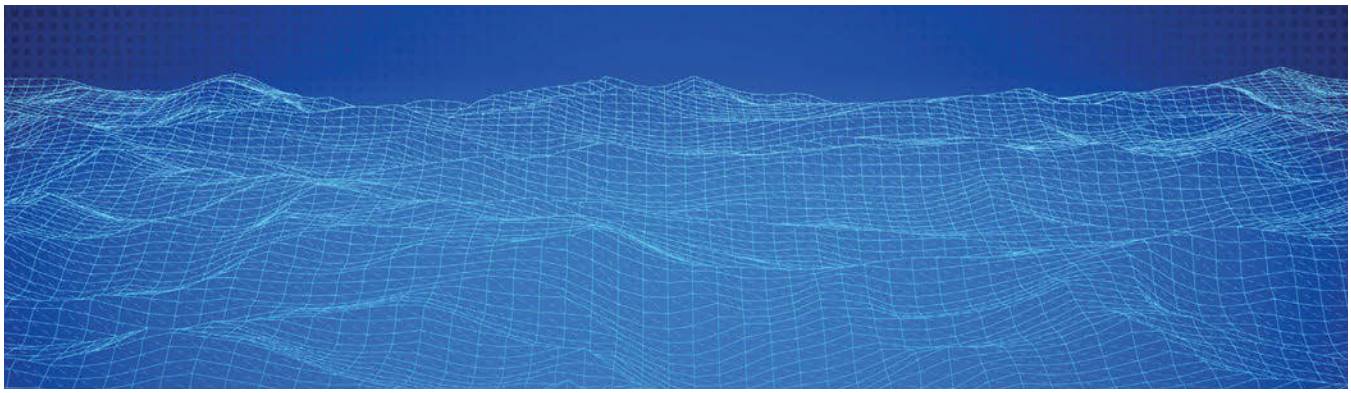
Next are the value categories. I distinguish five types of values that we should be concerned about in the context of water:

1. **Environmental values**—Values about the health and welfare of fish, wildlife, rivers, wetlands, aquifers and the whole water-linked ecosystem.
2. **Economic values**—Values about not wasting resources and finding least-cost solutions; applying water to its most productive uses; and recognizing economic values embedded in other kinds of values, like ecosystem services of the river and the tourism potential of water recreation.
3. **Social values**—Values about equity and social justice (not shutting off the water service for poor families that have no income; not situating the uranium mine in Indian country just because it's easier to get a permit there) as well as values about social benefits from water: safe water and sanitation; healthy rivers and wetlands; the social benefits of a robust agricultural economy that depends on secure water for irrigation.
4. **Cultural values**—Spiritual values about rivers and springs, whether a special spring like Lourdes or every river in Australia, which are all sacred to Australian First Nations; emotional and aesthetic benefits from walking along a river, kayaking on it, or swimming or fishing in it, and our relationship to water bodies as part of our place-based cultural and personal identities.
5. **Governance values**—Values about who should be involved in decisions about new water investments or policies, and the institutional architecture for making those decisions at multiple levels.

These values are relevant not only to direct water decisions (e.g., how much water should go to irrigation) but also to the "values-chain," the values advanced through the way that the irrigation water is used. What agricultural practices does the irrigation water support? Are the farm workers adequately compensated (social values)? Are pesticides impacting the groundwater (environmental values) or drinking water (social values)? The ethical ripple effects can be far-reaching, extending to the nutritional, economic and cultural values of the crops produced.

In addition to these categories of water and values, there are also different categories of ethics. A first distinction is between describing the ethics already in place (*descriptive* ethics) vs. advocating for the ethical principles one finds desirable (*prescriptive* or *normative* ethics). A second distinction is between *preventative ethics*, which focus on what we should NOT do (don't pollute) and *aspirational ethics*, which focus on what we would like to see happen (restore the river).

Finally, there is an overriding "meta ethic" about water governance that borrows from the field of medical ethics, where the practice of ethics related to medical decisions has become the expected and often legally mandated practice. The meta-ethic for water goes something like this: Since water is fundamental to life itself, decisions about how water is managed and governed should be guided by ethics. It is, in effect, unethical to make major decisions about water that do not consider the ethical implications. We have a moral responsibility, in other words, to treat water decisions with the



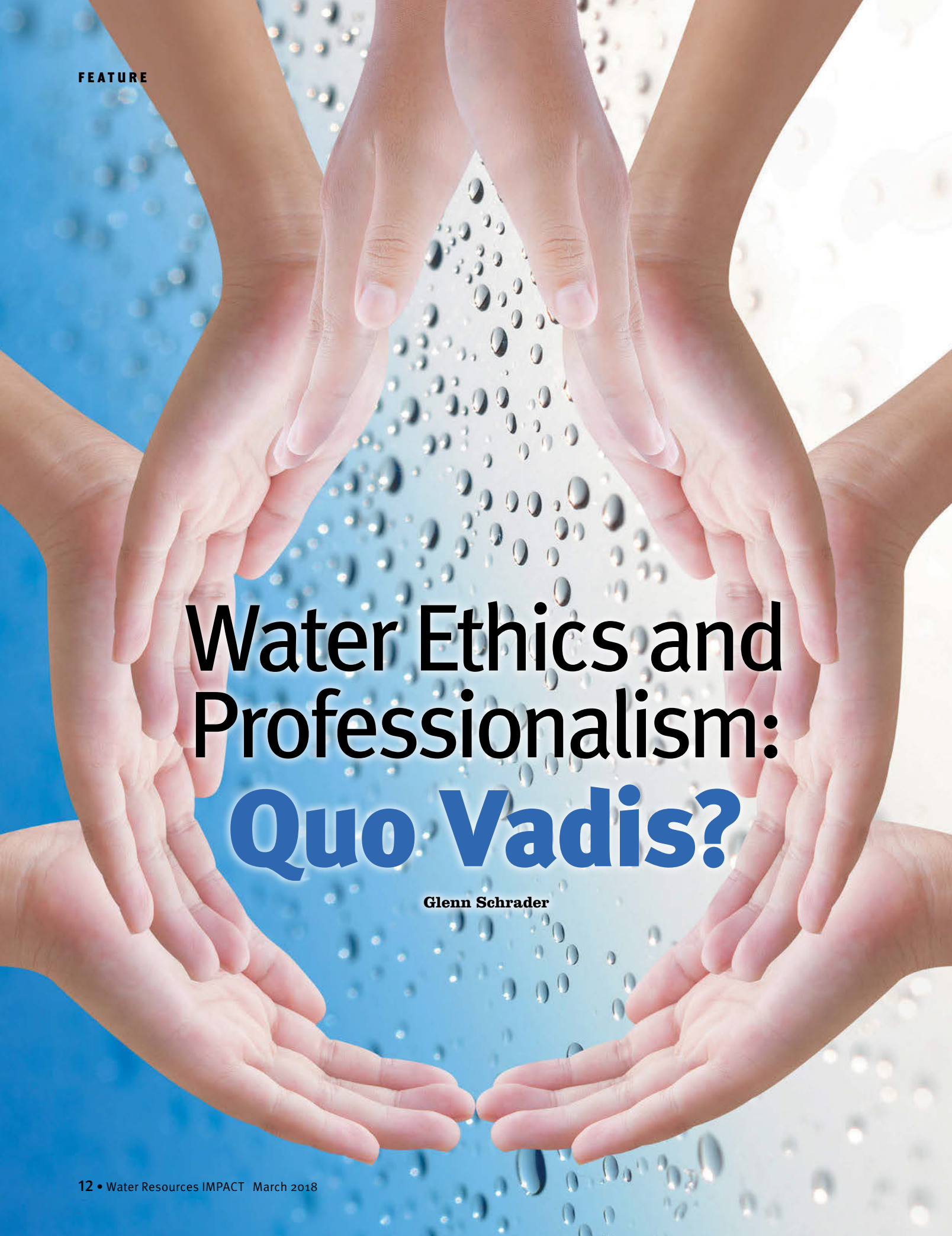
serious attention which they deserve, and ethics needs to be part of that serious attention.

Water professionals know the importance of water, or we would have chosen a different field. Indeed, members of AWRA might justifiably claim that our choice of profession was inspired by a sense of moral responsibility to ensure the sustainability of water resources. We are already predisposed to looking at water through ethical lenses, but we have been too complacent in viewing our profession as inherently occupying the moral high ground. Indeed, the dire state of the world's water is pretty strong evidence that we need to do something differently. Reflecting on the value assumptions lurking just below the surface of our water actions will help us see new opportunities to create "the world we want" within the context of our current jobs. And if not, we might want to look for new jobs more consistent with our values!

But in addition to bringing an ethics perspective into our water jobs, there is a parallel need to bring professionalism into the field of water ethics. Water is too important to be left to the forces of the market, or even to governments, as the arbiters of how it should be used. The field of bioethics has been developed to safeguard the sanctity of human life. We need something similar for water, which is often equated with life, for very good reasons. Water needs ethical protection just as people do.

I hope we can overcome the bad taste that the word "ethics" often invokes—the legacy of holier-than-thou attitudes that we have learned to avoid. Ethics is fundamental to good decision-making and also to innovation. It is by holding fast to ethical principles that we are motivated to find new solutions to old problems. Economic, environmental and social values are only in conflict when we lack the imagination to see the potential synergies. To paraphrase Aldo Leopold, bringing ethics into water decision-making is both very possible and very necessary for reaching that elusive goal of sustainable water management. ■

David Groenfeldt is an adjunct associate professor of anthropology at the University of New Mexico, Albuquerque. He established the Water-Culture Institute in 2010 to promote the integration of Indigenous and traditional cultural values into water policy and helped establish the Indigenous Water Initiative to coordinate inputs from Indigenous Peoples in the 2003 and 2006 World Water Fora. Contact: dgroenfeldt@waterculture.org.



Water Ethics and Professionalism: Quo Vadis?

Glenn Schrader

If you recently visited an engineering design classroom, you likely found eager students huddled in teams competing to solve a perplexing technological challenge. The enthusiasm is clearly contagious, and the goal of making "something work" is only exceeded by the often dazzling references of future profitability, market dominance and wealth. The next gizmo, widget or app is the goal—and speed is essential. No one doubts the lures and the challenges in the global marketplace: this is a realm for entrepreneurs, innovators and discovery agents—the nirvana for new science and engineering. Left to the side of this "highway-to-heaven," however, is the question: ***should*** this gizmo be unleashed in the human marketplace and environment? In essence, not necessarily "for"—but rather "on"—humans and the other living creatures inhabiting our common home, Earth.

There can be no doubt that technology has dramatically improved the quality of life for humans in the past 100 years. Standards of living and life expectancy have risen nearly throughout the world due to labor-saving machines, improved infrastructure and advanced medical care.

