So, How'd That Work Out?

Updates from the (water)front

The law is the law. Play by the rules. You can't fight city hall.

We tend to think of the legislation, regulations, codes, and policies that govern our lives as a kind of political accretion, each new rule layered onto an increasingly formidable reef of legal hazards. But "codify" does not necessarily mean "ossify." These regulations are subject to review and change.

Like the men and women who devise them, political interventions are usually well-intended, often smart, and yet frequently flawed. Those addressing water issues are subject to the inconstancies of political and business interests, new technology and scientific advancement, as well as consumer markets and human behavior.

Here then is an update on some significant regulations. Some are successes. Some are works in progress. As for some…well, mistakes were made.

— Elizabeth S. Padjen FAIA

Conservation

Section 10.14.3 of the Massachusetts Uniform State Plumbing Code

In 1988, Massachusetts became the first state in the country to require new toilet fixtures to consume no more than 1.6 gallons per flush. Though one of our state's lesser-known historic achievements, this amendment to the state plumbing code shaped a new standard in water efficiency. With support from Massachusetts Representative Chester Atkins, the 1.6 gpf requirement was incorporated into the national Energy Policy Act of 1992, and municipalities across the country awoke to the cost benefits of replacing inefficient fixtures. (Reducing water use conserves energy as well as water; the treatment and transport of water in the US currently amounts to 56 billion kilowatt-hours annually.)

The idea of adopting a 1.6 gpf standard in Massachusetts was introduced by Amy Vickers. An engineer in her late twenties with an undergraduate degree in philosophy, she joined the Massachusetts Water Resources Authority after a frustrating period in New York City, where shortsighted politicians showed more interest in increasing supply than in reducing demand. Having seen a similar standard adopted successfully at a smaller scale in Glendale, Arizona, Vickers was confident that low-flow fixtures, together with the MWRA's plans for infrastructure repairs and extensive public outreach, could halt the alarmingly steady rise of water demands.

Results were immediate and long-lasting: demand fell below 1970s levels in just three years, and continues to decrease steadily — even with more communities added to the MWRA district — as fixtures are replaced, infrastructure is repaired and upgraded, and industrial water use is diminished. Today, the MWRA reports total annual water system demands that are just two-thirds of what they were two decades ago, with water consumption in Boston down to 1910 levels.

Conservation and efficiency policies are now recognized as astute actions in a fight against rising demand. Last year, Texas and California addressed looming water crises by mandating the use of high-efficiency toilets (HETs) designed for a flush equivalent to 1.28 gallons. Engineers Bill Gauley and John Koeller have conducted tests demonstrating that many HET fixtures are capable of superior performance, though a newly formed plumbing research group is still assessing whether codes for horizontal drainage piping should be reconsidered.

Gauley and Koeller, "mythbusters" in the field of water efficiency, are also trying to eradicate confusion about the impact of automatic sensors perpetuated by published estimates of gallons saved by installing "automatic, low-flow" fixtures. A recent study logged the increase in water use associated with sensor-operated toilet fixtures at 66 percent. (Aside from wasting water, the "phantom flush" is also known to terrify small children.) Comparison of 1.8 gpm (gallons per minute) manual faucets with 1.2 gpm sensor faucets revealed a 30 percent increase in water consumption with sensors. Because water only comes out at the faucet's maximum flow rate, which is not typical user behavior, sensor-operated and metered faucets are inherently inefficient.

Similarly, while showerheads with flow rates higher than now permitted by code may facilitate slightly briefer showers, the net result is elevated water consumption. To address lingering issues with user satisfaction, the EPA's WaterSense label will soon evaluate showerheads based on performance standards. Apart from specifying a flow rate of 2.0 gpm or less (compared to the standard rate of 2.5 gpm at 80 psi), the program will set standards for spray force, spray coverage, and flow rate across a range of pressures.

But a focus on fixtures can only go so far. Municipalities seeking a broad reduction in water use, indoors and out, are now providing audits and adopting tiered-rate programs based on calculations of anticipated needs. Assigning individual responsibility offers a strong incentive to conserve.

