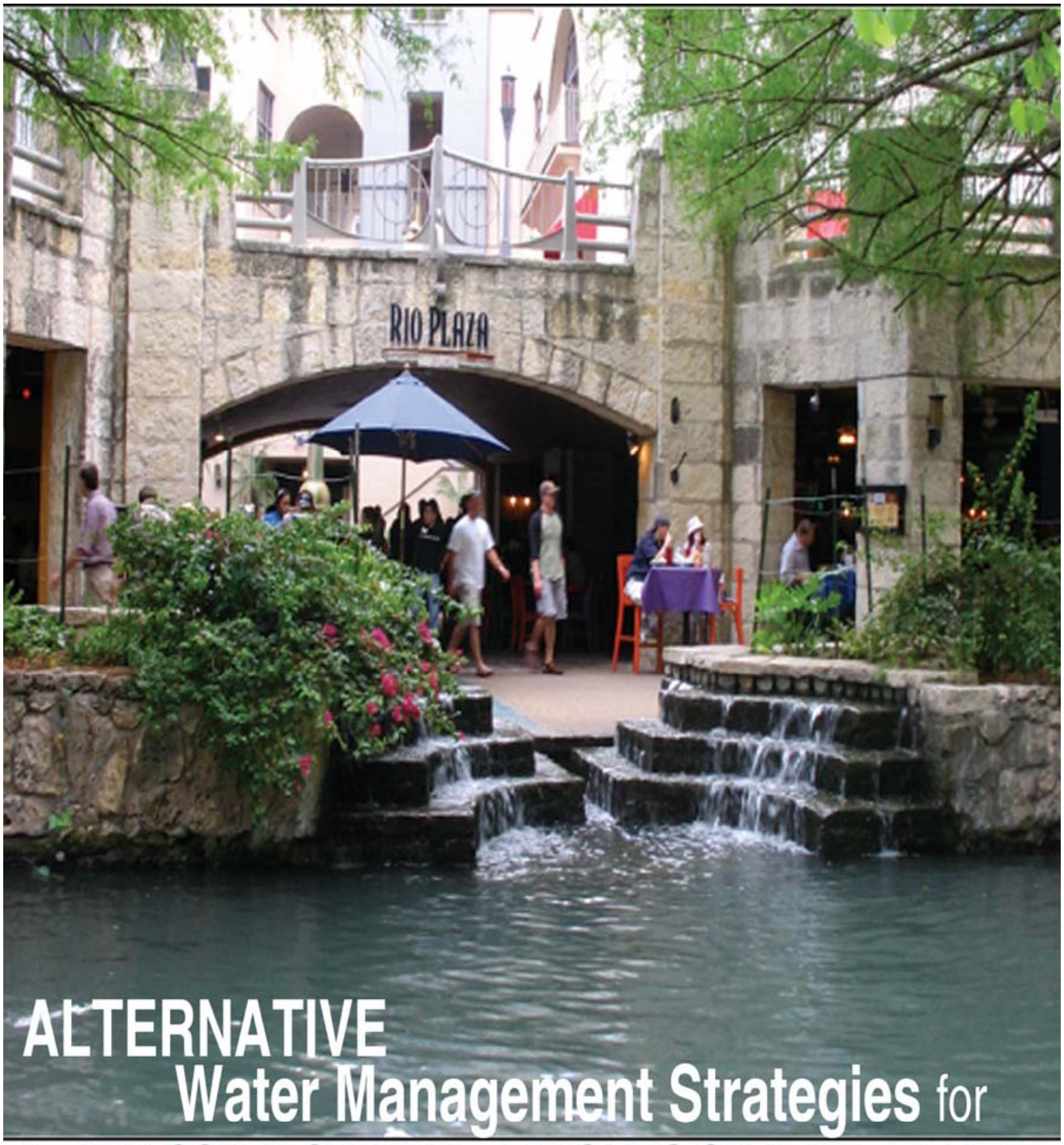

ALTERNATIVE Water Management Strategies for the 2006 SOUTH CENTRAL TEXAS REGIONAL WATER PLAN

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Lone Star Chapter

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ALTERNATIVE
Water Management Strategies for the
2006 SOUTH CENTRAL TEXAS REGIONAL WATER PLAN

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Acknowledgements

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This study is conducted as an activity of the Texas Living Waters Project. This project is a collaborative effort of the National Wildlife Federation, Environmental Defense, and the Lone Star Chapter of the Sierra Club. The goals of the project are to 1) ensure adequate water for people and environmental needs, 2) reduce future demand for water and foster efficient and sustainable use of current water supplies, 3) educate the public and decision makers about the impact of wasteful water use and the opportunities for water conservation, and 4) involve citizens in the decision making process for water management.