Estimates are that nearly two billion people would not be living on this planet if ammonia synthesis had not been invented and "reduced to practice" on a very large scale to produce fertilizer for crops; this same technology, however, has been responsible for the production of munitions for warfare on a scale that scarcely could be imaged a century ago.

Flood control and augmentation of water supplies for farming and human consumption are benefits of damming our natural waterways, but the scale of these endeavors seems staggering: since 1949, the number of dams has been estimated worldwide to have increased from 5,000 to 50,000 [D. Groenfeldt, *Water Ethics, 2013*].

Decades ago, Aldo Leopold cautioned against the proclivity of humans to harness the last stream of water, mine the last cache minerals, and till the last vestige of arable land so that nothing is left within the environment. Now, nearly all manufacturing requires the use of water and fossil fuels.

The rise of consumerism in the past 50 years has been unparalleled, and Max Weber in *The Protestant Ethic and the Spirit of Capitalism*, warned about a "'disenchanted,' or utterly secular, world fired by "economic compulsion" that detaches life from "the highest spiritual and cultural values'." More recently, Larry Rasmussen asked in *Earth-Honoring Faith: Religious Ethics in a New Key,* "Have we grown dependent upon a destructive way of life we know not how to escape?"

American educational systems, especially the public schools since the early 1900s, have been a conduit for achieving a higher standard of living through entrance to the professions, the "rise of the middle class."

With the explosive development of scientific knowledge, however, professional practice has become much more specialized and more narrowly defined, as documented by the Carnegie Foundation study discussed in William Sullivan's book *Work and Integrity: The Crisis and Promise of Professionalism in America*. Sullivan and his colleagues detected a growing disconnect with integrity that has increasingly led to a lost perspective regarding safety, reliability, and a commitment to the professions themselves.

The recent technological scandals involving automotive emission control at Volkswagen and safe drinking water in Flint, Michigan bear witness to the surrender of societal values to corporate allegiance and profitability.

So, what do the professions stand for today? And are they under severe strain to perform both profitably and ethically? There even seems to be considerable confusion about what it means to be a professional.

Exploring the internet (where young college students may be "learning" primarily when not in the classroom), leads to "helpful tips for professional" behavior in the workplace including: "Am I polite, honest, trustworthy, reliable, positive, supportive and a good listener?"—all admirable personal attributes but seemly missing-the-mark about the larger issues of societal values.

Some online courses emphasize that professionalism and ethics are "cultural" but they are most expediently derived by knowing the "corporate culture." "Professionalism is in the eye of the beholder" touts one course outline as a guideline. Another states that professional behavior "can ultimately translate into raises and promotions, chances to work on more assignments that you enjoy, less likelihood of being downsized when layoffs are being considered and the respect of peers and senior management."

Nevertheless, according to Sullivan, the public seems to entrust the professions to a surprising degree with the responsibility of maintaining key public values, including standards of health care, civil regulation, social wellbeing, technological safety, environmental protection, justice, education and reliable public information.

All professions have been "directly pledged to an ethic of public service." However, Sullivan and his colleagues provide a warning that a "civic ethic" is linked to the "condition of the polity." The question arises how well professionalism can function in a time when interest and participation in civic affairs continues to decline and when the conditions of much professional work are increasingly linked to market advantage and profitability, but much less to public benefit and wellbeing.

Professional engineering and scientific societies have addressed ethical behavior basically through "codes of conduct" that emphasize the agency of the individual, rather than the broader, more complex issues of the values or morality of society. Professions have followed a time-honored imperative: "watch one, do one, teach

one." The track of professional historically proceeds from the stages of academically controlled apprenticeship involving the study of texts and examples, to the observation of practice, to the assistance of practice, to highly supervised and monitored practice, to increasingly autonomous practice. But current "pared-down" engineering education skirts this perhaps outdated model and misses opportunities to address values even at the individual level.

L.R. Graham argues in *Between Science and Values* that the modern impact of increased scientific inquiry developed in modern research universities might have also bolstered a commitment to ethics, but there has always been a divergence of opinion: "expansionists" advocate that the understanding of nature which scientific knowledge brings can enlighten and improve political and social behavior; "restrictionists," on the other hand, contend that scientific knowledge and moral value comfortably belong to separate realms. The latter seems to have won the day.

Values do pervade cultures, but the origin and shape of the resulting ethical behavior is not easily discerned. And the "scale" at which the values are expressed is also determinative. In her book *Resisting Structural Evil*, Cynthia Moe-Lobeda reminds us that values are expressed at the individual, small group, community, national, international and corporate level and the outcomes originating from these starting points can be remarkably different.

"Starting at the bottom" is relatively rare in American society, where the human poor reside and where the even poorer creatures of our planet are nearly completely disenfranchised. Robert Chambers, years ago, advocated that decisions about sustainable development should start at the community level where shared values are most readily expressed. For issues related to water, watersheds might help to define meaningful boundaries for a community exploring value-based decisions [*Watershed Discipleship: Reinhabiting Bioregional Faith and Practice*, C. Myers, ed., 2016].

In the early educational stages for professional engineers and scientists at universities, it may be that the impending rigors of earning a degree simply do require much strong motivational enthusiasm and creative enjoyment.

The question remains: are there more comprehensive professional educational experiences—for both future and current technologists—that would seek to achieve a "restorative" balance beyond mere technical feasibility and economic profitability? Are there values traditionally associated with safety and health, impact on the environment, and quality of life for future generations that should be addressed in new, stimulating ways that also generate excitement and commitment? If so then, where are ethics and professionalism going? ■

Glenn Schrader served as research dean in the College of Engineering and department head for Chemical and Environmental Engineering at the University of Arizona. Previously, he was professor of chemical engineering and chief chemical engineer at Ames Laboratory at Iowa State University for 25 years. In 2002-2006, he served as program manager for Catalysis and Biocatalysis at the National Science Foundation. Contact: glschraderdc@aol.com.

The Ethics of Flood Risk Management

Neelke Doorn

The number and impact of catastrophic floods have increased significantly in the last decade, endangering both human lives and the environment. With ongoing climate change, the risk of flooding is likely to increase even further. Flood management touches upon three major ethical issues: (1) the distribution of risks or safety levels (i.e., distributive justice), (2) value conflicts, and (3) the distribution of responsibilities. Traditional approaches to flood risk management reduce this threefold challenge to an often-monetary optimization problem, emphasizing efficiency but ignoring ethical aspects. The ethical approach to flood risk management which I outline in this paper aims to balance considerations of both efficiency and equity.

> This discussion shows that flood risk management is more than an issue of efficiency and effectiveness. Distributive and procedural justice, values and responsibility may be equally important.

The first and most obvious ethical issue concerns the distribution of risks or safety levels, which I addressed in a 2015 article published, appropriately enough, in the journal, *Risk Analysis* (vol. 35, no. 3). Risks are not distributed equally; some people live in areas that are prone to flooding and the chance that they will die or suffer property loss from flooding is much higher than for those living in less flood-prone areas. Although this is partly determined by geographical conditions and therefore unavoidable, it is—to some extent at least—possible to implement flood protection strategies, which may significantly reduce the risk of flooding.

This prompts the ethical question: which inequalities should we accept as part of nature and when should we try to improve the safety in an area, for example by building higher levees or other hard flood protection structures, or by building retention areas that can temporarily hold flood waters in case of high water discharges in the rivers.

This question is often treated as an optimization problem, where the risks of flood damage are weighed against the costs to implement protective measures. If the expected gains from higher levels of protection are higher than the costs of the protection, we should implement these protective measures. If the expected gains are lower, we should not implement them.

This so-called Probabilistic Risk Analysis (PRA), which is based on cost-benefit analysis (CBA) is increasingly used as a decision support tool for investments in flood risk management. The PRA will identify areas of high economic value as the areas that need to be protected. Areas with low economic value will probably not be worthy of protection in this calculation.

This immediately shows one of the important drawbacks of this approach: it does not take into consideration how risk levels are distributed. Thus, poor urban areas will probably not be identified as areas worthy of protection. In fact, rural areas generally are less likely to be identified as areas worthy of protection in this probabilistic calculus.

Hence, people who are already at an economic disadvantaged are more likely to suffer disproportionate impacts of flooding—or other natural disasters for that matter. The recent damage and fatalities caused by hurricanes Harvey and Irma highlight how poor neighborhoods are often most vulnerable to flooding. The implementation of flood protection measures using a probabilistic calculus will further increase inequalities between relatively rich and relatively poor areas.

Another drawback of this optimization approach is that it does not differentiate between people who freely decide to live in a flood-prone area, and those people who have no alternative. Where we could say that the first group has consented with a higher risk, we cannot say the same of the second group and they may be more deserving of protection or at least compensation in case flooding occurs.

A second ethical issue in flood risk management concerns value conflicts. Different flood protection schemes are about protecting the ecosystem, cultural heritage, the water system in general, and of course, human lives. PRA expresses all these impacts as monetary values, so they can be compared. This requires monetizing human lives as well as ecosystem health or cultural heritage. Is this really possible? There is no doubt that traditional "hard engineering solutions" to flooding come with a huge impact on the ecosystem. For example, closing off intertidal estuaries obliterates entire brackish ecosystems.

PRA favors "cheap" solutions that are biased towards the protection of human safety in relatively well-off areas and often undervalue environmental and other cultural impacts. Alternative decision-making procedures are needed that also take into consideration the long-term irreversible impact of flood protection measures. Here, ethical analysis comes in as a decision-support tool that can consider a broad range of incommensurable values.

The third ethical issue is the distribution of responsibilities. Who should be responsible for what? In some countries, e.g., the Netherlands, central government used to be responsible for the flood safety of its citizens. In recent decades, we have witnessed a governance turn in flood risk management, in which private parties as well as regional and local governmental bodies have a role to play. This transition has been marked by a shift from "flood fighting" to the paradigm of flood risk management, which recognizes that safety can be provided through multiple management strategies, for example through better evacuation and emergency plans, or flood insurance.

The role of government policy is now focused on guiding the conduct of citizens and the private sector, and the distribution of responsibilities depends on the particular strategies adopted for managing flood risks. For example, some countries rely on flood insurance

through private providers, a strategy that may increase inequality between those who can and those who cannot afford flood insurance. While the distribution of responsibility between the state and individual citizens depends partly on the prevailing politics of the country, it is reasonable to hold the state ethically responsible for establishing a viable strategy by which the flood risk to vulnerable populations is minimized.

