Texas Water Management: A Fourfold Proposed Solution

How can four vast problems – droughts, floods, depleting aquifers and aging dams all hold each other's solution? The answer is a patent-pending market-driven response de-siloing institutional disciplines, updating water law to benefit all stakeholders and leveraging technology to manage the resulting system.

Four of Texas' water-related challenges could hold the answer to each other's solution. Firstly, droughts challenge the state's growth, posing a serious threat to the state's water supplies. Secondly, floods of staggering proportion cost billions of dollars, and too often result in loss of life. Thirdly, the state's largest aquifer is depleting and a significant portion of the rest of the state's groundwater is brackish. Finally, Texas has a massive inventory of aging dams, most of which lack provision for maintenance.

Adaptation of aging dams for use in a statewide grid could result in not only systemic flood reduction for the state but would serve to produce a water supply revenue stream for their perpetual maintenance. A key to this system is the increase in the volume and frequency of capture of floodwaters for water supply and aquifer replenishment, which in turn would provide drought resiliency. Access to the stored surface waters and groundwater could generate revenue which would be used to pay back the initial investment to repair/upgrade the existing dams, establish the grid and maintain the dams and other related infrastructure.

Figure 1 – Wichita Falls, Texas/USA – May 28, 2014: Lake Arrowhead, Wichita Falls' drinking water supply seen at extremely low levels due to drought. John Huntington/Shutterstock.com

DROUGHTS. Water has long been a challenging resource for Texas not in the absolute, but rather in the extremes. As the saying goes, "Texas' weather consists of extended droughts interrupted by severe floods." Certainly, the state's history is replete with droughts. The drought of record (1949-1957), not long after the memory of the dust bowl led to the establishment of the Texas Water Development Board. During the worst single year drought – 2011, the State consumed 59% of existing lake capacity. TWDB Chairman Bech Bruun, in his issuing letter for the 2017 State Water Plan said that Texas is never more than about 12 months away from a water crisis.

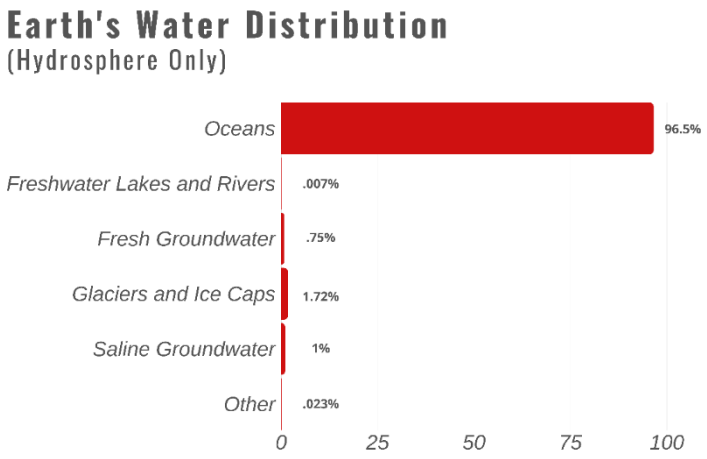

*Figure 2 – Source: gor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources (Oxford University Press, New York). *Source found on U.S. Geological Survey Website, "Where is Earth's Water?", Accessed 17 April 2020.*

FLOODS. To understand Texas' flood challenges, it is not necessary to look beyond recent news. 2015 and 2016 brought a string of extreme rainfall events followed by Hurricane Harvey's record shattering 50-inch point rainfall in 2017. Infamously, the September 8-10th, 1921 flood killed 215 and has been said to be the result of the greatest rainstorm in Texas history, stretching from San Antonio to Temple. This historic flood had a peak total

of 39.7 inches in 36 hours in the town of Thrall, Texas. Further examples include 36 inches in the town of Falfurrias during Hurricane Beulah and tropical storm Allison's 40-inch rainfall, which resulted in 22 deaths and $5.2 billion in damages.