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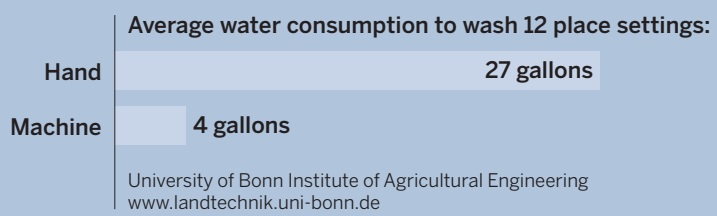
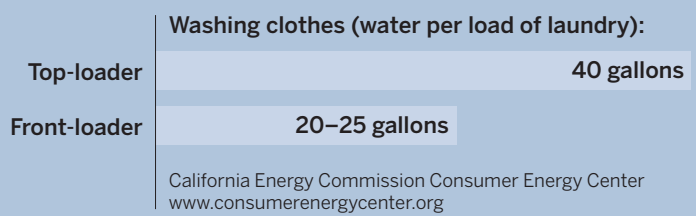
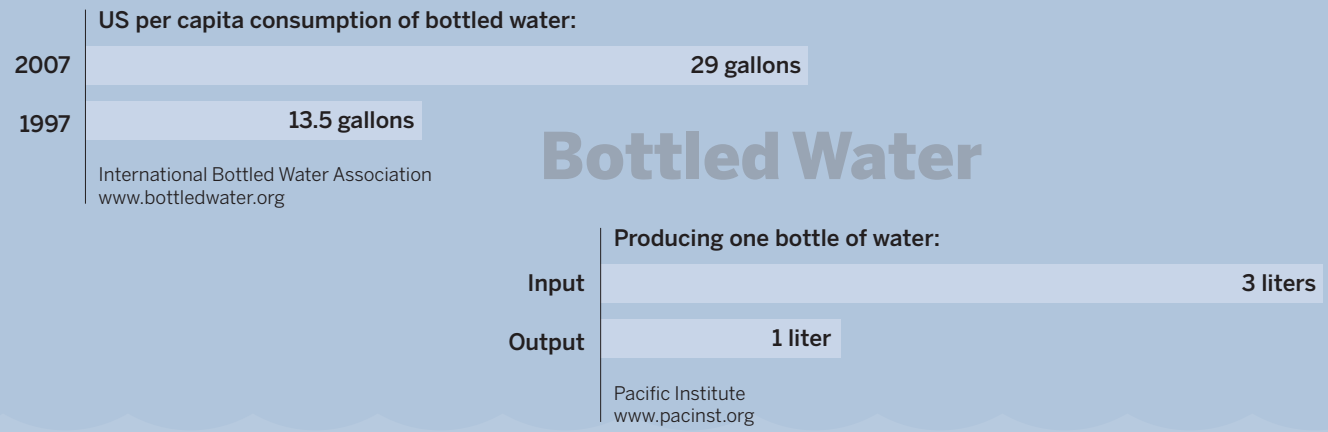
Household Water



University of Bonn Institute of Agricultural Engineering
www.landtechnik.uni-bonn.de



California Energy Commission Consumer Energy Center
www.consumerenergycenter.org



Reuse

Massachusetts Department of Environmental Protection Interim Guidelines on Reclaimed Water (2000)

When it comes to renewable resources, water could be the poster child for recycling. Through a perpetual round of condensation, precipitation, infiltration, and evaporation, H_2O is endlessly renewed and made available again for our use. And use it we do, second only to oxygen as a ubiquitous resource that we take for granted as a basic entitlement.

Our experience and conditioning conspire to convince that water comes in two categories: clean or dirty, fresh or foul, pure or polluted. This prejudice is a costly one, resulting in the use of highest-quality H_2O for flushing toilets and watering the lawn, and countless gallons of additional wastewater diverted from watersheds to expensive treatment facilities. But what is perhaps the simplest strategy for changing this behavior — the reuse of water for non-potable purposes — may be the most controversial.

It is not a new idea. The 18th-century Yin Yu Tang house, built in southeastern China and now on display at the Peabody Essex Museum in Salem, Massachusetts, diverts all roof runoff to cisterns in the courtyard so that it can be used for domestic purposes. Currently an estimated 20 percent of the world's agriculture is produced with reused raw wastewater. Yet in the US, the approved use of "gray water," as the more lightly polluted form of used water is described, is sporadic at best, although the International Plumbing Code now allows it for toilets and underground irrigation.

Here in Massachusetts, old habits are giving way to new behaviors. Interim Guidelines established in 2000 by the Massachusetts Department of Environmental Protection (DEP) allowed water reuse for irrigation of golf courses and commercial nurseries (for non-food crops); recharging of certain stressed aquifers; and toilet flushing in commercial buildings.

Following the successful implementation of the Interim Guidelines, the state issued new regulations in March 2009 — 314 CMR 20.00 — which established a reclaimed-water permit program overseen by DEP for the uses that had been outlined in the Interim Guidelines. The Massachusetts Plumbing Board has responded to the new regulations by allowing gray-water systems under specific conditions, including: required board approval, devices to prevent contamination of potable water by the gray-water system, identification and labeling to prevent visual confusion of the systems (gray-water piping must be painted purple), and identification of gray water itself through the addition of a non-toxic blue dye.