The state also has an obligation, in my view, to ensure that the responsible parties, whether homeowners, business owners or municipalities have the capacity and resources to meet the responsibilities called for in the state's flood risk strategy. Additionally, from a democratic point of view, individual citizens should be given a voice when deciding about the objectives of flood risk management. This issue is often referred to as "procedural justice" and is equivalent to the concept of "governance ethics" in the terminology of the Water Ethics Framework (Groenfeldt, this issue).

This discussion shows that flood risk management is more than an issue of efficiency and effectiveness. Distributive and procedural justice, values and responsibility may be equally important. As explained under the first ethical issue, PRA and CBA requires that all impact is reduced to a common denominator. This is problematic as the things that are compared are in essence incommensurable: we cannot say that the loss of some unique ecosystem is of equal worth of, say, 3% economic growth in the neighboring area.

In practice, CBA and PRA tend to undervalue environmental, cultural and other non-tangible impacts. Hence, they should be complemented with ethics-based approaches that take this incommensurability seriously and that leave room for ethical reflection and procedural justice concerns. Such ethics-based approaches emphasize the inclusion of relevant stakeholders in the decision-making and they may include, for example, participatory planning, mediation and consensus-building. When CBA and PRA dominate the decision-making, there is little room for ethics; but when CBA and PRA are used more modestly to identify those values that can be easily monetized, but without forcing monetization on cultural values or biodiversity protection, or human life, then we have a more robust framework for supporting good decisions about flood management strategies. ■

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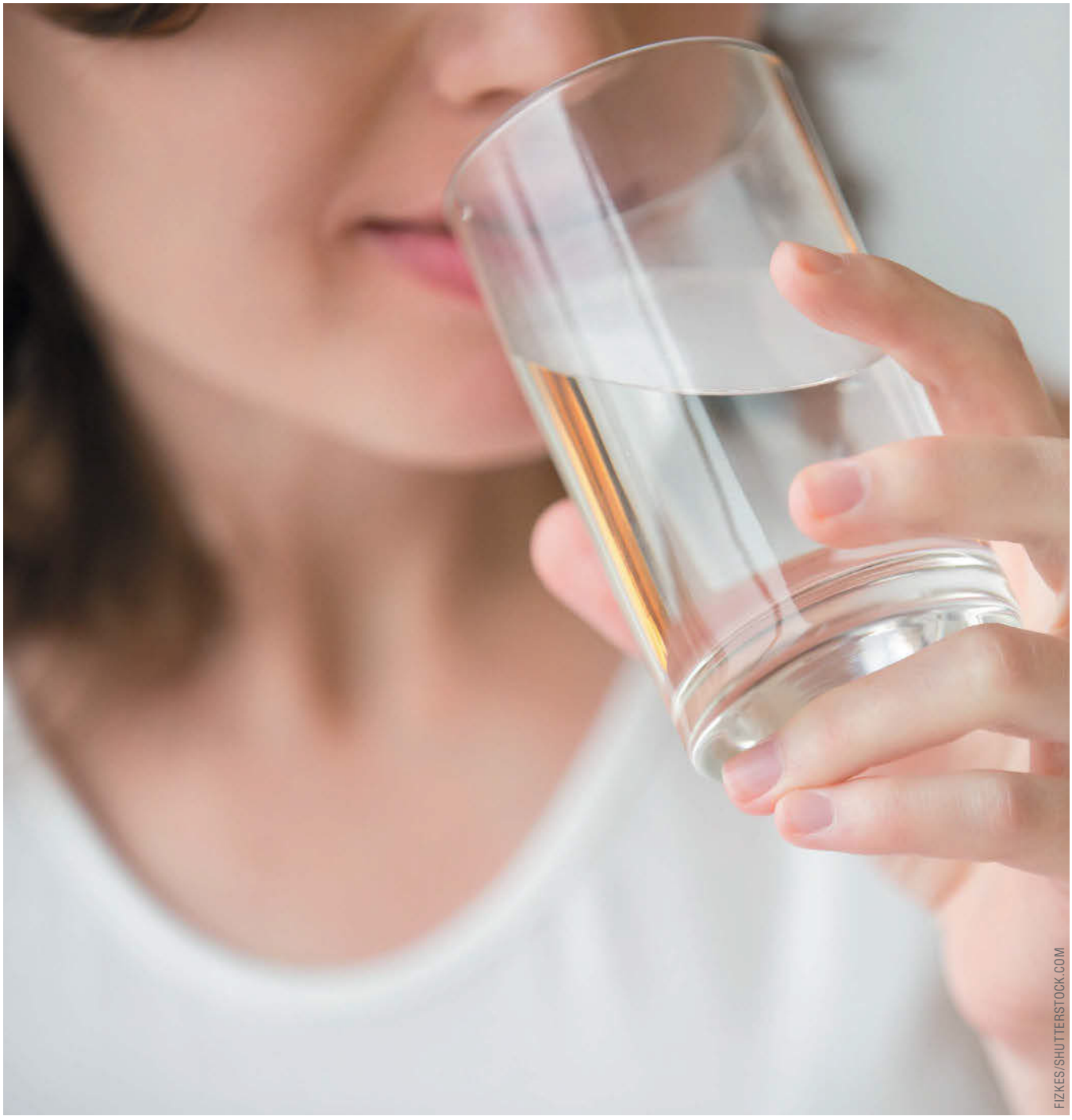
Endangered By Injustice

The human right to water in the United States

Susan Lea Smith



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The internationally recognized human right to water requires that every nation provide safe, affordable water for household uses. While most Americans enjoy safe drinking water from their household tap, the human right to water in the United States is endangered by multi-faceted social injustice that pervades modern America—injustices born of racial and wealth disparities, the unwillingness of the rich to invest in public water infrastructure, and corporate willingness to pollute in unconscionable ways in pursuit of the almighty force of quarterly profits.

Moreover, safe drinking water in the United States has fallen victim to political indifference and public distrust. It is telling that more than half of Americans no longer have confidence in their tap water and two-thirds do not drink untreated tap water due to concern about its safety. Even this statistic has a racial dimension. About 40% of whites are willing to drink untreated tap water, but fewer than 20% of blacks and Latinos will take that chance.

Superior cost-benefit analysis and integrated water resources management are powerless to restore the human right to water in the United States because neither focuses on the injustices at the root of our drinking water problems. Instead, we must name the injustices and then we must correct them. We must rededicate ourselves to the ethics of water justice that demand every human being, rich or poor, urban resident or rural, white or any other color, have safe drinking water made available on an affordable and non-discriminatory basis. Otherwise, we face the real prospect that the days of enjoying safe drinking water from the tap in America are numbered.

American tap water: safe to drink?

One out of every 12 Americans—77 million people—drank water from a community water system that violated health-based standards of the Safe Drinking Water Act (SDWA) in 2015. Some 5% of Americans contracted an illness in 2015 from their tap water. Most had diarrheal or other gastrointestinal illnesses far too mild to be reported to health authorities. However, other illnesses from drinking water are far more severe. According to a Centers for Disease Control (CDC) report, 42 drinking water-associated reported outbreaks during 2013-14 caused at least 1,006 cases of acute illness, including 13 deaths caused by *Legionella* bacteria. Chemicals, toxins and parasites such as *Cryptosporidium* and *Giardia* together accounted for another 30% of the outbreaks. A single release of a coal-washing chemical in West Virginia caused 369 people to fall ill, with 13 hospitalized.

And these figures don't even count chronic conditions triggered by contaminated drinking water, such as the severe neurological impairments from lead poisoning, which can dramatically affect so many lives.

The Flint lead poisoning incident reminds us that contaminated drinking water from the tap has become a dangerous reality for a disturbing number of Americans, particularly poor people and people of color. The Flint tragedy is not unprecedented. Washington, D.C. experienced an even more severe lead poisoning crisis from 2001 to 2004, in which the period of lead exposure, the lead levels, and the number of people exposed far exceeded Flint. The subsequent minimization of that crisis by the federal government, including a 2004 CDC report downplaying the significance of lead exposures from D.C. tap water, was equally devastating to public safety and trust. The rainbow colors of Americans deprived of their human right to safe drinking water in recent years also include the low-income Latino communities in the San Joaquin Valley and the 13% of Native American households that lack safe drinking water.

Profit-driven corporate pollution also endangers drinking water

Two pervasive, mostly invisible hazards affecting drinking water are nitrate pollution caused by corporate agriculture and chemical pollution by oil and gas fracking. Both industries have successfully secured exemptions from regulations designed to protect drinking water with appalling damage to public safety.

The highly contaminated San Joaquin aquifer in California provides nitrate-laden drinking water to 254,000 people. And nitrate contamination is not limited to groundwater. In 2014, nitrate pollution of Lake Erie caused algae blooms with cyanobacterial toxins that sickened 116 people in Ohio. Nitrate pollution is facilitated by the exemption of irrigation run-off from water pollution regulations.

Oil and gas companies pollute groundwater via fracking production wells freed from regulation through the "Halliburton exemption" from the SDWA Underground Injection Control program. EPA's 2016 report to Congress confirmed that fracking activities contaminate drinking water with a severity ranging from temporary contamination to rendering private wells unusable for drinking. As if to punctuate that conclusion, EPA and California admitted that they mistakenly allowed the industry to inject fracking waste into an estimated 2,500 wells through underground drinking water aquifers, a practice that violating state and federal law.

Safe drinking water: an unaffordable luxury in 21st century America?

The human right to water requires that drinking water be affordable; according to the EPA standard, water is affordable if the total cost paid by a household for water is less than 1.5% of mean household income. In many American communities,

> While most Americans enjoy safe drinking water from their household tap, the human right to water in the United States is endangered by multi-faceted social injustice that pervades modern America—injustices born of racial and wealth disparities, the unwillingness of the rich to invest in public water infrastructure, and corporate willingness to pollute in unconscionable ways in pursuit of the almighty force of quarterly profits.

the cost of water is well above this level. For example, San Joaquin communities subject to nitrate contamination of well water spend 4.6% of their household income on water. During the lead poisoning crisis, Flint issued thousands of shut-off notices for late payments, a triple travesty of justice against poor Flint residents who were receiving contaminated water at rates inflated by the city's misuse of water and sewer funds.

Across the nation, water and sanitation services for the lowest 20% income earners cost more than 4-19% of monthly household income, well beyond what is affordable. And water rates are bound to skyrocket as water utilities seek rate increases to cover the estimated $1 trillion investment to update American water infrastructure.

We need to replace old, often poorly maintained water lines because more than 240,000 water mains break each year. Up to 10 million lead service lines must be replaced to avoid lead poisoning. Water treatment plants must be upgraded because they cannot remove many new toxic chemicals and pathogens. The hydraulic capacity of sewage treatment plants needs to be increased and combined sewage overflow systems eliminated to prevent discharges of untreated or poorly treated sewage into drinking water sources.

