Major US Cities Running Out of Water

By Kelly A. Reynolds, MSPH, PhD

A new study highlights that nearly one in 10 watersheds in the United States is considered stressed. Without intervention, stressed watersheds are not sustainable given that the demand is greater than the natural rate of replenishment. Considering current, regional trends in water supply and demand, researchers have compiled a list of 11 US cities projected to completely deplete their water supply in the not so distant future. Water-stressed regions frequently suffer from multiple economic and public health adversities, including food and water quality issues. The need is clear for the development of a sustainable water use/management plan for the future.

Global supply and demand

Of all the water on earth, only 0.3 percent is usable by humans. The vast majority of the useable water is in underground aquifers followed by freshwater lakes and rivers. In the US, the demand for freshwater is primarily associated with industry withdrawals (i.e., thermoelectric power, 41 percent) followed by agricultural practices (37 percent) and municipalities (19 percent).[1] Globally, the majority of annual water withdrawals is for use in agriculture (69 percent) followed by industry (23 percent) and domestic use (eight percent including municipal, household and personal water uses). The minimum standard to meet basic human water needs for drinking, hygiene, sanitation and food preparation is 50-100 liters (13-27 gallons) per person per day. A minimum of five liters per day are needed for drinking, 20 liters per day for sanitation, 15 liters per day for bathing and 10 liters per day for food preparation.[2] Consumption in the US is approximately 578 liters (150 gallons) per person per day compared to greater water-stressed regions like Africa, where the per capita use averages 47 liters (12 gallons per day).

Regional water shortages can have an impact on water quality. Water shortages also prompt increasing efforts for water reuse along with new challenges for effective treatment. As supplies are stored or transported across the miles, the opportunity for contamination is also a reality, requiring new assessments for water quality assurance.

Demand for water beyond the recharge rate eventually leads to a stressed supply. In the global arena, the Falkenmark Indicator of water stress is commonly used. Based on per capita use, volumes <1,700 m^3/person indicates water stress, whereas water scarcity is defined as <1,000 m^3/person.[3] A recent study, however, evaluated US water supplies by region to quantitate the level of stress on that supply relative to the regional demands. In consideration of projected use, population changes, climatic events and other factors, watersheds were defined stressed if demand for water is higher than the natural supply. Globally, there is no shortage of water but there is a growing number of regions with scarce water sources. According to the CDC, 1.1 billion people (one-fifth of the population) lack access to clean water and 2.6 billion people worldwide lack access to adequate sanitation. By 2025, two-thirds of the world's population may be under water-stress conditions.[4] By 2030, urban sprawl could result in demand exceeding water supply by 40 percent.

US woes

Thirty percent of the water used in the US is applied outdoors. Only a small fraction (0.4 percent) is actually used for drinking. Flushing toilets alone accounts for 100 liters (27 gallons) of water use per person per day. While water sustainability has been a buzz word for decades in the US, there is still the cultural perception that there is plenty of clean, fresh water available. Interestingly, despite a growing US population, total water use has changed very little, with overall consumption increases below six percent since 1985. More efficient water use has a net effect of balancing population increases. However, specific regions in the US report declining water resources, particularly in the southwest. A bird's-eye view of national available water averages disguises the deficiencies in some of our most vulnerable cities. Economic factors, technological innovations and social behaviors promise to drive future water demands. Infrastructure support in the form of reservoirs, inter-basin transfers or use of recycled or reclaimed water sources can change the overall landscape of stressed regions as well. Given current and projected use patterns, researchers from the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado and others evaluated 2,103 watersheds and found that 193 (9.2 percent) have greater demands than the natural freshwater supplies can support.[5]

Regional effects

While the majority of the predicted water stress is in the western US, less obvious regions such as the Great Lakes, along the Mississippi River and some regions along the Appalachian Mountains are also experiencing negative useable water replacement values. Whereas many regions in the west rely on reservoirs with large storage capacity for snow melt, climate variations and long drought spans add to water-stress indicator levels. Climate variations and shifts in water availability are not uniformly distributed, leaving some regions with more than enough water and others severely lacking. As the CIRES report details, national averages do not provide the full picture of water shortages in highly regionalized areas. The report further details

sector-specific trends and use patterns relative to agriculture, municipalities and power plants, using geospatial mapping tools. Overall, withdrawal trends are driven by irrigated agriculture, particularly in the western US. Water demand in the eastern US is driven by population and industrial centers, as well as the more common thermoelectric power plants that use fresh water for cooling. Popular media summarized the CIRES report, and others, by listing 11 US cities that dramatically exceed their natural water source's rate of replenishment. Salt Lake City, UT is one city determined to be at high risk for water shortage where even minor increases in climatic temperatures can affect the flow of important creeks and streams. Lincoln, NE is also at risk given extreme drought conditions that affects 96 percent of the state. Other cities on the list: Cleveland, OH; Atlanta, GA (drought patterns); Miami, FL (low-storage capacity); San Francisco, CA (population growth, climate change, salt-water intrusion); Houston, TX; Washington, DC and El Paso, TX. The number-one most at-risk city for exceeding supply is San Antonio, TX with a population of over 1.3 million. Most of California is also at high risk for water stress. Los Angeles and much of the western cities rely on supply from the Colorado River to meet demand, which is likely unsustainable.

Water quality impacts

Water from the Colorado River is delivered to central and southern Arizona via an open canal that spans over 330 miles from Lake Havasu City to Tucson. When the Colorado River water first entered the pipes in Tucson, residents were horrified to turn on their faucets and find a stream of red, rusty water flowing freely from the tap. The different pH and mineral content of the water caused a sloughing of rust from the city mains and household plumbing. The event was a public-relations disaster for promoting Colorado River water use. Regional water shortages can have an impact on water quality. Water shortages also prompt increasing efforts for water reuse along with new challenges for effective treatment. As supplies are stored or transported across the miles, the opportunity for contamination is also a reality, requiring new assessments for water quality assurance.

References

1. Kenny, J.F.; Barber, N.L.; Hutson, S.S.; Linsey, K.S. and Lovelace. J.K. *Estimated Use of Water in the United States*, US Geological Survey, Reston, 2009.

2. Brown, A. and Matlock, M.D. *A review of water scarcity indices and methodologies*. The Sustainability Consortium, The University of Arkansas, 2011.

3. Falkenmark, M. "The massive water scarcity threatening Africa-why isn't it being addressed," *Ambio*, vol. 18, no. 2, pp. 112-118, 1989.

4. CDC, *Coping with water scarcity*. Centers for Disease Control and Prevention, 19 March 2007. [Online]. Available: www.cdc.gov/ncidod/water_scarcity.htm. [Accessed 14 December 2013].

5. Averyt, K.; Meldrum, J.; Caldwell, P. *et al.* "Sectoral contributions to surface water stress in the coterminous United States," *Environmental Research Letters*, vol. 8, p. 9, 2013.

6. Ferner, M. "These 11 cities may completely run out of water sooner than you think," *The Huffington Post*, 4 December 2013.

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