Texas A&M Journal of Property Law

Volume 1
Number 1 *Water Law Edition*

Article 1

2013

Coping with Water Scarcity, Risk & Uncertainty: Resilience & Hope

G. Tracy Mehan III

COPING WITH WATER SCARCITY, RISK & UNCERTAINTY: RESILIENCE & HOPE

By G. Tracy Mehan, III[†]

I. INTRODUCTION: RISK AND UNCERTAINTY

It is most appropriate that we gather here in Texas, a state blessed with a vibrant economy and robust population growth, but still coming to terms with a searing drought.[1] Here we get a glimpse of the daunting circumstances impacting water supply and security throughout the United States. This is a good time and place to consider how we often undervalue a resource and commodity that is so important in our lives. In this way we can secure our future water supplies while coping with all the risks, challenges and opportunities this entails.

The great Scottish economist, Adam Smith, captured the paradox of diamonds and water, at the margin, in his classic book, *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776) published the same year as the signing of America's Declaration of Independence:

> Nothing is more useful than water; but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it.[2]

Thus, diamonds, which are for mere adornment, are valued more highly than water, which is essential for life on this planet. Trying to overcome or resolve this paradox in the United States is an ongoing challenge for all Americans, as well as Texans. Take the case of the Colorado River, which provides water for millions of people from San

† Principal, The Cadmus Group, Inc. (www.cadmusgroup.com); Former Assistant Administrator for Water, U.S. Environmental Protection Agency, 2001–2003; and adjunct professor for environmental law, George Mason University School of Law. This Article is based on the Author's Keynote Address to the Symposium on Securing Water Supplies for the Future: Risk, Challenges, and Opportunities, sponsored by the Texas Wesleyan Journal of Real Property Law, Nov. 9, 2012.

1. For general background on the Texas situation, *see* Documentary: *Life By the Drop: A Special Report on Drought, Water and the Future of Texas,* STATEIMPACT.NPR.ORG, http://stateimpact.npr.org/texas/tag/life-by-the-drop./.

2. ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS at ¶13 (1776).

DOI: https://doi.org/10.37419/JPL.V1.I1.1

Diego to Denver and many farms, cities and towns in between.[3] It is also an area of rapid population increase.

A blue-ribbon committee of the National Research Council ("NRC"), part of the National Academies, reviewed data from tree-ring studies which provide a much longer-term picture of weather and climate patterns than do stream gauges which extend back only a hundred years. Tree-ring data sets go back 300, 500 or 800 years and indicate that average annual water flows vary more than previously thought. Extended droughts are not uncommon at all, and future droughts may be longer and more severe because of an evident regional warming trend. The preponderance of the evidence suggests that rising temperatures will reduce the river's flow and water supplies, says the NRC.

In 1922, when the Colorado River Compact was originally established and allocated water between upper and lower basin states, negotiators assumed that there would be greater annual average river flow. But the tree-ring data reconstructions show that the years from 1905-1922 were exceptionally wet ones, hardly the basis for sustainable calculations of water availability for the long run. Arizona increased its population by 40% since 1990, the state of Colorado by 30%. Clark County, Nevada, home to Las Vegas, doubled its water consumption between 1985 and 2000 even in the face of improved water conservation efforts. Las Vegas gets its water from Lake Mead, America's largest artificial reservoir.[4] It has, at various times, been half full as has Lake Powell, another manmade structure on the Colorado River. Most disturbing, researchers at the Scripps Institution of Oceanography believe that there is a 50% chance Lake Mead will run dry by 2021 and a 10% chance it will run out of usable water by 2014 depending on the drought worsening and water use increases. This, in turn, will interfere with the generation of electricity by threatening the operation of Hoover Dam's turbines.

Notwithstanding its reputation as a boom town and for wretched excess, Las Vegas is an interesting case study illustrating the daunting challenges of transplanting a humid lifestyle to an arid land.[5] The Las Vegas Strip, home to many of the world's largest hotels, with fountains, a lake and even Pirate ship battles, demonstrates the benefit of

3. Most of my discussion on the Colorado River and Basin draws off the recent report by NAT'L RESEARCH COUNCIL, COLORADO RIVER BASIN WATER MANAGEMENT: EVALUATING AND ADJUSTING TO HYDROCLIMATIC VARIABILITY (2007).