Local and state governments cannot fund these infrastructure improvements because they are hamstrung by anti-tax measures promoted by wealthy individuals and vested special interests. Given the priority placed by Congress and the President on cutting taxes for corporations and wealthy individuals, the federal government seems unlikely to pick up the rest of the tab, which would require increasing infrastructure spending from $2.37 billion to $8 billion annually.

Curing water injustice

So how can we make the human right to water and other water justice principles the guiding lights of water resources management?

First, we can educate the public about the dangers threatening our water, their right to safe drinking water, and broader water justice principles.

Second, we can join with others who are seeking to protect safe drinking water, environmental flows and prevent economic exploitation of water, particularly faith communities and indigenous peoples who are stalwart advocates of ethical water resources management. Water justice has become a critical issue for faith communities. The World Council of Churches, for example, has established 10 ecumenical water justice principles to guide Christian communities and individuals in the ethical treatment of water. Indigenous peoples rely on the traditional wisdom of elders to govern their relationship with water.

Third, we can raise ethical values and concerns, whenever we are discussing water conflicts or making water resources decisions.

Finally, we can embed ethical management of water resources in law. We can campaign in our state legislatures for legislative recognition of the human right to water. The Safe Water Alliance, a broad coalition of faith-based, environmental justice, tribal, consumer and public health advocates, campaigned tirelessly and successfully for California's Assembly Bill 685, which states: "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes" and requires California state agencies to consider that policy in their decision-making. Since legislative recognition may prove too ephemeral, we can use citizen initiatives to incorporate the human right to water into state constitutional law to assure the human right to water serves as an effective limit on state legislatures and state water resources agencies prioritizing economic interests.

In addition, we can foster ethical management of water resources by integrating other water justice principles in state law: provisions confirming that water is a public good impressed with a public trust, assuring water for farmers and fishers whose livelihoods depend on water, and guaranteeing the aquatic life and other creatures have life-sustaining water. Such steps radically improve the ability of water resources managers to follow their moral instincts and do the right thing, rather than being forced to do the bidding of special interests.

Together, we can usher in the era of ethical water resources management that is based on sound science, cognizant of sustainable economics, responsive to public sentiment, and deeply respectful of all life. ■

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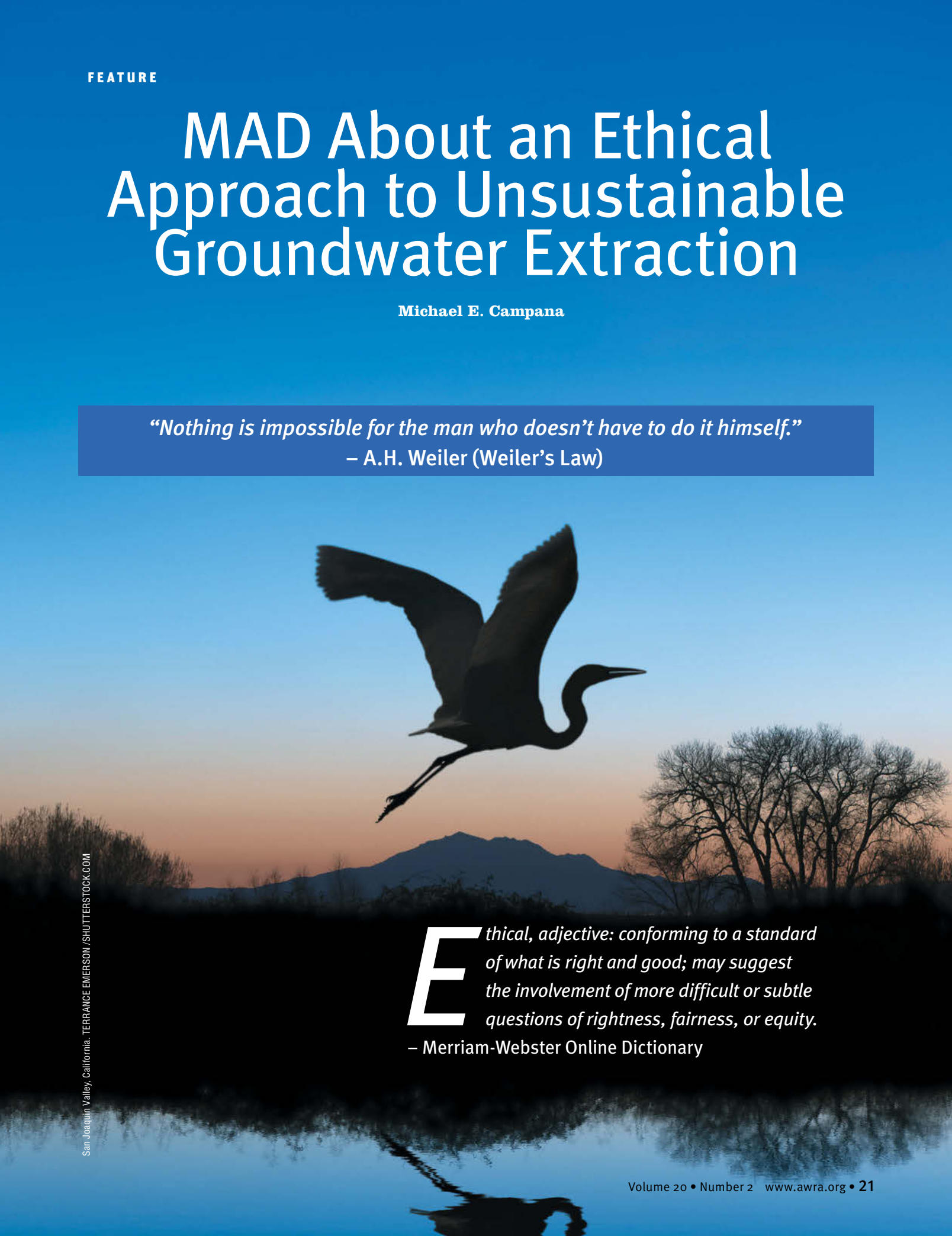
MAD About an Ethical Approach to Unsustainable Groundwater Extraction

Michael E. Campana

"Nothing is impossible for the man who doesn't have to do it himself."
– A.H. Weiler (Weiler's Law)



San Joaquin Valley, California. TERRANCE EMERSON /SHUTTERSTOCK.COM

Ethical, adjective: conforming to a standard of what is right and good; may suggest the involvement of more difficult or subtle questions of rightness, fairness, or equity.
– Merriam-Webster Online Dictionary

> One of the tenets of ethical groundwater management is sustainability, that is, pumping groundwater no more than the amount that assures the aquifer will not be depleted.

A long time ago in a university far, far away

I recall the day with uncharacteristic clarity. It was 47 years ago this month. I sat at the University of Arizona office of my advisor, Eugene S. Simpson. At the time I was a graduate student in his groundwater hydraulics class. Two of my classmates and I listened as Gene waxed eloquent about groundwater management in California. He was unimpressed with it. So what else is new, you're saying.

Gene pointed out that we had known about land subsidence in the San Joaquin Valley as early as the 1930s, yet here we stood in 1971 (try 2018) and subsidence was still occurring. He did note that to lessen groundwater pumping and mitigate subsidence, surface water was now being transported from northern California to the valley and points farther south.

"So what's the safe yield of the San Joaquin Valley groundwater system?" he inquired. Safe yield was a vague concept in vogue at that time. It purported to indicate how much groundwater we could take from an aquifer without producing an undesirable effect(s). Clearly, safe yield hinges upon what one considers 'undesirable effects' and their evaluation. Gene asked us what some relevant undesirable effects were.

We named the usual suspects: land subsidence; streamflow depletion; economics (pumping costs increase as well water levels drop); conflict (causing someone else's well water levels to drop); water quality degradation; impairing another's water rights, etc. The perceptive reader will note that nowhere is something like 'degrading ecosystems' mentioned. Remember, this was 1971. We three were happy with what we had produced.

Gene took a long draw on his corncob pipe. His next question, asked with an impish smile, threw us for a loop: "Does this have anything to do with the ethical management of groundwater?"

Almost 50 years would pass before I addressed that question. That day has arrived.

Of groundwater, checkbooks, streams, stocks and flows

[For an excellent introduction to groundwater, visit the U.S. Geological Survey (USGS) website: https://on.doi.gov/2kYoEmV]

One of the tenets of ethical groundwater management is sustainability, that is, pumping groundwater no more than the amount that assures the aquifer will not be depleted. This is analogous to a checking account in which the deposits and withdrawals (inflow and outflow - the *flows* of the checking account) are equal in a given time period, such that the checking account balance (the *stock*) remains constant. As long as inflow and outflow are balanced, the checking account *balance* is irrelevant (remember this quirk—I'll come back to it later). But if the inflow and outflow are not balanced and the latter exceeds the former, trouble could result—like an overdraft notice from the bank.

One can analyze groundwater in a similar stocks-and-flows checkbook fashion. The physics of groundwater are more complex than those of a checking account, but the general concept holds: we seek balance—or at least inflows (deposits) greater than outflows (withdrawals)—so that the balance (stock) remains constant or increases.

For a given aquifer system, the *stock* means the volume of water stored and *flow* means the flow rate of water. The flows of specific interest are inflows or *recharge* to the aquifer and outflows or *discharge* (via pumping, springs, evaporation, transpiration, etc.) from the aquifer. Just like oil, all the water in an aquifer is not totally recoverable via pumping; some always remains behind. When I say *stock,* I am referring to the amount of *recoverable* water.

Unlike most streams, aquifers have stocks that are much greater than their flows; they are *stock-dominated.* Streams are typically *flow-dominated.* That's one reason why streams are often dammed—to create more storage so that water will be available during dry years (low flows). The large stocks of many aquifer systems (as well as the inability to see them) serve to mask groundwater depletion and lull users into imagining that the groundwater will last forever.

Pumpers' (ethical?) dilemma: the High Plains Aquifer of Texas

In many regions such as the San Joaquin Valley of California; the North China Plain; northwestern India and the High Plains Aquifer System (aka Ogallala Aquifer) of the United States Great Plains, we are pumping groundwater unsustainably. The balance of our checking account is declining to an alarming degree—with the risk that soon the recoverable groundwater will be exhausted.

The main culprit causing the imbalance of groundwater flows, or *overdrafts*, is food production via irrigated agriculture—a crucial human use of water. Even when practiced efficiently, irrigated agriculture consumes large amounts of water—the single highest human use of freshwater on Earth. That's just the nature of the beast.

Commentators often vilify those who pump groundwater unsustainably and those who allow such behavior, because unsustainable groundwater use depletes

a critical resource without any perceived concern for ecosystem needs, their neighbors or the future. On the other hand, such pumping provides not only food but also livelihoods for those who depend upon agriculture. Should we just tell these folks to quit pumping so much water?