The National Oceanic and Atmospheric Administration reports a statewide average of 9.05 inches (130 million acre-feet) fell in May 2015. Leading into that period, the total available supply of Texas lakes was approximately 20 million acre-feet, whereas the total conservation capacity is 31.5 million acre-feet. The storms were not evenly distributed (time and area) but fell largely on already saturated soils. The vastly greater portion (some estimates higher than 120 million acre-feet – equal to more than 6 years of annual demand) of the rainfall, unfortunately flowed uncaptured, into the Gulf of Mexico.

Figure 3 – Neff Lake Dam, Texas, Aug 25, 2010

AQUIFERS. Although Texas is underlain by vast aquifer systems, its largest aquifer, the Ogallala, is no longer the resource it once was. Lying only partially in the state, this aquifer supplied the Texas Panhandle for some time making Texas a member of the "breadbasket of America". Pumping water into farmlands was cheap and seemed endless. However, supplying the water needs for the aquifer's 8-state region for over half a century with comparatively negligible replenishment largely due to minimal outcropping and below average rainfall has taken its toll.

Contrary to common misconceptions of underground lakes, rivers, or caverns, aquifers are more typically isolated pockets of thin but saturated underground, permeable layers (similar to beach sand). Water reaches these aquifers typically very slowly, often over millennium, only through surface outcroppings of the permeable layers.

If aquifers could be recharged with water of the quality native to the aquifer and at least at the rate of withdrawal, then groundwater can be a sustainable source. This is important because groundwater holds four key advantages over surface storage: 1) groundwater is not susceptible to evaporation, 2) acquisition of property is not typically necessary to achieve vast aquifer storage, 3) environmental impacts are minimal, and 4) globally, groundwater accounts for 30.1% of all freshwater, while lakes hold only 0.25%.

DAMS. Texas has only one natural lake, half of which is in Louisiana. Dam-building, therefore, has been the crucial answer to this vital need. Dams capture runoff thereby reducing flooding downstream while storing water for later use. Consequently, to even populate the state, Texas had to build dams.

The National Inventory of Dams currently lists 7,324 regulated dams for Texas. The total number, including unregulated dams is significantly greater. Most of the dams were built in the last 50 to 100 years with an expected useful life of 100 years or less. The Texas State Soil and Water Conservation Board's website observes: "due to the passage of time and difficulty in raising adequate funds locally, many sponsors approached the Texas Legislature with their concerns over the amount of needed O&M and repairs." Addressing the need, in 2019 the 86th Legislature

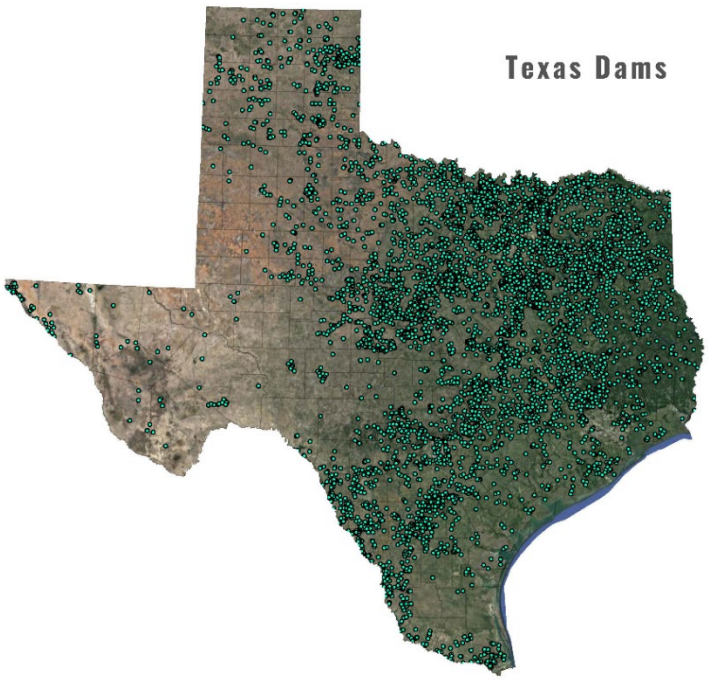

*Figure 4 – Sources: "National Inventory of Dams." National Inventory of Dams, U.S. Army Corps of Engineers, nid.sec.usace.army.milords/f?p=105:1:::::: Accessed 20 APR 2020 *Source downloaded from "Downloads (Public) > TX"*

passed a bill appropriating $150 million for the repair and rehabilitation of flood control structures. While this is welcome given the long-standing trend of postponement, much more is needed.