These incremental steps will likely soon lead to routine water reuse, perhaps eventually extending to residential and agricultural applications. In combination with efforts to limit stormwater runoff by reducing impervious surfaces and installing constructed wetlands, these practices may amount to more than just a drop in the bucket toward maintaining our water resources and protecting critical habitat.

Vernon Woodworth AIA, LEED AP represented the AIA as a member of the International Code Council's Sustainable Building Technology Council, which recently completed work on the International Green Construction Code. He helped draft requirements for stormwater runoff, rainwater reuse, and the installation of green roofs.

Management

Arizona's Groundwater Management Act of 1980

Back in the 1970s, a number of people in Arizona became very concerned about water. It wasn't just that the growth patterns at the time were draining the ancient aquifers under the desert. The population projections foretold even more water use, with no additional supply in sight, unless usage was tightened. Facing up to this dead-end scenario prompted passage of the Groundwater Management Act of 1980, heralded as a state-of-the-art approach in identifying water supplies and requiring conservation that would head off groundwater overdraft and ensure a "safe yield" through 2025 — in other words, to make sure the place didn't run dry.

Although New Englanders might question the wisdom of so much expansive growth in the middle of a desert in the first place, Arizona's experience tackling water-resources management holds some valuable lessons for this, and indeed any, region. Recent critiques suggest that it's necessary to be continually vigilant through the boom and bust of economic cycles. Being prudent with water requires not only regulatory action, but also a cultural transformation by both consumers and developers, who now have many more tools to make conservation part of their building plans.

Water and human settlement go hand-in-hand everywhere in the world, but especially so in Arizona. Snowpack from the state's mountains feeds into four rivers, but that water quickly evaporates in the desert, which only gets 8 to 14 inches of rainfall a year (New England receives 35–55 inches of precipitation). Early settlement relied on pumping water out of the underground aquifers, and irrigation canals and projects like the Roosevelt Dam, 80 miles east of Phoenix. The state also engaged in an ongoing brawl with California over rights to water from the Colorado River. Through the 1960s and '70s, sprawling development patterns required more water from aquifers than could possibly be restored, and more from dams and rivers. Following the $4 billion Central Arizona Project Canal, which delivered water from the Colorado, state leaders, led by then-governor Bruce Babbitt, began to focus on the demand side — namely, the 1980 legislation restricting the amount of groundwater that could be used. The statute led to the creation of the Arizona Department of Water Resources, charged with monitoring "withdrawals" and conservation targets for agricultural, municipal, and industrial users, and enforcing the mandate that new subdivisions have future renewable supplies of water.

What followed next is a cautionary tale for New England policymakers. The quest for loopholes was almost immediate. Farmers, for example, could take land out of production and bank or trade their water rights. Some complained that the baseline for water use was too low, and restrictions phased in too slowly. It was not clear how violations would be penalized, which undermined the authority and intention of the regulations. Municipalities received funding for conservation programs regardless of how much water they actually saved. A requirement that new development show a 100-year water supply was significantly altered due to pressure from real-estate interests and the development community. "The conservation goals of the law have been systematically weakened by legislative amendments, consumer resistance, and timorous regulators," writes Arizona State University professor Paul Hirt in the July 2008 issue of *Environmental History*. A sustainable future water supply, he says, is "a mirage."

Jim Holway, director of Western Lands and Communities, a joint venture of the Sonoran Institute and the Lincoln Institute of Land Policy, sees things more optimistically. "We have three decades of experience in comprehensive water management programs, in the face of limited and highly variable water supplies and changing demands," he says. The 1980 law has been augmented with requirements for an assured water supply for growth, groundwater recharge projects, banking water underground for future shortages, and the reuse of treated wastewater. The state is now turning to the next big curve ball — the inevitable impacts of climate change.

Success means an evolutionary process, says Holway, who was formerly assistant director at the Department of Water Resources. That includes identifying issues as they come up, measuring and reporting water use to facilitate planning, and quantifying water rights and permits to provide incentives for conservation. Only by managing all sources of water — groundwater, surface water, reclaimed wastewater, and stormwater — can a place like Arizona avoid going dry.

Anthony Flint is director of public affairs at the Lincoln Institute of Land Policy, a think tank in Cambridge, Massachusetts.