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Cover photo: San Antonio River Walk by Lara Stuart; cover design by Jerome Collins

Introduction

The Edwards Aquifer is a sole-source aquifer for more than 1.3 million people in South Central Texas. If this resource is managed carefully, it can continue to provide drinking water to the area on a sustainable basis. The level of water in the aquifer is recharged annually by rainfall. Sustainable management of the aquifer requires withdrawing water in an amount equal to or less than the recharge amount. Variability in annual rainfall amounts can create years with drought or years with high-water flow and dramatic flood events. By reducing water use in the region and using nearby aquifers with available storage capacity, the Edwards Aquifer can be managed in a sustainable manner, and the need for expensive projects to develop new water sources can be reduced or possibly eliminated.

Region L, South Central Texas, is a regional water planning area that encompasses all or part of 21 counties and several cities, including San Antonio, Victoria, New Braunfels, San Marcos, and Seguin. The Region L Water Planning Group is among 16 regional water planning groups initially appointed by the Texas Water Development Board (TWDB), under the authority of Senate Bill 1 (SB1). The Group includes representatives from 12 interests including the public, counties, municipalities, industries, agriculture, the environment, small businesses, electric-generating utilities, river authorities, water districts, and water utilities from across the region. The South Central Texas Region L Water Plan follows state guidelines and is incorporated as part of the State Water Plan. Those guidelines require the planning group to identify water needs in the region and the available means of meeting those needs from now until 2060. The Region L Planning Group is evaluating a number of water supply strategies that will have significant environmental and economic costs that are unnecessary and burdensome to the residents of South Central Texas.

Acre-foot – An acre-foot is a volume unit used to measure large quantities of water. One acre-foot (AF) is the equivalent of 325,851 gallons. If the average citizen in a city uses 140 gallons of water a day (gpcd), then 1 AF would supply 6.4 people for a year.

The Lone Star Chapter of the Sierra Club believes that much of the identified water needs in Region L can be met through aggressive conservation and the use of aquifer storage and recovery. Several water resource alternatives are examined below that will potentially satisfy a large portion of water demands in both wet and dry years.

A common method of reducing annual water use is to minimize its use through water-efficient technology. There are specific technologies available for use in the State Water Plan for municipal, industrial, and agricultural users. South Central Texas has already conserved much water and can continue to expand its successful efforts. San Antonio has reduced its per capita water use more than 30% since the 1980s, from more than 200 gallons per capita per day (gpcd) to less than 140 gpcd. The potential for further savings in Region L is analyzed in the section of this report on municipal conservation. More than 72,000 acre-feet per year

(AFY) are estimated as potential savings in the Region L Municipal Conservation Water Management Strategy Alternative.

Annual water use in Region L can be further reduced through conserving water used in farm irrigation, primarily by substituting flood or furrow irrigation with a center-pivot system. In 2000, the San Antonio Water System (SAWS) funded a study that estimated the amount of water that could be conserved in Bexar, Medina, and Uvalde counties through installation of center pivots. The report calculated that the total amount of water that could be saved in the study area using this plan is 37,291 AFY (Westland, 2000).

Another way to reduce irrigation water use is to increase the efficiency by which the water is transported to the fields. This can be accomplished by lining irrigation canals and field ditches with an impervious material, or by replacing the canals and ditches with pipes. One area where this water-saving method would be particularly effective is in the Bexar-Medina-Atascosa Counties Water Control and Improvement District 1 (BMA District 1) where implementing these techniques could save more than 33,718 AFY.