4. *Lake Mead May Dry Up by 2021*, NAT'L GEOGRAPHIC NEWS, NATIONALGEOGRAPHIC.COM (Feb. 13, 2008), *available at* http://news.nationalgeographic.com/news/2008/02/080213-AP-lake-mead.html.

5. George F. Will, *A City That Bets on Water*, WASH. POST (Feb. 27, 2005), *available at* http://www.washingtonpost.com/wp-dyn/articles/A54745-2005Feb25.html. For an extended discussion of Las Vegas's sustained efforts at managing its water resources, *see* ROBERT GLENNON, UNQUENCHABLE: AMERICA'S WATER CRISES AND WHAT TO DO ABOUT IT, 1–16 (2009).

water reuse and recycling, an increasingly attractive option given the scarcity and price of water and water treatment. The average hotel room uses 300 gallons of water per day, but almost all of it is recycled. The Strip accounts for barely 1-3%[6] of Nevada's water use but generates 60% of its economic output.

Note that, statewide, agriculture accounts for 75% of water use.[7] This historic allocation, as well as the differential in economic value between agriculture and non-agricultural uses, raises the possibility of water transfers or trading, which would provide newer uses more water while offering financial incentives to agriculturalists. Las Vegas started paying homeowners $1 per square foot to remove Kentucky bluegrass or turf and saved 2.8 billion gallons of water. Water consumption has actually declined despite population growth from 2002 to 2004. Yet, the city is pursuing water transfers from outside its watershed to secure future supplies.

Professor Robert Glennon of the University of Arizona's Rogers College of Law, author of *Unquenchable: America's Water Crisis and What To Do About It,* observes: "To understand the depth of the water crisis, consider that more than thirty-five of the lower forty-eight states are fighting with their neighbors over water."[8] Looking forward, if the economy continues its recovery, and, as predicted, America's population grows by more than 135 million over the next forty years, effective water stewardship will remain a pressing issue for decades to come.[9]

II. RESILIENCE & HOPE

There are, indeed, many risks and much uncertainty in our nation's water future. That said, people, their businesses and enterprises, and the communities in which they live, are all capable of great ingenuity, resilience and adaptability in the face of adversity. Resilience is predicated upon "staunch acceptance of reality; a deep belief, often buttressed by strongly held values, that life is meaningful; and an uncanny ability to improvise." That is the view of Diane L. Coutu, senior

6. There is a discrepancy between the Will and Glennon accounts. Glennon quotes the top local water official regarding the 3% figure. *See generally* Will, *A City That Bets on Water*, *supra* note 5; GLENNON, *supra* note 5.

7. *Current Water Use*, CRWUA, CRWUA.ORG, http://www.crwua.org/Colorado River/MemberStates/Nevada.aspx (last visited Feb. 11, 2013).

8. GLENNON, *supra* note 5, at 18.

9. An Urgent Call To Action: Report of the State-EPA Nutrient Innovations Task Group, State—EPA Nutrient Innovations Task Force 1 (Aug. 2009) (citing U.S. Census Bureau reports from 2008 & 2009), *available at* www.epa.gov/waterscience/criteria/nutrient.

editor at the Harvard Business Review who specializes in psychology and business.[10]

Resilience, however, is not the same thing as optimism. Coutu cites James Collins, the celebrated author of the best-selling business book, *Good to Great,* on the case of Admiral Jim Stockdale, a prisoner of war who was tortured by the Vietcong for eight years. In response to Collins's enquiry as to who did not make it out of the camps, Stockdale replied, "Oh, that's easy. It was the optimists. They were the ones who said we were going to be home by Christmas . . . . You know, I think they all died of broken hearts."

"But for bigger challenges, a cool, almost pessimistic, sense of reality is far more important," says Coutu. To successfully adapt to changing realities, we must soberly assess the situation in order to realistically manage ourselves as well as hydrology.

A. *Signs of Hope: Pricing, Markets, Technology*

Let me offer some thoughts on how sound economics, especially water pricing and markets, along with technological innovation, offer hopeful signs in terms of actions already underway and those yet to be undertaken to secure our water future. As to our water supply issues, we should recognize that our situation is neither dire nor hopeless. We are blessed with vast resources, great wealth and advantages in terms of our ability to manage our natural resources and, hopefully, ourselves.