Virtual Water

	Water required to produce:
One ton of steel	62,600 gallons
One ton of cement	1,360 gallons

Charlotte Harbor National Estuary Program
www.chnep.org

	Water required to produce:
One gallon of paint	13 gallons
One board-foot of lumber	5.4 gallons

Charlotte Harbor National Estuary Program
www.chnep.org

Public Access

Chapter 91, the Massachusetts Public Waterfront Act

The year 2010 marks the 20th anniversary of the Massachusetts Department of Environmental Protection's regulations implementing Chapter 91, the Public Waterfront Act. Since 1990, much has been learned about development along urban waterfronts, especially Boston Harbor, and it is instructive to take a look at the successes and shortcomings of the program as originally envisioned.

Chapter 91 introduced new requirements for both public access and public ground-floor uses; its greatest success has been to demonstrate the value of opening previously inaccessible waterfront areas for the enjoyment of the public. Real estate developers have become some of the strongest advocates for public access, recognizing the inherent value of an active, public waterfront.

While the creation of public access has been a resounding success, the development of public uses has had a mixed track record. The Chapter 91 regulations require that Facilities of Public Accommodations (FPAs) be located on the ground floor of buildings that are within 100 feet of the shoreline; buildings on Commonwealth tidelands must dedicate the entire ground floor to FPAs. The definition of FPAs encompasses retail, restaurant, and hotel uses, along with other public uses such as museums, art galleries, and cultural institutions. The public-use requirements were based in part on the early work of the City of Boston in developing its Harborpark zoning. The City developed the idea of requiring at least one public use in each waterfront project in order to guarantee that public access would be achieved without an actual taking of private rights.

The Chapter 91 framers expanded this concept to require that most or all of the ground floor be public. But, with the exception of hotel projects, most waterfront developers have been unable to achieve full compliance, particularly in low-density and residential projects, such as in the Charlestown Navy Yard. Urban planners have learned that public uses are more successful when concentrated around public squares and in dense retail districts with high pedestrian and vehicular traffic. Waterfronts, however, have four inherent disadvantages in attracting public uses: the public can be drawn from only 50 percent of the surrounding area, since one half of the nearby area is the harbor itself; parking is strongly discouraged and expensive because it must be built below grade; there is virtually no pass-by traffic; and density is limited by Chapter 91 height and open space requirements. It is therefore not surprising that the vision of interior FPAs has not been successfully realized, and that storefronts have remained vacant for many years. Even Rowes Wharf, the model of waterfront development and public programming, has been unable to fully develop its ground floor with public uses.

So what is the fix? Waterfronts can never overcome the obstacles presented by their location at the "edge" rather than at the center. We must carefully consider what is realistic. New Urbanists have demonstrated that streets can feel public, even in exclusively residential areas. Form-based codes have shifted the focus toward the "feel" of the architecture and the place, and away from regulating specific land uses. These planning concepts move us away from the traditional zoning standards that were the underpinnings of the Chapter 91 regulations. We need to understand that public ground-floor uses are less important to the success of a waterfront project than the public use of the exterior spaces.

In an active, ever-changing urban environment, 20 years is a long time to go without rethinking the rules. It is time to take a fresh look and consider whether there are better solutions.

A longer version of this story, including the history of waterfront regulation in Massachusetts, is available at: www.architectureboston.com.

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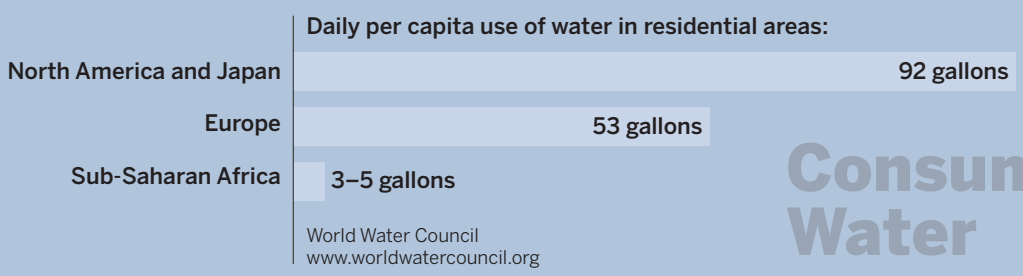