An important practice initiated by SB1 was the requirement that all water purveyors (municipalities, water supply corporations) in the State of Texas must develop a drought management plan. State regulation also requires all surface water rights holders, those who receive state funding for water resource projects, and those wholesale customers who have contracts with water rights holders, to implement a water conservation plan for their service area. **The required drought management and conservation plans will inevitably cause a reduction in water demand, thus eliminating the potential need for expensive new water projects. By examining the water savings achieved through the imposition of drought restrictions, the Regional Water Plan could more accurately reflect real water demands and needs during dry years.** Using information gathered from analysis of successful drought measures and water use curves of South Central Texas cities in 2000, the Sierra Club estimates summertime water demands to be reduced 47,000 AFY in 2060.

Need is defined in the water planning process as a deficit between available supply and anticipated demand. Region L projects water needs of 220,000 AF by 2060 for Bexar County.

Aquifer storage and recharge (ASR) is an efficient and less environmentally damaging means to manage our water supplies and avoid overpumping from the Edwards Aquifer. ASR does not constitute a new water source; rather, it is a strategy for maximizing water storage. In ASR, water is injected through a well into an aquifer to be recovered when needed. This avoids water loss through evaporation in a surface water reservoir, and does not destroy riparian habitat. SAWS has already constructed a seasonal ASR facility; this could easily be expanded to a long-term ASR storage facility. **As the concept is used in this document, ASR *does not* refer to the possible injection of treated wastewater into**

aquifers for storage—only to storage of Edwards Aquifer water in other aquifers with available capacity for storage.

This integrated approach to water supply management focused on conservation and aquifer storage and recovery can supply much of Region L's projected water needs for the next five decades. The conservation strategies supply more than 190,000 AF, while ASR has the potential to efficiently store large volumes of excess water for use in times of drought.

Municipal Conservation

Municipal water conservation involves both minimizing water use with water-efficient technology and affecting water use behavior with incentives and/or penalties. Municipal conservation efforts can be separated into two categories: residential and industrial/commercial/institutional (ICI) conservation. Each group has both indoor and outdoor water savings potential.

Water User Group (WUG) – a classification that includes municipal utility districts, municipalities, water conservation districts, water supply corporations, and all other water purveyors. There are currently 130 municipal WUGs in Region L. Of those WUGs, 73 had per capita water use of 140 gpcd or greater in the year 2000.

The Region L Water Planning Group (Planning Group) currently projects municipal water demand declining in Region L through conservation with the following assumptions:

- Municipal water user groups (WUG) with per capita water use greater than 140 gpcd will reduce gpcd 1% a year until they reach 140 gpcd, and reduce gpcd by 0.25% thereafter.
- Municipal WUGs with per capita water use less than 140 gpcd will reduce 0.25% per year.

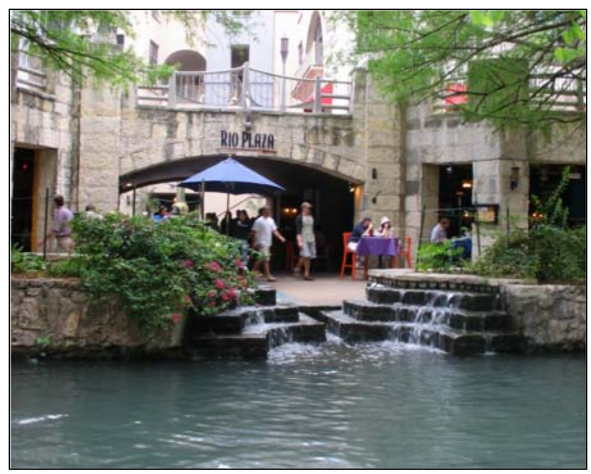
These assumptions were adopted by consensus as the highest practicable level of water conservation for this planning period. The Sierra Club supports the Planning Group's current water conservation goal. However, in light of SAWS efforts to reduce per capita use from a 2004 level of 132 gpcd to between 116 and 122 gpcd by 2017, it should be recognized that the goals could be more stringent for WUGS with per capita use of less than 140 gpcd (SAWS, 2005).