One very positive development, an indicator, possibly, of a new appreciation of water's value, is the finding of the U.S. Geological Survey that water use has varied less than 3% since 1985 as withdrawals have stabilized for the two largest uses—thermoelectric and irrigation—basically a flattening out or decline of water use despite a growing population and economy.[11] Ironically, many large drinking water systems, not just in the western United States, are getting quite anxious about declining water demand or usage and its impact on their traditional volumetric pricing model.[12] This recent trend, emerging since 2008, is probably due to the prevalence of water-efficient toilets

10. Diane L. Coutu, *How Resilience Works*, HARV. BUS. REV. 2, 4 (May 2002).

11. Susan S. Hutson et al., *Estimated use of water in the United States in 2000*, U.S.G.S. 1268 CIRCULAR 46 (released 2004, revised 2005), *available at* http://pubs.usgs.gov/circ/2004/circ1268/. For more detailed water-use information see http://water.usgs.gov/watuse. Estimates of water use in the U.S. indicate that about 408 billion gallons per day (one thousand million gallons per day) were withdrawn for all uses during 2000. *See also* Susan S. Hutson et al., *Estimated Use of Water in the United States in 2005*, U.S.G.S. 1344 CIRCULAR 42–45 (2009), *available at* http://pubs.usgs.gov/circ/2004/ circ1344.

12. *See* Janet A. Beecher & Thomas W. Chesnutt, *Declining Sales and Water Utility Revenues: A Framework for Understanding and Adapting*, NAT'L WATER RATES SUMMIT ALLIANCE FOR WATER EFFICIENCY (2012), *available at* http://www.allianceforwaterefficiency.org/Declining-Sales-and-Revenues.aspx.

and fixtures, modern building codes and even learned behavior from water conservation and efficiency drives which target water users during droughts. The fundamental economic problem is the loading of fixed costs into a variable revenue source.[13] This may be a "new normal."

Debating the allocation between swimming pools, drinking water, trout streams, irrigation and industrial uses is important, but it is not a matter of life or death in America or Canada as it is in sub-Sahara Africa or parts of Asia. Many of our problems stem from our affluence rather than our want. "More than half of the residential water in Southern California (an arid region) goes for landscaping; across the U.S., the average household uses about one-third of its water outdoors," writes economist David Zetland.[14] There is nothing wrong with landscape irrigation or swimming pools in and of themselves, but there is something very wrong with our pricing system which fails to establish the value of water for swimming pools and Scottish lawns in the desert relative to other human uses, wants and needs.

"Absolute scarcity is not our problem," maintains Peter H. Gleick, president of the Pacific Institute for Studies in Development, Environment, and Security in Oakland, California, and a MacArthur ("genius") Fellow, viewing the matter from a global perspective. He believes that "there is almost no place on the planet where basic human needs for drinking, sanitation, cooking, cleaning cannot be met with locally available resources."[15]

What is true for the entire world is even more so for the United States, although we aspire to very ambitious standards of economic growth and personal lifestyles. Given our expectations—rational or "exuberant"—it is necessary to redefine proper water management to encompass demand-side management as much as the supply-side, and proper pricing of water and water services to include not just the cost of collection, treatment, and delivery, but also water's scarcity value. Moreover, it is well past time to start treating wastewater as an asset, and emphasizing water efficiency, conservation, reuse and recycling. There is no such thing as wastewater, goes the current saying, just water that is wasted!

Getting the prices right will be necessary for purposes of maintaining water infrastructure while encouraging water efficiency. In the United States at least, we do not cover the full cost of our infrastructure, on a life-cycle basis, or its operations and maintenance

13. The Author thanks David Zetland for this formulation of the economic problem.

14. DAVID ZETLAND, THE END OF ABUNDANCE: ECONOMIC SOLUTIONS TO WATER SCARCITY 65 (2011).

15. Dr. Peter H. Gleick, *The 15th Abel Wolman Distinguished Lecture*, THE U.S. NAT'L RESEARCH COUNCIL OF THE U.S. NAT'L ACADEMY OF SCIENCES 9 (Apr. 23, 2008).