My Texas trip

This dilemma was brought home to me when I visited Lubbock, TX, in February 2016 to discuss the depletion of the High Plains (Ogallala) Aquifer by irrigators. In Texas, a landowner can pump as much groundwater as she wants from beneath her land without any 'reasonable use' restriction. The only stipulation is that no 'malicious pumping' is allowed. Local groundwater districts may place some restrictions on pumping.

The Texas approach provides little or no incentive for conservation and actually encourages overconsumption. If you conserve, your neighbor may not and start pumping some of *your* water. It's the classic 'race to the bottom' or the 'tragedy of the commons.' Communities over the Ogallala Aquifer are not certain whether or when the water is going to run out, but in the meantime, they enjoy the fruits of over-pumping. That's the dilemma facing the communities in the area I visited. [Note: the film *Written On Water* by Merri Lisa Trigilio documents this plight. http://bit.ly/2CTrpiF]

Is such water use profligate and unethical? What should we do to address this situation?

Managed Aquifer Depletion (MAD)

We need to acknowledge that unsustainable groundwater use is a fact of life and is not going away soon. Too many rely on it and see no alternatives. For situations like the Ogallala Aquifer in Texas, we should implement *managed aquifer depletion,* which yields the appropriate (?) acronym MAD. This management approach requires that we determine groundwater stocks using a combination of fieldwork and modeling. To be clear, stakeholders must buy into this approach and considerations must be given to ecosystems, unintended consequences, and yes, the future.

Sustainability advocates do not often see the necessity for evaluating stocks because their approach demands equality of inflows and outflows, so who needs to know stocks? Recall the checkbook example.

I consider MAD an ethical approach because it accounts for the communities' wishes, provides certainty, and does not simply demand (perhaps unrealistically) that pumpers 'cease and desist.' Managed aquifer depletion can also provide water for future generations—perhaps for hundreds of years. This depends upon those doing the planning. Will they attempt to provide some groundwater for the future, or will they decide to use it all themselves? This latter viewpoint is exemplified by an irrigator who said he didn't care how much groundwater was left in 2040. Why? Well, he needed it now to grow more food so he could send his children to college. They'd already told him they weren't coming back to be farmers; the 'big city' was their destination. So who needs the groundwater in 2040? Not his family!

Interestingly enough, the Texas Water Development Board encourages an approach based on community-determined *desired future conditions* (DFC), which is its version of the managed aquifer depletion approach. (see http://bit.ly/2lAyc74)

The end

Eleven years ago, I heard a talk by Robert Hirsch, who was then the U.S. Geological Survey's Chief Hydrologist. Bob is of my generation, so his comments about hydrologic education rang true. In his 1970s engineering hydrology class, the question was, "How much water can we take out of the river for human use?" Now, it's "How much water should we leave in the river?" I would amend that to ask, "How much water is in the aquifer and should we use it all or save some for the future?"

As the South Africans would say: "Some for all, forever." ■

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Indigenous Water Ethics: Protecting our Sacred Waters for Future Generations

Mona Polacca and Darlene Sanderson

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Water is sacred. Our rivers are the arteries and veins of Mother Earth.
– A collective statement from Indigenous Elders, United Nations Permanent Forum on Indigenous Issues, NYC, 2007

As demonstrated in our submissions to the World Water Forum and other fora, indigenous peoples call for consideration of our views regarding the protection, conservation, safety of and access to clean water (both fresh and saltwater) with sanitation.

Indigenous peoples' outcry to protect water comes from their worldview: Water, (including surface water, subterranean water and evaporated water) carries the essential cultural, social, historical, genealogical and economic connectedness of all people, plants and animals in the region. Cultural and social perspectives of water and oceans have existed for millennia, and are largely overlooked when decisions are made that affect our waterways. Climate change exacerbates these challenges. Although many efforts address water issues raised by indigenous peoples, this article focuses attention on the efforts to hold the Indigenous World Forum on Water and Peace, an event to give voice to the indigenous peoples' perspective on water issues and contribute solutions at the global scale.

There is a growing global community of indigenous leaders from across the regions of Mother Earth who are unifying to address the imbalance in humanity's relationship with water. In 1999, at the World Indigenous Peoples Forum on Education in Hilo, Hawai'i, a call was issued to indigenous peoples to address water issues by organizing an indigenous-led forum on water.

Since then, there have been similar calls at the 3rd, 4th and 5th World Water Fora (in Kyoto, Japan in 2003, Mexico City, Mexico in 2006, and Istanbul, Turkey, 2009). Also, at the UN Permanent Forum on Indigenous Issues in New York in 2007, 2008, 2009 and 2011, indigenous peoples urged all nation states and all UN agencies concerned with water to support an indigenous-led World Forum on Water and Peace. At least 35 non-governmental organizations, including the Global Indigenous Youth Caucus, the Global Indigenous Women's caucus, the Global Indigenous Peoples Caucus, and the North American Indigenous peoples Caucus as well as UNICEF endorsed this recommendation.

The 2007 final report of the UN Permanent Forum on Indigenous Issues included this recommendation. However, the report failed to identify clear lines of support for such a forum. To date, no nation state has yet responded with

financial support for the IPFWP, and we are now seeking UNESCO support.

Efforts to address the call for an Indigenous World Forum on Water and Peace began in 2008. Indigenous leaders involved in water issues convened at Beecher Bay, Coast Salish Territory under the leadership of Tom Goldtooth, Director of the Indigenous Environmental Network, and established an International Advisory Body to plan the Indigenous World Forum on Water and Peace.

The members of the Indigenous World Forum on Water and Peace International Advisory Group are:

- ***Darlene Sanderson*** (World Water Forum: Citizens Forum 2018—Indigenous peoples Focal Point, Co-Secretariat of the IWFWP);
- ***Tom Goldtooth*** (USA—Indigenous Environmental Network)
- ***Motarilavoa Hilda Lini*** (Vanuatu—traditional hereditary chief);
- ***Mona Polacca*** (USA—World Water Forum: Citizens Forum 2018—Indigenous peoples Focal Point, Co-Secretariat of IWFWP;
- ***Lucy Mulenkei*** (Kenya—Indigenous Information Network);
- ***Te Huirangi Waikerepuru*** (Aotearoa/New Zealand—Maori kaumatua/traditional Elder;
- ***Jebra Ram Muchahary*** (India—NE Indigenous tribes); and
- ***Tomas Alarcon*** (Comision Juridica Para el Autodesarrollo de los Pueblos Originarios Andinos, Juridical Commision for the Autodevelopment of First Andean People, Peru).

The group established preliminary plans for the Indigenous World Forum on Water and Peace (IWFWP), which was envisioned as an event to develop innovative water solutions, seek new opportunities for positive adaptation, indigenous resiliency, and applications for the recognition and implementation of our water rights and our responsibilities. We aspire to raise awareness and to create opportunities to have our voices and the indigenous worldview heard by participating in dialogue in various fora related to water.

IWFWP is just one step in reclaiming balance: knowledge, experience and traditional wisdom will contribute to the dialogue of science, offering solutions for a sustainable future that are rooted in language and cultural practices. This work is not just about indigenous peoples: it is for all of humanity, and all of life on Mother Earth. The work is meant to share the Traditional Indigenous Elders' call to all, particularly those with the power to implement economic, social and cultural development policies, to seek and recognize alternative solutions to water issues. The work offers the possibility for development based on the care and protection of all peoples, lands and cultures, including life in all of its manifestations. In essence, this work aims at protecting everything that lives and nourishes life.

This call is urgent, as many indigenous peoples face an imminent threat to the survival of their cultures and territories. Infrastructural encroachment, from mines, dams, roads, ports and industrial plants, contaminates ground and drinking water—the very essence of life on Mother Earth. Beyond the physical impact of encroachment lies an even more delicate issue: the gradual degradation of the ancient way of thinking, permeating and influencing the traditional and cultural values that preserve the wisdom of how to maintain the balance of Mother Earth. Indigenous peoples emphatically ask all citizens of the world, governments, corporations, and other organizations to embrace our sense of commitment to act responsibly to ensure future generations, our children, grandchildren and great-grandchildren, receive a landscape full of promise and peace.

The planning of the IWFWP is inter-disciplinary and cross-cultural because of the interconnectedness of the Earth, the socio-cultural nexus between traditional ecological knowledge and Western science, and the fact that water crosscuts disciplines: health, education, law and the environment. To understand how to have a healthy environment, we must know our creation stories, our genealogical ties to the land, and the original laws, values and principles embedded in our language and cultural practices. We must appreciate the spiritual understandings that connect us to ourselves, families, communities and nations and are an essential part of our health and wellbeing. By integrating clean and renewable technologies with indigenous traditional knowledge, we generate solutions for the future.

Cross-cultural and interdisciplinary exchanges allow us to achieve greater awareness of the meaningful role that indigenous peoples can play in solving the challenges we collectively face with water. Together we can generate solutions that recognize indigenous laws, values and practices that respect water; improve the health and well-being of all; and foremost, assure clean water is maintained and sustained, in the rivers and the oceans, for future generations. ■

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> "Although many efforts address water issues raised by indigenous peoples, this article focuses attention on the efforts to hold the Indigenous World Forum on Water and Peace, an event to give voice to the indigenous peoples' perspective on water issues and contribute solutions at the global scale."

Fr. Damien of Molokai, Catholic Social Justice and the Human Right to Water

Eric J. Fitch

ERIC BRODER VAN DYKE/SHUTTERSTOCK.COM

Waves roll towards Kalaupapa Peninsula on Molokai, which is the site of Saint Damien's mission where he ministered for 16 years to those suffering from Hansen's Disease.

IN 1873, BISHOP Louis Desire Maigret, vicar apostolic of the Diocese of Honolulu in the Kingdom of Hawai'I, called for volunteers from his priests to minister to the leper colony on Molokai. He received four volunteers. The first priest to go was Fr. Damien De Veuster, a Belgian national who was a member of the Congregation of the Sacred Hearts of Jesus and Mary. He had come to Hawai'i in 1864 and was ordained in that same year. He spent the first nine years of his ministry serving in parishes on the Island of Hawai'i. In 1865, King Kamehameha IV and the Hawai'ian legislature created a leper colony on the Kalaupapa Peninsula on the coast of Molokai, and separated from the rest of the island by 2,000 foot high cliffs. The residents of the colony were separated physically from the rest of humankind. They were under-provisioned and functionally abandoned by the Kingdom. Not only were they suffering from Hansen's disease (leprosy), but from abandonment and exile by their people. They were a perfect example of what Christian teaching calls the "least of our brothers."

