The reality of drought

By Milan J. Michalec

The ongoing drought has kept water not only in the local headlines, but regionally throughout the Hill Country from San Antonio to Austin.

As the drought persists, water availability, which by definition of State water planners is "the maximum amount of water available during the drought of record, regardless of whether the supply is physically or legally available," is being reduced.

In turn, this is affecting the existing water supply – defined as the "maximum amount of water available from existing sources for use during drought of record conditions that is physically and legally available for use."

Though it may be possible to develop alternate water supplies, they are many years and many dollars away.

As the primary source of water in this area is the Trinity Aquifer, this means today the existing water supply is finite and drought is reducing it daily.

To meet a reality like this, drought contingency plans are implemented when necessary to protect the health and safety of the public.

Until this drought ends, drought contingency plans are going to remain a necessary way of life for those who live in both the cities and rural areas of the Hill Country.

Two years of drought in the Hill Country

Rising from the western edge of the South Central Region of Texas and continuing into the Edwards Plateau Region, is the Hill Country. From San Antonio to Austin a drought which began in 2007 is beginning to take a heavy toll on water resources.

The affects of record low precipitation, coupled with record high temperatures, for an extended length of time, are vividly seen as area creeks and tributaries that feed the major rivers have mostly dried up.

A portion of the Guadalupe River is a dry riverbed just above Canyon Reservoir. This reservoir and many others in the region are reporting all time low levels.

As it is the groundwater from the Trinity Aquifer system that discharges to feed those creeks and rivers, that can only mean the level of these aquifers is steadily dropping as well.

Near Wimberley, one can look into the Trinity Aquifer through Jacob's Well. Sixty feet down, the artesian springs ceased to flow in October 2008. Electronic monitoring today indicates the flow is again near zero.

Physical evidence throughout the region is clearly showing us the water available from both surface and groundwater sources is being reduced in this time of drought.

Until the rains return, in order to meet the minimum standard needs for health and safety, most existing water supply systems will depend on the effectiveness of water restrictions.

Water conservation versus water restrictions

Restricted water use is the result of implementing of a Drought Contingency Plan.

The Texas Commission on Environmental Quality (TCEQ) requires water utilities to prepare, adopt, and when necessary, implement drought contingency plans. They are intended to reduce the use of water for short periods of time should a water supply become inadequate.

The Texas Water Code requires Groundwater Conservation Districts to address drought planning as part of the District Management Plan. To facilitate implementation of management objectives related to drought, a drought contingency plan would be included in the Rules of the District.

Because local conditions can be unique, these plans can prescribe varying levels of restricted water use. Managed in response stages, the points that trigger each stage can be variable as well.

The most common goal in a typical plan is to reduce outdoor watering. This is because outdoor water use can account for as much 60 percent of the daily water use in the average household.

The 40,000 foot view

Looking beyond the single individual or family whose water supply comes from the groundwater of a single private well or a much larger source supplying water for thousands within the boundaries of a single community, water planners recognize water resources are shared regionally with the potential to affect the entire population of Texas.

Three basic terms form the basis of water planning. These terms explain why we are seeing widespread implementation of drought contingency plans throughout the Hill Country.

The key terms that need to be understood are available water, existing water supplies and drought. Note there is a critical distinction between available water and existing water supplies.

As the agency responsible for the State Water Plan, the Texas Water Development Board (TWDB) defines available water as "the maximum amount of water available during the drought of record, regardless of whether the supply is physically or legally available."

The existing water supply is defined by the TWDB as the "maximum amount of water available from existing sources for use during drought of record conditions that is physically and legally available for use."

Texas water planning requires both must be managed under a worst case scenario – the drought of record. By TWDB definition this is "the period of time during recorded history when natural hydrological conditions provided the least amount of water supply. For Texas as a whole, the drought of record is generally considered to be from about 1950 to 1957."

Though this mid-fifties drought is considered the standard for all State water planning, far worse droughts have been documented. A 2006 University of Arkansas tree ring study commissioned by the Guadalupe - Blanco River Authority (GBRA) indicates a drought in 1707 - 1717 in South Central Texas exceeded the drought of record. In the Edwards Plateau, and the Hill Country, the worst drought was documented in the years of 1571 – 1580.