("O&M"). The American Water Works Association ("AWWA") recently estimated the cost of restoring existing drinking water systems and expanding them to serve a growing population to be "at least $1 trillion over the next twenty-five years, if we are to maintain current levels of water service."[16] "Most Americans pay less than $3.75 for every 1,000 gallons of safe water delivered to their taps," says AWWA, a veritable bargain compared to a bottle of water.[17]

The 2011 American Water Intelligence ("AWI") Tariff Survey[18] offers a critical appraisal of where we are in this country on water pricing. AWI is the U.S. spin-off of Global Water Intelligence, a highly regarded trade magazine in the water business. Water rates increased an average of 8.1% between July 2010 and July 2011. Rates rose in twenty-nine of the thirty-three American cities for which AWI could compile comparative historical data. AWI sees this movement on rates as positive, but just a beginning. "Americans continue to buy water at half the cost that they would pay if they lived in Northern Europe. It is an amazing price discrepancy for a product that is pretty similar on both sides of the Atlantic."[19]

Americans use twice as much water, per capita, as Europeans. Thus, actual household water bills are not much different. "But American utilities have to work harder to produce the same amount of money," observes AWI. "The result is that the operating surpluses that can go toward supporting capital projects are typically smaller in the U.S. than in Europe (the average surplus in the U.S. is in the region of 28 percent compared to 35 percent in Northern Europe)." So "the main implication of the low level of operating surplus is that the U.S. water and sewer utilities spend less on capital projects than their Northern European counterparts," opines AWI. "This is evident in the number of main breaks, boil orders and discharge permit violations in the U.S. compared to cities in Northern Europe (Southern Europe is a different story)."

Unfortunately, the 8.1% increase in rates is not a robust signal that American utilities are moving to address this shortfall in capital investment. The data indicate that the average increase is driven by a small number of cities pursuing very large increases. "11 cities have

16. *Buried No Longer: Confronting America's Water Infrastructure Challenge*, AM. WATER WORKS ASS'N 3, http://www.climateneeds.umd.edu/reports/American-Water-Works.pdf.

17. *Id.*

18. *Cities Hike Water Charges as Financing Options Evaporate*, AM. WATER INTELLIGENCE 8–11 (Sept. 2011), http://www.americanwaterintel.com/archive/2/9/analysis/cities-hike-water-charges-financing-options-evaporate.html. (Summarizing the results of the Tariff Survey, "the full survey, spreadsheet, complete with details of tariff structures and social tariffs, will be available to download from the AWI website within the next month.").

19. *What does an 8.1 percent water tariff increase mean?,* AM. WATER INTELLIGENCE 4 (Sept. 5, 2011), http://www.americanwaterintel.com/insight/what-does-81-percent-water-tariff-increase-mean.html.

above average increases, but 22 have below average increases," says AWI. "Furthermore, falling volume demand as a result of the economic downturn (and in some cases demand management programs) may mean that increases in tariffs lead to smaller increases in revenue."

"In the longer term, it is inevitable that all U.S. water and sewer utilities will have to increase their operating surpluses to European levels because there are no longer any alternative sources of funding in the U.S.," claims AWI. "In the meantime, we will see a period of growing diversity-and creativity." As the Northern European experience shows, pricing is also a critical demand-side management tool. Consider also the case of Santa Barbara, California as told by David Zetland.[20]

In the early 1990s, after several years of drought, Santa Barbara saw its reservoir shrink. Limits on lawn watering and car washing were imposed. Then the water agency instituted steep, increasing block rates resulting in prices 200% higher at the upper rates of water usage. "The impact on changes in behavior and aggressive price penalties was fast and significant. Median monthly consumption dropped from 25 to 17 [cubic meters] per month," writes Zetland. And the consumption stayed low: "After the drought ended and prices were lowered, consumption was still only 60 percent of pre-drought levels."[21]

Last year, the United States Conference of Mayors City Water Conservation Achievement Awards garnered fifty-six applicants for two awards. I had the pleasure of serving as a judge in this competition as I had several years prior. Many, if not most, of the applications were from communities in arid states and Florida dealing with pressing water demand. There were an overwhelming number of affirmative responses to the following question: "Does your city use water rates to achieve water conservation?"

While most of the applicant communities, quite rightly, used a broad range of non-price policies and programs to encourage water efficiency and conservation, an overwhelming number indicated that they at least partially relied on pricing as a demand-management tool. Some used increasing block rates, similar to those in Santa Barbara. Others used seasonal or drought pricing strategies. But compared to the competition several years earlier, this was a huge jump in the number of municipal water systems utilizing pricing for such purposes. I took this to be an encouraging development.