US Army Corps of Engineers National Inventory of Dams in Texas. Despite the large number of dams, very few are engaged as water supply or flood control dams or even tasked as such. If existing dams were rehabilitated and during the process, improved to more effectively capture floodwaters, these floodwaters could be injected as groundwater storage or transferred via the grid to needed areas throughout the state.

While the grid would be the responsibility of a state-charter, participation by individual owners of privately-owned dams would be on a voluntary basis. Private dam owners would retain rights and access to the original allotment of water while gaining resiliency and increased availability. Private owners would receive long needed repairs, upgrades, and perpetual maintenance while these dams take a vital role in achieving resiliency and increased supply for the state. Texas could also enjoy greater and more granular flood control while the replenishment of the state's aquifers and the geographical availability of groundwater would expand. Perhaps one of the most compelling issues for the plan is an alternative to the difficult, costly, environmentally challenging permitting and construction of large new dams.

LEGAL. Water rights, of course, are a challenge. With rule of capture for groundwater and prior appropriation for surface waters, numerous river authorities, Groundwater Management Areas and many Groundwater Conservation Districts variously organized, the effect can be disincentivizing for conservation and alternative resource development.

The exhibit below hints at the complexity and should demonstrate that one size will not fit all. A granular process, that considers all stakeholders, senior rights, local and regional needs, and resources, will be needed. But the prize would be well worth the effort.

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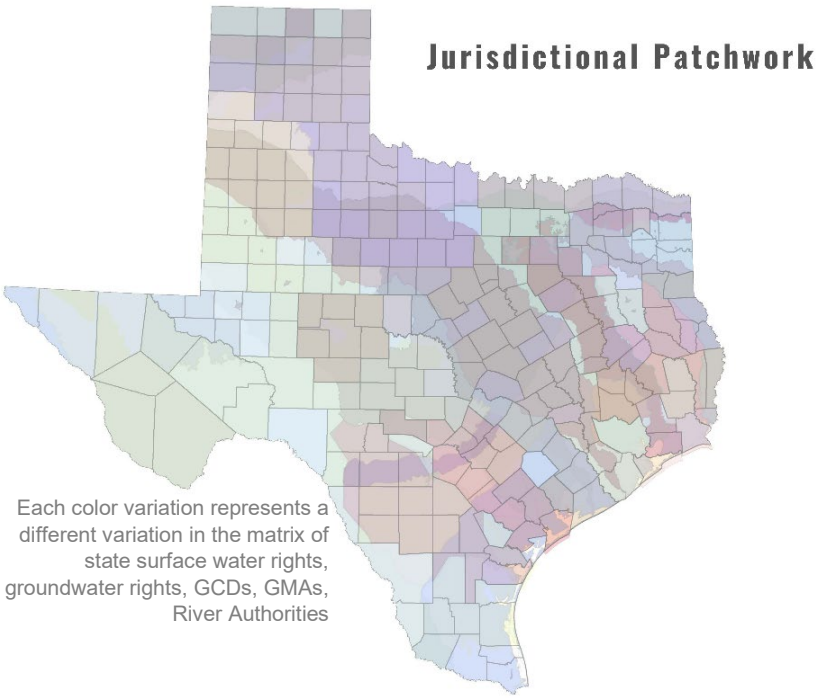

Figure 5 – Sources: "Groundwater Data Viewer." Water Data Interactive, Texas Water Development Board, www3.twdb.texas.gov/apps/WaterDataInteractive/Groundwater DataViewer. Accessed 20 APR 2020.