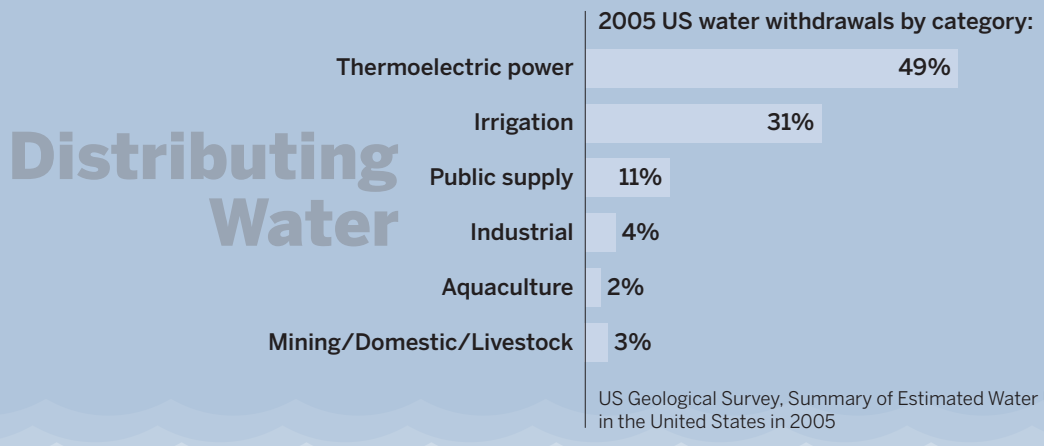

Groundwater

The Boston Groundwater Conservation Overlay District Boston Zoning Code Article 32

Many Bostonians became aware of the danger that lurked below only during the early 1980s, when a church and other buildings on the flat of Beacon Hill began to crack because low groundwater levels had destabilized their foundations.

Groundwater continues to be a challenge in Boston and elsewhere, as levels fall below the tops of the wood piles that support buildings, allowing the wood to rot and threatening the structural integrity of what is above ground. And efforts are growing, both in kind and geographically, to address the issue.

In 1986, in response to the apparent crisis, the Boston City Council created the Boston Groundwater Trust. Revived by Mayor Tom Menino in 1997, the Trust monitors groundwater levels and recommends solutions — a mandate strengthened by the adoption in 2006 of Article 32, creating Boston's Groundwater Conservation Overlay District (GCOD). The district extends from the Fenway through the South End, Back Bay, and Chinatown, skipping over downtown's terra firma but including smaller districts encircling downtown, such as the Bulfinch Triangle, the wharf areas along Commercial Street in the North End, and the Fort Point Channel area.

The GCOD is a success, according to Elliott Laffer, executive director of the Boston Groundwater Trust. Its regulations apply to excavation-related construction and to rehabilitation or expansion (of any structure) of an area greater than 50 square feet. It requires a study to determine the effect on area groundwater, and installation of a recharge system. A homeowner in the Back Bay doing a gut rehab, for example, has to capture the equivalent of roof water from a one-inch rain and drain that water back into the ground. Complying with Article 32 typically costs several thousand dollars — compared to the hundreds of thousands of dollars it can cost to replace the tops of rotted piles and restore a foundation. Since the creation of the GCOD, more than 150 cases have been through the Zoning Board of Appeals, which issues permits, and there has been almost 100 percent compliance. Laffer also reports that a new, ongoing study by Tufts University researchers has found that the recharge wells installed since 2006 have resulted in a small but measurable improvement, which will increase as more wells are put in.

Apparent success has spawned ambitious imitation. Legislation was filed during the last session on Beacon Hill with the intention of protecting similarly endangered buildings elsewhere in the Commonwealth. But, because of the potentially enormous cost of remedies and uncertainty about where and to what extent the problem exists outside Boston, that legislative proposal will be rewritten and filed in the next session, according to one of the sponsors, Democratic State Representative Marty Walz of the Back Bay. The legislation included a provision for tax credits for homeowners who install recharge systems, assistance that will now be provided under another bill, filed on behalf of the City of Boston. It also would have required that governmental bodies remedy groundwater depletion caused by tunnels and other infrastructure under their control, an unrealistic demand in today's fiscally challenged economic environment.

Some infrastructure repairs are already under way. The Boston Water and Sewer Commission has had an inspection and replacement program for several years to address the problem of broken sewer pipes that drain groundwater out from under neighborhoods along with sewage. A recharge system was installed in the Fenway, and the Massachusetts Water Resources Authority is currently replacing pipes in East Boston.

A central element of the proposed statewide legislation is regulations on sump pumps, Walz said, to keep water that is pumped out of structures from going into the sewer or storm overflow system and to direct it to replenishment of the groundwater table instead. "The goal is preventing groundwater depletion," she said, adding that the GCOD in Boston is good but doesn't go far enough. "We've got to get government to repair infrastructure."

Tom Palmer is a consultant specializing in public relations and strategic and crisis communications. He formerly covered real estate and development for *The Boston Globe*.