The typical Texas water cycle - drought and flood

Available water, existing water supplies and drought are most influenced by run-off producing precipitation. In the Hill Country, rain is characteristically produced in high quantities for short periods of time or more commonly described, long periods of drought interrupted by short periods of floods.

This is because rainfall in Texas is nearly exclusively the result of convection - thunderstorms.

These rain events are primarily the result of the prevailing southeast wind which brings moist air from the Gulf of Mexico.

Without this source of precipitation, much of Texas would be left primarily to the westerly winds which drop Pacific Ocean moisture in the Rocky Mountains. Between the desert climate of the west and the moisture rich east, much of Texas is semi-arid. This means the Hill Country literally lies on the edge of a desert.

However, when the rains do come, most of this precipitation is lost at or near the ground to a condition known as evapotranspiration, where plants and earth intercept and release moisture.

When precipitation exceeds what the earth and plants absorb, excess water is available as runoff. This can be as much as 25 percent in east Texas at the Sabine River, but less than 10 percent over the Hill Country near San Antonio. Traveling west, this figure diminishes rapidly.

A team of Texas A&M University scientists, sponsored by the Texas Wildlife Association Foundation, recently conducted a technical review of water conservation practices that could be applied to land management practices to increase groundwater availability.

One particular practice, if done correctly in the appropriate locations and maintained over time, can produce a significant return on investment.

In the Edwards Plateau, it was confirmed that for every five to eight acres cleared of brush or high density trees like the Ashe juniper, commonly known as cedar, an acre foot of water can be retained.

An acre foot of water is 325,851 gallons and represents enough to meet the needs of two families of four for a year.

Why don't we store water behind dams?

Run-off provides the opportunity for capture and storage of excess water, yet large scale storage in the Hill Country is principally limited to existing reservoirs or aquifers.

The bulk of Texas reservoir construction was from 1940 to 1970. With very few exceptions, high construction costs, limited appropriate sites, and environmental issues have prevented further construction of these reservoirs.

To compound the lack of surface water storage, the accumulation of silt has reduced the storage capacity of existing reservoirs. Additionally, losses due to evaporation must be considered. What remains is a calculated "firm yield" to be allocated under drought of record conditions.

By TWDB evaluation, the existing water supplies in Texas are declining and by 2060, they are projected to have decreased approximately 18 percent. This is due to sediment accumulation in reservoirs and depletion of aquifers.

The first large scale project of the twentieth century was the Medina Lake System. It was completed in 1913 and used private funds to provide supply water for irrigation in Bexar, Medina and Atascosa counties using the Medina Canal System.

Because of surface water losses and the conditions of the TCEQ permit, the firm yield is essentially zero and is not included as a surface water source for the South Central Texas Region.

Most familiar to those who know of the Hill Country is the Guadalupe - Blanco River watershed and the associated Trinity Aquifer. Both form the basis of the principal regional water supply.

The most significant surface water supply is situated on the Guadalupe River above New Braunfels. According to the Guadalupe-Blanco River Authority (GBRA), Canyon Reservoir has two purposes - flood control and water supply.

Built by the U.S. Corps of Engineers, in partnership with GBRA, Canyon Reservoir began to fill in 1964. By 1968, it reached its conservation pool of 909 above mean sea level (msl). An overflow safety spillway is reached at 943 msl.

The Corps of Engineers has responsibility for water releases above 909 msl. Below this level GBRA has acquired the rights to distribute water down to 800 msl for distribution within the San Antonio and Guadalupe-Blanco River Basins. This includes the permit obligations for municipal, agricultural, industry, environmental and recreation uses all the way to the Gulf of Mexico.

By TCEQ permit, which is based on the calculated firm yield, GBRA is allowed to divert a five year average of 90,000 acre feet per year.

At full production capacity, approximately 16,000 acre feet of this existing water supply will be distributed to contracted GBRA customers through the water treatment facility and the 40 plus miles of pipes and pumps of the Western Canyon Treated Water Supply Project.

Customers receiving water from this project include the cities of Boerne, Fair Oaks Ranch and San Antonio, Cordillera Ranch near Bergheim and the Johnson Ranch development of Bulverde.