Fr. Damien arrived on Molokai at the colony in May 1873. His "job" was to minister to the spiritual needs of the residents of the colony, avoid exposure to what was considered a highly contagious disease, and rotate out when his replacement arrived in a few months. He was to be one of four part-time pastors, but he was so touched by the plight of his flock

that he wrote Bishop Maigret asking to post him permanently at the colony. With some reluctance, the bishop agreed, and he became forever Fr. Damien of Molokai committing himself to the residents of the colony with the words "one who will be a father to you, and loves you so much that he does not hesitate to become one of you; to live and die with you."

Despite the fact that 95% of all people are immune to Hansen's, Damien did contract the disease and eventually died from it, in a way fulfilling to the letter his original commitment to his flock. Because of his ministry to this outcast community and miracles attributed to his intercession, in 2009, Fr. Damien became a canonized saint of the Roman Catholic Church.

Fr. Damien tended to the spiritual side of the colony's needs, saying Mass, hearing Confession, burying the dead and providing the other Sacraments. He organized the construction of a church, St. Philomena's Church in Kalawao, Molokai. He also cared for the physical needs of his flock. He bound ulcers, taught them, helped them to work together for the common good, helped relocate them to an area on the peninsula with better conditions for shelter and growing food and many other practical down-to-earth tasks.

One of his most important accomplishments was in organizing his flock to help him divert a stream and construct a reservoir to provide them with potable water, sanitation and irrigation. Damien's mission was not just to care for the souls in his charge but to help them provide themselves with the necessities of life—none less than the water of life.

Does the Catholic Church recognize that there is a basic human right to water or was St. Damien of Molokai off on some tangent? In the Compendium of the Social Doctrine of the Church it states, "The right to water, as all human rights, finds its basis in human dignity and not in any quantitative assessment that considers water as a mere economic good. Without water, life is threatened. Therefore, the right to safe drinking water is a universal and inalienable right." Access to water for sustaining life is one principle of the "practical" side of Catholic theology: the theology of Social Justice. The modern Catholic Church, especially in the 50-plus years since the Second Vatican Council, has emphasized the relationships between humans in society and humans with God's creation. Water as essential to life has been a critical part of those teachings.

> "The moral necessity of protection of water resources and provision of water to all in need is not a matter of fancy words and no practical action, nor is it a sign, as some have claimed, of a "political liberalization" of the Church."

In 2006, Pope Benedict XVI spoke directly to the subject, tying his teaching back to his predecessor Pope John Paul II. "Water is much more than just a basic human need. It is an essential, irreplaceable element to ensuring the continuance of life. Water is intrinsically linked to fundamental human rights such as the right to life, to food and to health. Access to safe water is a basic human right. In 2004, Pope John Paul II wrote, 'as a gift from God, water is a vital element essential to survival, thus everyone has a right to it'."

Pope Francis in 'Laudato Si (Praise Be)" writes of the sickness in the Earth from human generated pollution poisoning our waters. The Church speaks of a "preferential option" for the poor; the last shall be first and the least of us should be the first in our concern and action. Human actions in creating global climate change exacerbates for many, and especially the poor, problems with access to potable water and water for sanitation and irrigation. Negative impacts of humans on the quantity and quality of fresh water not only impacts humans, but helps to destroy global biodiversity and betrays the stewardship responsibilities for creation which God has placed upon humans from our earliest days.

The moral necessity of protection of water resources and provision of water to all in need is not a matter of fancy words and no practical action, nor is it a sign, as some have claimed, of a "political liberalization" of the Church. These imperatives are considered to be as old as Creation and foundational to the actions of the Church in the World. The statistics that one-sixth of the world's population has no access to clean water and that one-third of the world's people do not have water for sanitation and thus health are not cold numbers. Following the charge of St. Benedict to the members of his order, "Ora et labora" (work and pray). The statement that there is a human right to water by the Church means nothing unless we pray to God for guidance and work to make the right a reality for all humankind. ■

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Testing the Waters: Integrating Hydrography and Elevation in National Hydrography Mapping

Silvia Terziotti, Karen Adkins, Stephen Aichele, Rebecca Anderson and Christy-Ann Archuleta

RELIABLE AND ACCURATE hydrography data are critical to sound decision-making for many natural resource activities, ranging from traditional water resources subjects like surface water flow management, water resources planning, water quality and flood risk management to conservation and management of aquatic ecosystems, wildlife and habitat, forests and coastal zones. To better understand user requirements and associated benefits of improved hydrography data, the U.S. Geological Survey (USGS) and Natural Resources Conservation Service (NRCS) interviewed respondents from federal, state and local government agencies, private industry, and nonprofit organizations for the Hydrography Requirements and Benefits Study (2016, https://nationalmap.gov/HRBS.html). Results regarding mission critical activities found that annual benefits of existing hydrography data exceed $530 million. Implementing all reported requirements was estimated to add an additional $600 million in benefits. Respondents identified integrated hydrography and elevation data as necessary to their most critical activities, and notably, their greatest need was for hydrography data to align with elevation data at 1:12,000 or better scale.

From the beginning of USGS topographic mapping in 1884 and throughout the era of manual cartography, hydrography and elevation information were collected simultaneously and presented jointly on single map sheets. With the arrival of the digital age, hydrography and elevation data were acquired and managed separately due to disparities in data formats and relative accuracies. Although the national elevation and hydrography datasets have diverged, the user need for integration remains strong as noted in the Hydrography Requirements and Benefits Study.

The USGS is responding to the need for integrated hydrography and elevation data in two ways. First, the USGS is developing the National Hydrography Dataset Plus High Resolution (NHDPlus HR), which is built from 10-meter data from the 3D Elevation Program (3DEP), the National Hydrography Dataset (NHD), and the Watershed Boundary Dataset (WBD). These three data sources are integrated into a geospatial framework that determines the path that water would flow from any point in a stream or on the land surface. The tools to build the NHDPlus HR alter the elevation surface to conform to the hydrography, which is a quick, practical solution if the elevation data are less accurate than the hydrography layer, as has been the case in the past. However, recent growth in high resolution elevation data in 3DEP light detection and ranging (lidar) collections has provided a new opportunity to use another approach to the integration of hydrography and elevation data.

A new technique for providing integrated hydrography and elevation data is being developed using the 1-meter 3DEP lidar-derived elevation data across the nation. The USGS elevation and hydrography programs are currently exploring how to derive hydrography data directly from lidar data, with the goal of updating the National Hydrography Dataset (NHD). This approach of using high accuracy elevation data from 3DEP to create lidar-derived hydrography will greatly enhance the vertical and horizontal spatial integration between landscapes and the stream network, providing the level of accuracy and detail required for local scale applications (Figure 1).

In 2017, the USGS funded a pilot project in five geographic areas to better understand the costs and utility of deriving hydrographic features from lidar data and adding attributes to allow users to relate the lidar-derived linework to the NHD (Figure 2). The USGS developed a data dictionary with a simplified set of hydrographic features that match features in the NHD, such as Stream/River, Artificial path, Lake/Pond, or Canal/Ditch, and developed a set of additional feature

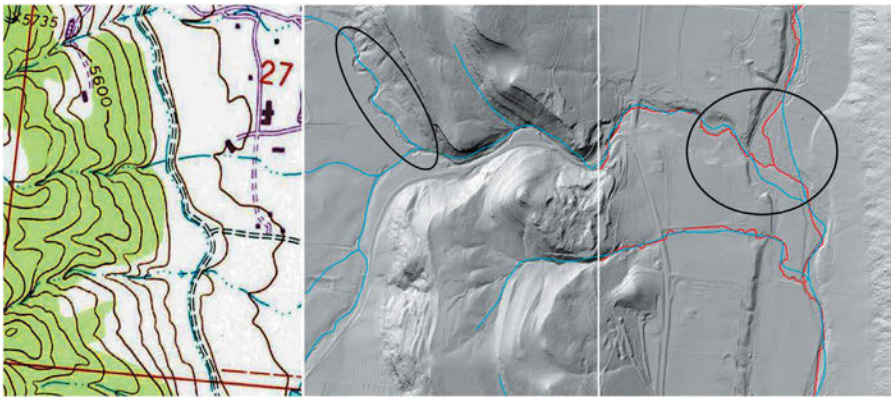

Figure 1. Elevation and hydrography datasets collected separately will have some misalignment of features (circled areas). *(A)* USGS topographic map: streams and contours match at the 1:24,000 scale; *(B)* the NHD high resolution streams and a lidar-derived shaded relief elevation surface showing some misalignment; *(C)* comparison of horizontal alignment of NHD and densified lidar-derived stream network. *Base credit: U.S. Historic Topographic Map Collection, 3D Elevation Program, National Hydrography Dataset, The National Map*

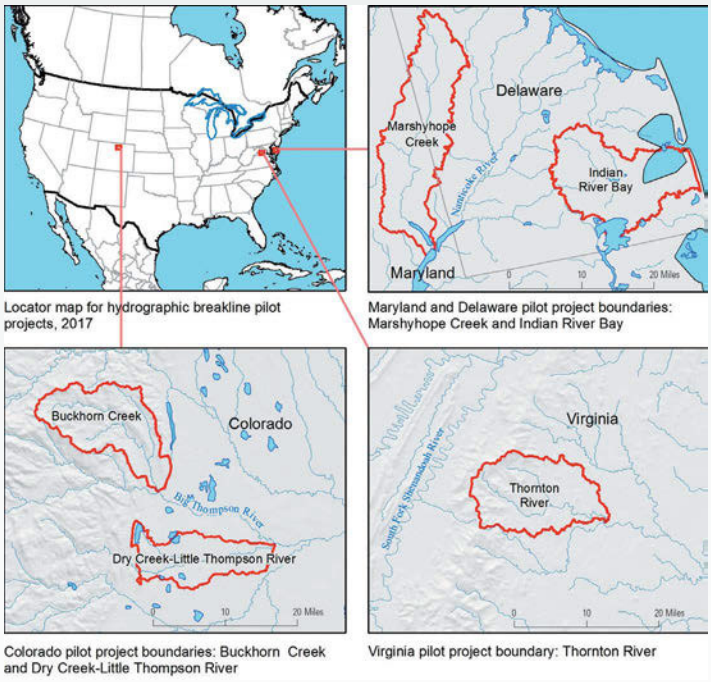

Figure 2. Pilot project study areas. Each pilot area had quality level 2 lidar available and shapefiles that contained the hydro-flattening linework. The drainage areas within the study areas ranged in size from 104 square miles to 220 square miles. The study areas were chosen to represent five landscapes: humid flat, humid coastal, arid mountainous, arid flat, and humid mountainous. The five landscapes were chosen to evaluate differences in cost based on topographic setting. *Base credit: 3D Elevation Program, National Hydrography Dataset, The National Map*