---

20. *See* ZETLAND, *supra* note 14, at 48.

21. *See generally* G. Tracy Mehan III & Ian Kline, *Pricing as a demand-management tool: Implications for water policy and governance*, AM. WATER WORKS ASS'N 61 (2012) (extending the discussion of the literature on demand-management pricing), http://www.cadmusgroup.com/wpcontent/uploads/2012/11/Mehan_JAWWA_Feb2012.pdf.

We should provide a basic water supply for every household to use at reasonable cost. Beyond that basic level necessary for human needs, users should pay a price that includes both the cost of the infrastructure and the scarcity value of water. They are not buying a mere commodity, but a very sophisticated, highly technical, heavily engineered, capital-intensive service.

In addition to the movement towards getting the prices right, water markets are emerging throughout the arid west. Given the prior appropriation doctrine for allocating water ("first in time, first in right"), which obtains in western states, water rights are very real, i.e. legally defensible. Thus, they can be bought, sold or leased-to cities, farmers, environmental groups, and the like. "Rarely does one hear of a crisis in condominiums, pick-up trucks or laptop computers, mainly because markets work to eliminate shortages by balancing supply and demand," writes Terry Anderson, Brandon Scarborough and Lawrence Watson, in their new, magisterial study of water markets.[22] "Without markets and prices to provide incentives for both demanders and suppliers, water crises will persist."[23]

Agriculture is the biggest user of water on the planet by far, typically using 70-80% or more of available water.[24] This is very much the case in the arid states in the western U.S. Recall Nevada, which I already mentioned. Robert Glennon has observed: "The economic value of water for municipal and industrial uses dwarfs the value of the same water to farmers. California growers consume 80 percent of the state's water yet contribute only 2 percent to the gross state product."[25]

Given that most of the water rights are held by farmers and ranchers, and the relative disparity in economic value between, say, growing and selling crops and municipal and industrial use, e.g., manufacturing computer chips, there is an incentive for mutually beneficial transactions, assuming third-party and environmental impacts can be mitigated. Many farmers, who happen to be senior water appropriators, may be in a position to make a lot of money selling or leasing water.

Glennon also noted that it takes roughly 150,000 gallons of water to produce one ton of alfalfa, but it takes fewer than ten gallons to produce Intel's Core 2 Duo microprocessor which sells for $400. A ton of alfalfa fetches up to $110 (as of 2009). "In other words, each acre-foot used to grow alfalfa generates at most $264," writes Glennon. "That same acre foot used to manufacture Core 2 Duo chips generates $13 million."[26] So it should come as no surprise that between 1987 and

22. TERRY ANDERSON ET AL., TAPPING WATER MARKETS 5 (2012).
23. *Id.* at 6.
24. STEVE MAXWELL & SCOTT YATES, THE FUTURE OF WATER: A STARTLING LOOK AHEAD 54 (2011).
25. GLENNON, *supra* note 5, at 18.
26. *Id.* at 201.

2005, there were 3,232 sales and leases of water rights in the western states, involving a "staggering" (Glennon's term) 31 million acre feet of water. "That's more than twice the annual flow of the Colorado River," claims Professor Glennon.[27] Consider, again, the case of the Las Vegas Strip using such a small amount of water for such a large amount of GDP.

Water markets can offer environmental benefits, too. Today, most western states allow the leasing of water rights by fish and game agencies or water trusts to protect fisheries and other environmental values. The pioneering institution in this area was the Oregon Water Trust, now the Freshwater Trust,[28] which paid ranchers to permanently shorten their irrigation season and leave water instream in late summer when the fish needed it most.[29]

"From 1998 until approximately 2006, more than $300 million (adjusted for inflation) have been spent on leases and purchase of water for instream, which is nearly four times the amount spent by private entities and government agencies between 1990 and 1997."[30] Encouraging the growth of water trusts, with a view toward emulating the boom in land trusts in this country, would be an effective water management tool.

Finally, technology will be instrumental in achieving sustainability in water management, specifically, for water reuse and recycling, and to ensure an adequate supply of potable water. Desalination, microfiltration, reverse osmosis, and ultraviolet light are some of the approaches which will, increasingly, be deployed to attain this goal in the face of droughts, climate change, population shifts and the demands of either affluence or poverty. New technology will also facilitate the deployment of cost-effective distributed or decentralized systems to supplement traditional, large-scale treatment works.