Groundwater storage issues

The primary groundwater source in the Hill Country is the Trinity Aquifer. This aquifer is noted for highly variable yields. Recharge rates are estimated at less than 5 percent, the most optimistic say this could be as high as 7 percent. This is very much in contrast to the neighboring highly prolific Edwards Aquifer where recharge can be immediate and nearly totally absorbed.

Physical evidence indicates the existing groundwater supplies in much of the Hill Country have reached their maximum capacity. Entering the second year of this current drought, numerous public water systems have reported watch conditions where a water shortage is possible.

By August of 2009, the TCEQ had identified six public water systems limiting water use to avoid shortages in Kendall County and fourteen in Comal County. Nineteen more were in Bexar County. The growing list also included eleven in Bandera County and four in Hays County. The source of these wells is the Trinity Aquifer.

By the first week of August, Bexar Metropolitan Water District was hand delivering notices announcing impending mandatory restrictions for customers in north Bexar County. Addressing the groundwater supplying these neighborhoods, a spokesman noted in the San Antonio Express News: "The Trinity Aquifer is feeding these systems and it does not recharge as well and it does not rebound as easily as the Edwards,"

Though the lack of rain is a factor, the main cause of reduced groundwater is the increased demand from more population. Drought conditions are proving the existing demand has already outpaced the existing groundwater supply, yet the population continues to expand rapidly.

The two fastest growing counties in the San Antonio Metropolitan Statistical Area (MSA) are Kendall and Comal. According to the U.S. Census Bureau, Kendall County increased in

population from 22,200 in 1998 to 32,866 by 2008 – a 48 percent increase. During the same timeframe, Comal County jumped from 72,954 to 109,635- up 50.3 percent.

Underscoring the regional impact on groundwater, consider the Austin MSA where the Hays County population has increased from 89,991 to 149,476, a 66.1 increase percent in ten years.

With the passage of House Bill 1763, Groundwater Conservation Districts are expected to adopt a new strategy, regional groundwater management based on a Desired Future Condition.

Using this modeling approach, an aquifer can be deliberately drawn down to a specific level by consensual agreement of the Districts within a Groundwater Management Area (GMA). A GMA could also vote to limit drawdown for other factors such as preservation of springflow.

The results of such a drawdown over a specific period of time can be simulated, but groundwater models have limits. In the Hill Country Groundwater Availability Models, modeling the drought of record was problematic.

It was determined the best way to plan for and manage drought in this point in time is through the management plans and rules of the local Groundwater Conservation Districts.

Combing ground and surface water – the conjunctive water source

To meet expanding demand, many municipal public water systems have developed conjunctive water sources. This is the combined use of groundwater and surface water sources to optimize the beneficial characteristics of each.

In much of Kendall and Comal counties, this strategy involves a combination of groundwater from the Trinity Aquifer and surface water from Canyon Reservoir.

It is important to note the baseflow of the Guadalupe River is maintained by the discharge of springs from the groundwater of the Trinity Aquifer system. This relationship is clearly seen today as the combined discharge of springs and wells has reduced springflow to the point where a dry riverbed, where the Guadalupe River once flowed, is a steadily increasing occurrence.

A conjunctive approach is used to supply water to the City of Boerne using several city wells in the Trinity Aquifer, surface water from Boerne Lake and Canyon Reservoir from GBRA.

The City of Fair Oaks Ranch is another example where dozens of wells in the Trinity Aquifer and surface water from GBRA are combined. A similar approach is used for Cordillera Ranch near Bergheim and Johnson Ranch in Bulverde.

Though the primary source of water for San Antonio is the Edwards Aquifer, this city too takes water from both sources.

Water began flowing from Canyon Reservoir through the Western Canyon Treated Water Supply Project for distribution at a storage facility to San Antonio Water System (SAWS) customers in north Bexar County in 2007.

To augment this supply, groundwater from the Trinity Aquifer has been pumped from wells adjacent to the same facility in increasing quantities since 2002.

Originally planned to yield over 5,000 acre feet a year, the average annual production was approximately 1,000 acre feet from 2004-2007. Current production has been reduced further to reduce the drawdown of adjacent private wells.