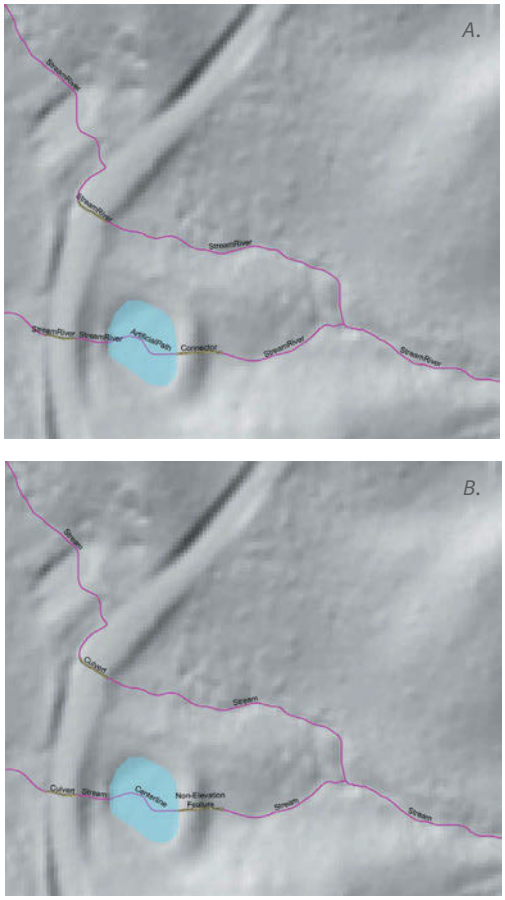

Figure 3. Examples of (A) hydrography codes and (B) elevation codes used to differentiate stream features.

codes that include Culverts and Dams to support derivative elevation surfaces, hydro-enforcement, and hydro-flattening (Figure 3).

The results of the pilot project documented the need to provide training on the NHD data model, as well as clearer data capture guidelines to ensure that new hydrography linework is spatially integrated with lidar-derived elevation surfaces. Additionally, the pilot project found that the integrity of the linework and proper application of the NHD attribution coding is essential for integration into the NHD database. The pilot also emphasized that elevation and hydrography information for a location should be collected based on the same data source.

To facilitate integrated collection, the USGS is providing new guidelines within the USGS Lidar Base Specification. The Lidar Base Specification v1.2, (https://pubs.er.usgs.gov/publication/tm11B4) currently requires the collection of a limited set of hydrography features that are horizontally and vertically integrated into the elevation data. The subsequent version (v1.3), currently in press, will provide optional guidelines and a data dictionary for a more complete collection of hydrographic linework. By expanding the features for collection, the hydrographic linework may be used as a source to enhance the NHD.

While the pilot project provided one example of how to efficiently and accurately integrate hydrography and elevation data, the USGS continues to investigate how to provide better integrated, current elevation and hydrography products to increase the return on geospatial data infrastructure investments for the nation.

Readers are encouraged to visit the 3DEP website (https://nationalmap.gov/3DEP/) and the USGS Hydrography website (https://nhd.usgs.gov/index.html) to learn about USGS-integrated topographical mapping. ■

Silvia Terziotti is the associate national map liaison for North Carolina and South Carolina. She has worked with the USGS as a GIS specialist with Water Science Centers since 1988. She currently splits her time between geospatial support of USGS Water Mission Area projects and support of National Geospatial Program activities. Contact: seterzio@usgs.gov.

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American Water Resources Student Chapter, University of Wisconsin – Stevens Point

The AWRA–UWSP student chapter has been very active this semester in education, service and development for our members and the communities of Central Wisconsin. We have supported two speaking events on campus, including the Clean Wisconsin Environmental Speakers Program focusing on Wisconsin's water resources. Every year, we have hosted river clean up days for members and the community, and this fall, we officially adopted a one-mile stretch of the Wisconsin River through Living Lands and Waters adopt-a-river mile program. Almost every weekend, we have organized events for members such as aquatic invertebrate collection tours, lake sampling and groundwater monitoring workshops. As winter sets in, we have been focused on bringing professionals in water related fields to meetings to discuss their careers in water resources. Our plans for next semester include hosting an ice fishing tournament to raise money to send students to the AWRA State Conference in Appleton, WI.

AWRA Florida Continues Momentum in 2018

In February, AWRA Florida co-hosted the 27th Annual Southwest Florida Water Resources Conference in Fort Myers. The conference theme was the Changing Climate of Regulation and Funding. Regulations regarding sea level rise and flood mitigation and insurance were discussed, which is a hot topic due to Florida's extensive coastline. The keynote address was given by Michael Grunwald, author of *The Swamp: The Everglades, Florida, and the Politics of Paradise*. Performance of regional water systems during and after 2017's Hurricane Irma was another session topic. Flooding impacts on native ecosystems was discussed, and the degree of preventative maintenance of stormwater systems on flooding problems was highlighted. In addition, a statewide water resources student research poster contest was held for high school and university students and many cash prizes were awarded.

FGCU Student Chapter of AWRA Service Project

The FGCU Student Chapter of AWRA is initiating a service project to read surface-water gauges on our campus in Fort Myers, FL. The gauges measure water level in stormwater detention ponds around campus, and will be used in future research on hydrologic and hydrogeologic modeling for the campus and its watershed. The project will expand to include installing more gauges and conducting more analyses, giving hands-on experience to Chapter students and providing data to municipalities in our region. The Chapter held a canoe field trip in the Imperial River estuary, and is developing a series of speaker presentations and future field trips. We also helped plan and support the February 2, 2018 Florida Section AWRA meeting in Fort Myers.

Front to back: Kira (the dog), James Anderson, Bodie McCosby, Alec Malone and Becca McCosby (photo provided by Brandon Kautzman).

Central Washington University AWRA Student Chapter

Alec Malone (photo provided by Bodie McCosby).

The Central Washington University AWRA Student Chapter recently took a cross country skiing trip to Blewett Pass in the Cascades. They explored the snowpack in the upper elevations and learned about the importance of winter precipitation for water resource planning in the warmer months. Topics included how the SWE (snow water equivalent) has been measured for decades, and how modern SNOTEL (snow telemetry) stations provides important data for water resource planning in the near and distant future. Once spring arrives, the students at CWU hope to be treated to a tour of the Yakima River Drainage Basin, with veteran water resource professional Tom Ring, to learn what happens to this accumulated winter snowpack once temperatures begin to increase. ■

AWRA's 2017 Annual Water Resources Conference

Student Presenter Competition

CONGRATULATIONS TO THE Student Presenter Competition winners of AWRA's 2017 Annual Water Resources Conference held during the conference in Portland, Oregon, Nov. 5-9.

Thirty-five students participated and were scheduled throughout the 22 oral sessions as well as the poster session. Conference attendees were given the opportunity to judge the students during their scheduled session. The following individuals were selected as the outstanding winners:

Winner of Student Oral Presentation: Using Smart Meters to Uncover Drivers of Water Use for Nonresidential Urban Irrigation- Kim Quesnel, Stanford University, Stanford, CA (co-authors: N. Ajami, J. Urata, A. Marx)

Kim Quesnel is a Ph.D. candidate at Stanford University in the Civil and Environmental Engineering department as part of the NSF Engineering Research Center for Reinventing the Nation's Urban Water Infrastructure (ReNUWIt) and Stanford's Water in the West program. In Kim's research, she takes an interdisciplinary approach to investigating urban water demand as a key component of advancing future supply planning. Additionally, motivated by the water sector's chronic fiscal challenges, Kim is researching novel approaches to water financing and governance that can help to increase innovation in the water sector.

Prior to coming to Stanford, Kim worked as a civil engineer in Denver, Colorado in the field of environmental remediation, responsible for both technical design work and project management. She has also worked on a wide range of water-related research projects including the laboratory investigation of tsunami wave breaking behaviors at the O.H. Hinsdale Wave Research Laboratory in Oregon, the assessment and design of water filtration systems in rural Thailand, and the study of glacier hydrology through field research in Alaska.

Kim received a B.S. in Civil Engineering from California Polytechnic State University, San Luis Obispo and an M.S. in Civil and Environmental Engineering, Environmental Fluid Mechanics and Hydrology from Stanford. In 2016, she was awarded an Environmental Protection Agency STAR fellowship for her research on urban water demand.

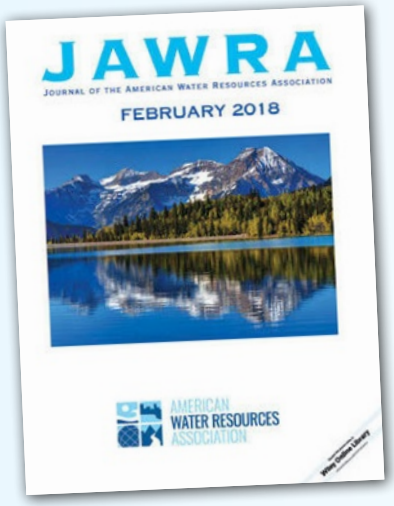
Winner of Student Poster Presentation: Degradation of Water Quality Through the Use of Synthetic Titanium Dioxide Nanoparticles and Oxybenzone: The Unfamiliarity of the General Public to Sunscreen Toxicity on Coral Reef Biotas – Martina Cavard, Oxbridge Academy, West Palm Beach, FL (co-authors: T. Thornton)

Martina Cavard is a senior at Oxbridge Academy, and has been conducting independent research regarding the effects of sunscreen on coral reef environments for the past two years. She recently attended the 2017 AWRA National Annual Water Research Conference, where she presented her poster and delivered a lecture presentation; she was one of only eight high school students invited to attend. At Oxbridge, Martina is a member of the Science National Honors Society, National Honors Society and French Honors Society. She is involved in her school's Green Club, where she organizes and partakes in schoolwide environmental initiatives. Martina is an active participant in her school's student government association, where she has served as class president and SGA class representative. She will be attending the School of Communication and Weinberg College of Arts and Sciences at Northwestern University in Fall 2018. ■

Highlights of the *JAWRA* Technical Papers

Volume 53, Issue 1, February 2018

The February issue of JAWRA is free to the public. View it at: https://tinyurl.com/ybbt8ycf



THIS ISSUE CONTAINS the National Interoperability Flood Experiment II featured collection as well as several other technical papers.

Featured Collection - National Flood Interoperability Experiment II (NIFE II)

The NIFE II featured collection presents seven papers that – 1) evaluate the outputs from the continental-scale flood forecast modeling system with field data and results from other hydrologic models; 2) discuss certain data driven approaches as alternative or complementary approaches to the national data model; and 3) illustrate how streamflow forecasts can be extended to flood mapping and damage assessment.