The business of water, sometimes referred to as the "water industry," is a multi-faceted sector that includes architectural and engineering services; pump, pipe and motor manufacturers; membrane technology companies; software and computer services; and numerous other providers of the myriads of equipment and tools necessary to the capture, treatment and provision of water and wastewater services.

The respected financial analyst, Steve Maxwell, describes this industry as "a balkanized and teeming 'bazaar' of fundamentally quite different businesses-all of which have something to do with the delivery of clean water but which can't all be quite accurately classified under

27. *Id.* at 273.

28. *See generally* THE FRESHWATER TRUST, http://www.thefreshwatertrust.org.

29. BRANDON SCARBOROUGH AND HERTHA L. LUND, SAVING OUR STREAMS: HARNESSING WATER MARKETS—A PRACTICAL GUIDE (2007), http://perc.org/sites/default/files/SOS_Full_Text.pdf.

30. *Id.* at 10.

any single heading."[31] Despite the lack of reliable market research on this business, Maxwell maintains that the size of the U.S. water and wastewater sector, i.e., industry, is "generally estimated" at $120 billion per year, with the world market roughly four times larger or about $500 billion per year.

There is much ferment and innovation, in the private water business, particularly in the areas of treatment technologies such as membranes and infrastructure innovations such as pipe linings. Given the universal, worldwide need for water and wastewater services, the "animal spirits" in this competitive private sector are generating many new ways of approaching enhancing stewardship of water resources. Mamta Badkar of Business Insider recently reported on a number of "fascinating" trends in the water industry based on a report by Citi Investment Research and Analysis.[32] Noting that global water consumption is doubling every twenty years, the $450 billion water market (a bit smaller than Maxwell's estimate) is rapidly innovating. Companies are turning to water reuse, desalination, and other economical technologies. They are also merging manufacturers with service providers. A sampling of some of the ten trends identified by Citi follows:

Water reuse will become a new source of water supply. This is consistent with the general shift in attitude which no longer speaks of "wastewater" but rather "water that is wasted." Innovations, again, in the area of membrane technologies are driving this change as is water scarcity; and Citi also sees these technologies displacing chemicals in water treatment as another trend to watch. The membrane water treatment market is predicted to grow from $1.5 billion in 2009 to $2.8 billion in 2020. Highly contaminated water, say, from hydraulic fracturing to obtain natural gas is driving point-of-use technologies to deal with the issues of disposal of "produced water" from this water-intensive practice.

Other developments highlighted by Citi are the replacement of chlorine, over time, by ultraviolet light disinfection and growth opportunities in water efficiency products. This latter trend encompasses water-efficient products such as bio-gas recovery systems, "water meters that could help companies gain from water footprint initiatives," pipe rehabilitation and relining systems, and water derivative products like water-free toilets.

The water business or industry is moving toward a sustainable business model which, in effect, yields a kind of stewardship for profit. It

31. Steve Maxwell, *A look at the challenges and opportunities in the world water market*, AM. WATER WORKS ASS'N 104, 107 (May 2010).

32. Mamta Badkar, *10 Fascinating Trends In The Water Industry And The Companies Poised To Gain From Them*, BUSINESSINSIDER.COM (May 25, 2011), http://www.businessinsider.com/10-fascinating-trends-in-water-companies-poised-to-gain 2011-5?op=1.

may approximate something like sustainability's triple bottom line (environmental, economic and social). The movement of private business capital into the water sphere is a welcome development which can benefit literally billions of people throughout the world. Steve Maxwell observes, "As the global water crisis intensifies, we face numerous and daunting political and economic challenges." "The flip side of this coin represents virtually limitless opportunities for creative and innovative firms to help provide needed solutions," says Maxwell.