The 2009 SAWS Water Management Plan update notes: "Given the hydrogeologic character and existing demands on the Trinity Aquifer, the Task Force determined that the existing Trinity supplies will be unavailable during a repeat of the drought of record conditions."

The use of water from conjunctive sources underscores the nature of how existing water supplies have evolved in Texas throughout the 20th century- a period of water development followed by a time of water distribution.

Accordingly, State Water Plans today rely heavily on water conservation to ensure an adequate existing water supply.

Groundwater supply, a final comment

To offset the inadequate capacity of an existing water supply, water purveyors would prefer to pump more groundwater locally as the lowest cost option. The alternative is to bring water from somewhere else.

In the case of growing cities like San Antonio, groundwater is being taken from rural areas for urban use in steadily increasing quantities. This export of groundwater can be viewed as taking from one to benefit another and may lead to the creation of future groundwater availability shortages when the time comes for these areas to develop.

Understandably, this can be viewed as a property rights issue. What complicates this property right - access to groundwater under the property, is the application of the Rule of Capture. This is the State doctrine where the biggest pump prevails.

In areas of the Texas with Groundwater Conservation Districts, locally elected officials using a State approved permit process based on site specific data and rule making authority, can ensure the property rights of those who would wish to sell the groundwater beneath their land.

The same process can also make sure enough groundwater would remain to support the present and future needs of those who do not wish to sell.

Pumping groundwater beyond the limits of an aquifer to recover through recharge is known as "mining an aquifer." In the Hill Country, mining the Trinity Aquifer would introduce the very real prospect of permanently losing the springs and streams critical to the environment that attracted the first inhabitants, and continues to draw many more today.

As groundwater availability would also decline, just as real would be the corresponding negative economic impact. When water supplies are uncertain, the value of land decreases. Devalued land means less tax revenue. Both business and homeowners would react accordingly and future economic development would be impaired.

Ironically, those who are the farthest removed from the typical water - short city, unarguably the best stewards of the land, would likely be the first to lose the resource they do so well to protect.

The bottom line

Though it may be possible to develop additional water supplies, they are many years and many dollars away. This means today the existing water supply is finite. To meet a reality like this, drought contingency plans are used to protect the health and safety of the public.

To avoid restrictions on water use, the implementation of water conservation measures can be effective in reducing the demand on an existing water supply. This too takes time.

However, any individual can adopt conservation measures today that are proven to reduce water consumption. These include establishing and maintaining landscapes appropriate for the local conditions or developing and using rainwater harvesting systems.

To reduce future water needs, municipal water systems can actually provide a near drought proof water source by processing and reusing the never ending flow of their own wastewater.

As the water cycle begins with the first drop of rain that hits the ground, all water users should consider the best return on investment – land stewardship.

The key to this practice is to maintain our open spaces and make the small investment in tree and brush control. When used in the appropriate locations and maintained over time, this is proven to pay big dividends as improved recharge.

These and many other conservation practices can be adopted to reduce water demand and increase the existing water supply, but this will require a change to the way we use water - a change in culture.

Until then, drought contingency plans are going to remain a necessary way of life for those who live in both the cities and rural areas of the Hill Country.

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Authors note.

The words of the Spanish philosopher George Santayana ring true today as the current drought worsens, “Those who cannot remember the past are condemned to repeat it”

Therefore, the author wishes to acknowledge a study of history as the fundamental basis of this paper. As a layman in the sciences of geology, hydrology and climatology considerable insight was gained be reading a variety of publications.

Three of the most compelling were, Texas Water at the Century's Turn- Perspectives, Reflections and a Comfort Bag, George H. Ward, Jr., Center for Research in Water Resources, The University of Texas at Austin, Water Conference, 23 – 25 September 2000. The Climate and Physiography of Texas, Texas Water Development Board, Report 53, 1967. A Study of Droughts in Texas, Bulletin 5914, Texas Board of Water Engineers, 1959.

Adding to these historical perspectives was the wealth of modern and historic information readily available to the public made possible by the leadership of the Texas Water Development Board, Guadalupe-Blanco River Authority, San Antonio Water System, at their respective websites.

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