In the Introduction, **Nelson** provides a synopsis of the seven papers of the NIFE II featured collection. Model evaluation studies include the paper by **Salas *et al.*** who demonstrate the three month nowcasting capabilities of a continental scale streamflow simulation and forecast system implemented through the National Flood Interoperability Experiment. **Quintero and Krajewski** compare streamflow predictions from the Hillslope Link Model operated by Iowa Flood Center and the National Water Model operated by the National Water Center of NOAA. Finally, **Lin *et al.*** assess a large-scale hydrologic modeling framework (WRF-Hydro-RAPID) for simulating evapotranspiration and streamflow over Texas.

Data driven modeling approaches include the paper by **Petty and Dhingra** who demonstrate the reliability of machine learning approaches to predict streamflows at inoperable gages. **Zhao *et al.*** use statistical and hybrid statistical and physics-based models in conjunction with web applications to predict reservoir inflows during flood events. **Selvanathan *et al.*** illustrate a hydraulic analysis methodology to estimate national level floodplain changes due to climate change. **Gutenson *et al.*** illustrate the utility of Flood Damage Wizard tool to estimate flood damage using approximate fuzzy text matching functions to illustrate how streamflow forecasts can be used in flood management.

Additional Technical Papers

Sadeghi *et al.* develop and test a method for optimally selecting and sizing stormwater control measures in urban landscapes.

Schifman *et al.* highlight the utility of EPA National Stormwater Calculator as a screening tool for assessing site runoff dynamics and stormwater management.

Kang and Sridhar assess the impacts of climate change on severity and intensity of future droughts in the Chesapeake Bay Watershed and emphasize the need for using multiple drought evaluation methods using both precipitation and temperature.

Ennenbach *et al.*, based on a national county-scale evaluation, indicate roof based rainwater harvesting has the potential to augment water supplies for urban and suburban uses across the US and especially in counties of the Pacific Northwest, Central, and Eastern regions of the nation. ■

AWRA Members: Gain full access to all current and back issues of JAWRA by logging into the AWRA website (www.awra.org) then click link to JAWRA Member Home.
Non-members: Find JAWRA at http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1752-1688.

2018-2019 Richard A. Herbert Memorial Scholarship Opportunities

Background

In 1980, AWRA established the Endowment-Memorial Fund to be used for the enhancement of education in water resources. The fund has since been renamed the Richard A. Herbert Memorial Educational Fund to honor Richard A. Herbert – a champion for water resources education – who passed away in 1994. In order to carry out his vision, AWRA is proud to announce the availability of scholarships derived from the proceeds of this fund.

Eligibility & Awards Available

Each applicant must be a national AWRA member. At least one $2,000 scholarship will be awarded to a **full-time undergraduate student** working toward his/her first undergraduate degree and who is enrolled in a program related to water resources for the 2017-2018 academic year. At least one $2,000 scholarship will also be awarded to a **full-time graduate student** enrolled in a program relating to water resources for the 2017-2018 academic year.*

Selection Criteria

The **undergraduate scholarship** will be awarded to the student most qualified by academic performance. Measures of academic performance include the cumulative grade point average, relevance of the student's curriculum to water resources, and leadership in extracurricular activities related to water resources. The **graduate scholarship** will be awarded to the student most qualified by academic and/or research performance. The measures of academic performance are identical to those of the undergraduate scholarship with the addition of the quality of the student's research and its relevance to water resources. Recipients will be selected by the AWRA Student Activities Committee and announced during summer 2018.

Application Process

A complete application packet contains:

- Title page that includes the applicant's full name, permanent mailing address, email address, phone number where he or she may be easily reached, and the type of scholarship (undergraduate or graduate).
- Two-page summary (approx. 500 words) of his/her academic interests and achievements, extracurricular interests, and career goals as they relate to the above selection criteria.
- Resume or curriculum vitae.
- Three signed letters of reference from professors and/or advisors. Letters of reference MUST include the signatures of the referee – PDFs of the signed letters work best.
- Transcripts of all college courses (undergraduate and graduate). **Legible** copies of "Issued to Student" transcripts are acceptable to save on fees but unofficial grade reports (such as those students can access from their online student accounts at the university) are unacceptable. ***Application packets that include unofficial grade reports will not be considered.***
- Application packets should be submitted electronically to info@awra.org and limited to 5mb in size to ensure delivery. All applications must be submitted in their entirety. AWRA will provide an acknowledgement of receipt of your application but will not provide updates to your application status or request missing information. Please make sure your application is complete when it is submitted. We look forward to hearing from you.

Deadline: All applications and supporting materials must be received electronically by APRIL 23, 2018.

Questions? Call AWRA at (540) 687-8390 or send an email to info@awra.org ■

**The AWRA Board of Directors may, at its sole discretion, approve additional scholarship awards, based upon the performance of the Memorial Fund.*

AMERICAN WATER RESOURCES ASSOCIATION

1 2018 Spring Specialty Conference: GIS and Water Resources X

Rosen Centre Hotel, Orlando FL
April 22-25, 2018

Early Registration Deadline:
April 2, 2018

www.awra.org

If you haven't attended this conference before:

This is the 10th in a series of conferences designed around geospatial solutions to water resources related problems. Innovative water resources scientists, engineers, modelers, software designers from the public/government agencies, academic and private sectors convene to exchange ideas, compare challenges and solutions. If your aquatic research, management, and conservation involves process models, georeferenced field data, remote sensing, or geostatistical models then this is the venue to show that work.

2 2018 Summer Specialty Conference: The Science, Management and Governance of Transboundary Groundwater

Worthington Renaissance Fort Worth Hotel, Ft. Worth, Texas
July 9 - 11, 2018

www.awra.org

To date, few treaties, decrees or formal agreements have been codified to manage groundwater as a transboundary resource, and there has been limited discussion on the manner in which these agreements could be effectively negotiated and what scientific information is necessary to support their development and implementation.

The goal of this conference is to stimulate conversations on innovative approaches for identifying the transboundary nature of groundwater resources and the methods that can be used to develop governance agreements to aid in sustainably managing groundwater resources that cross political boundaries.

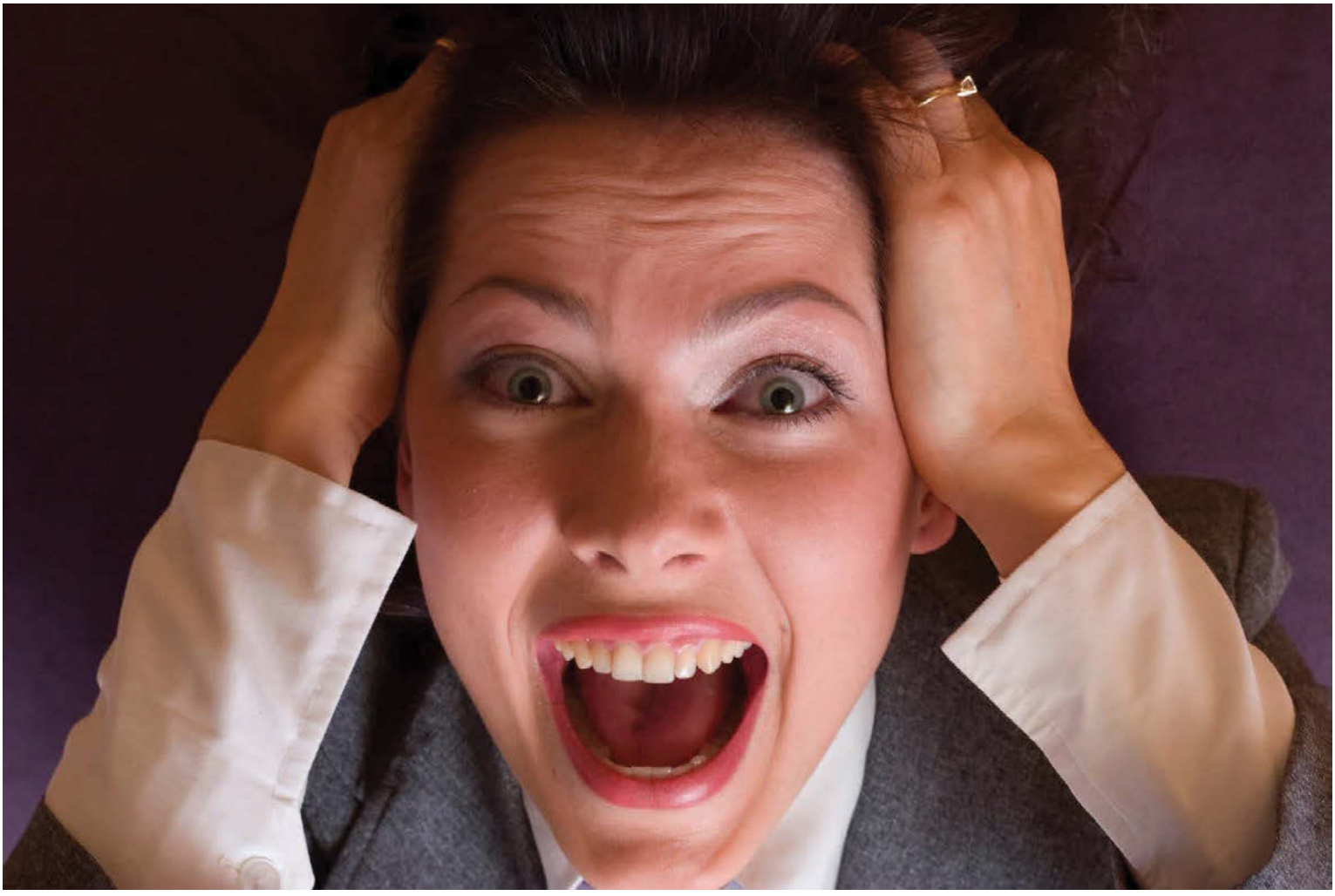
3 2018 AWRA Annual Water Resources Conference

Baltimore Marriott Inner Harbor at Camden Yards Baltimore, MD

November 4-8, 2018

www.awra.org

Photo Credit: Austin Kirk via Flickr



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(Contact Christine@awra.org with questions.)

Don't miss an issue of **IMPACT or JAWRA**. Register for a **webinar** or access the archives. Resolve to **join a technical committee** and/or post a query on **Conversations.awra.org** and interact with other professionals who, like you, are creating the day-to-day solutions for water resources management.

In everything we do AWRA works to bring together the thought leaders in water resource management, research and education. **Continue to be a part of everything we do. Renew today!**

RENEW. PARTICIPATE. CHANGE WATER RESOURCES MANAGEMENT – FOREVER!