Some of the biggest American companies have moved decidedly into these exciting, new water markets—GE , IBM, Dow, ITT (now Xylem). There are, of course, water technology enterprises proliferating throughout North America, Europe, Israel, Australia and Singapore. Desalination, a technology which utilizes the new filtration and membrane technologies removes salt from seawater or brackish groundwater, is a promising approach to water reclamation or treatment notwithstanding legitimate questions regarding financial, environmental and energy issues.[33]

Only 2.5% of the world's water is freshwater and suitable for human consumption. Hence, cities from Algiers to Tampa, Florida are pursuing desalination as a solution to water scarcity. The National Research Council ("NRC") notes that in 2006, worldwide online desalination capacity was roughly 10 billion gallons a day or 0.3% of the total freshwater used in the world. From 2000 to 2005, U.S. desalination capacity grew by roughly 40%, accounting for about 0.4% of freshwater used in this country. The NRC recommends an ambitious research project to address issues such as the effects of waste products of desalination. However, it notes that the cost of this technology is improving due to new, less expensive membrane technologies and greater energy efficiency and the increasing costs of other alternatives.

Water transfers or re-allocation and conservation will be cost-competitive given lower energy costs. Thus, the decision to use desalination will be a local decision dependent on the circumstances. El Paso, Texas is utilizing desalination as part of its overall program, which includes conservation and water reclamation.[34] Orange County, California is on the cutting edge of water recycling, reuse or reclamation. With an expected increase in water demand of 16% by 2030, it has

33. For the discussion of desalination, *see generally* DESALINATION: A NATIONAL PERSPECTIVE, COMMITTEE ON ADVANCING DESALINATION TECHNOLOGY, NAT'L RESEARCH COUNCIL (2008), http://waterwebster.org/documents/NRCDesalinationreport_000.pdf.

34. Neda Simeonova, *A Forward—Looking Approach: El Paso Water Utilities Explores Aggressive Reclaimed Water Programs*, WATER & WASTES DIGEST 24 (Apr. 2008), http://www.wwdmag.com/sites/default/files/AForward.pdf.

implemented an ambitious system by world-class standards.[35] As described by Anjali Athavaley of The Wall Street Journal, this operation yields 70 million gallons of water a day for 500,000 people a year. It cost $481 million to build and $29 million per year to operate.

Elizabeth Royte, the author of *Bottlemania: How Water Went on Sale and Why We Bought it,* wryly commented that, "[i]f you like the idea [of water recycling], you call it indirect potable reuse. If the idea revolts you, you call it toilet to tap."[36] Humor aside, Orange County's project is a state of the art system which starts with treated wastewater and serves up essentially distilled water. Utilizing microfiltration, reverse-osmosis, ultraviolet light and hydrogen peroxide, it provides indirect potable water that is pumped into a groundwater basin where it takes a year to move through sand, gravel and clay to a drinking water well. Jim Cook, who chaired the NRC's committee on reclaimed water, says that Orange County's final product is cleaner than its groundwater.

Technology may not be a sufficient condition for successful water management in the 21st century, but it will certainly be a necessary condition given the growing economy, constant population shifts, affluent lifestyles, droughts and climate variability, all of which will continue to put pressure on a limited supply of potable water.

B. *Hope Amidst Risk and Uncertainty*

There is a rational basis for hope in our quest to secure our water future. Americans are an innovative and prosperous people. And, as Winston Churchill supposedly said, "You can always count on Americans to do the right thing, after they've tried everything else."[37] We will, no doubt, continue to pursue those supply-side solutions where we can find them. But the truly cost-effective sources of new water will be found on the demand side through realistic pricing and the creation of expanding water markets to reallocate water use in relative economic terms and to protect environmental and natural resource values.

We will also discover new supplies or sources of water, right under our noses, through water reuse, recycling and reclamation, which renders obsolete the very idea of wastewater. These new sources will not come from the ground or from watercourses but, ultimately, from the minds and imaginations of creative men and women focused on water

35. *See also* Kate Galbraith, *Texas' Water Wars Spark Interest in Desalination: The Last Drop*, WATER-SPOUTS.BLOGSPOT.COM (June 10, 2012), http://water-spouts.blogspot.com/2012/06/texas-water-woes-spark-interest-in.html.

36. Elizabeth Royte, *A Tall, Cool Drink of . . . Sewage*?, N.Y. TIMES (Aug. 10, 2008), NYTIMES.COM, *available at* http://www.nytimes.com/2008/08/10/magazine/10wastewater-t.html?pagewanted=all&_r=0.

37. The Author says "supposedly" because he cannot find a definitive source for this quote although the internet has countless citations un-sourced.

and its paramount role in our lives and communities. There we will find the true source of resilience in the face of risk and uncertainty, thereby justifying our hopes for the future. We may even get beyond just coping and actually thrive in the renewal of our sense of water stewardship.