Municipal water conservation is one of the most often cited successes in SAWS's efforts to respond to cyclical drought and limits on pumping of the Edwards Aquifer. San Antonio has reduced its per capita water use more than 30% since the 1980s. In addition to the successes of existing conservation efforts, San Antonio can still reduce its per capita water use. The existing SAWS Conservation Program and projected practices can serve as a template for other WUGs in Region L (and throughout the state). Recommended conservation practices for full implementation by SAWS and other WUGs are summarized in the next section.

Description of SAWS Water Conservation Programs

SAWS has established several very successful residential and commercial conservation programs including "Plumbers to People," "Kick the Can," and "Wash Right." Some of the water savings estimated by SAWS staff for these conservation programs are listed below:

- Established by SAWS in 1994, the “Plumbers to People” program serves households with an income that is 125% or less of the federal poverty line. In 2002, plumbers made 790 visits under this program, fixing leaks and replacing older, inefficient fixtures, and an estimated 1,185 AF of water was saved over a two-year period.
- The highest portion of indoor domestic water use in the residential sector is water for flushing the toilet. Through the “Kick the Can” program, SAWS handed out 38,869 rebates for ultralow-flush (ULF) toilets purchased since 1994. SAWS is currently ending its toilet rebate program with the intent of focusing efforts on a toilet distribution program, and has distributed 16,704 free ULF toilets since 2002.
- Clothes washers constitute the second largest indoor water use in most single-family homes. SAWS has distributed customer rebates for 12,102 water-efficient washing machines through its “Wash Right” program, saving approximately 2,033 AF of water.
- SAWS offers a free outdoor water use analysis to its residential customers. In 2002, SAWS conservation staff performed 463 free irrigation audits, and these resulted in an estimated 192 AF of water conserved.
- The Commercial Washing Machine Retrofit program distributed 103 washing machine rebates in 2002.
- SAWS’s Commercial Toilet Rebate Program and its Commercial Toilet Distribution has resulted in the replacement of 39,755 high-flow (HF) toilets with ULF toilets since 2002.



The San Antonio River Walk (Photo: Lara Stuart)

The San Antonio Water System still has much potential for water conservation through these existing programs, as less than 50% of all toilets and less than 10% of potential clothes washers have been replaced. Many of the smaller communities in the region have even greater potential for water conservation. Below are some of the additional programs that SAWS is contemplating and that others could also implement to achieve the targeted reductions in demand.

Potential New Water Conservation Programs

Conservation can be one of the most cost-effective water resource options because its success depends upon using existing water supplies in a more efficient manner.

Accelerating Plumbing Retrofits

Due to the fact that conservation efforts cost less than building new water supply reservoirs, cities that will have water shortages should accelerate those retrofits by providing incentives such as rebates or vouchers, or by implementing ordinances requiring retrofits upon the resale of property. Plumbing retrofits include ULF toilets, low-flow showerheads, and water-efficient washing machines. Dual-flush toilets have recently begun to enter the market, and their increased use will result in greater savings.

SAWS Conservation Ordinance

The Conservation staff and Community Conservation Committee of SAWS developed a conservation ordinance for the City of San Antonio. San Antonio City Council passed this ordinance in January 2005. The provisions of this ordinance could be adopted by other cities in Region L to increase water savings. Ordinance provisions include:

- Cooling towers must run at least four cycles, if not using recycled water;
- Vacuum systems cannot be single-pass potable water-cooled when alternative systems are available;
- Newly installed ice machines cannot be single-pass water-cooled;
- Commercial and institutional dining facilities serve water only on request, and have positive shut-off on handheld dishwashing wands, and flow restrictors in garbage disposals (HB 2428, passed in the 79th Legislature, standardizes what is sold in Texas);
- AC systems in new construction must be built in such a way as to allow draining AC condensate to a common drain (effective January 2006);
- Rain sensors are required on all irrigation systems (effective January 2006);
- Commercial power washer users must be registered to obtain a certificate from the Director of Conservation (effective January 2006);
- Soil depth of four inches is required under turf grass (effective January 2006);
- Homebuilders and/or developers subdividing lots and/or constructing new single-family residential homes must offer a xeriscape landscape option to prospective home buyers (effective January 2006);
- Annual irrigation system analysis is required for athletic fields, golf courses, and large properties (effective May 2006); and
- Turfgrass incapable of summer dormancy is prohibited (effective January 2007).

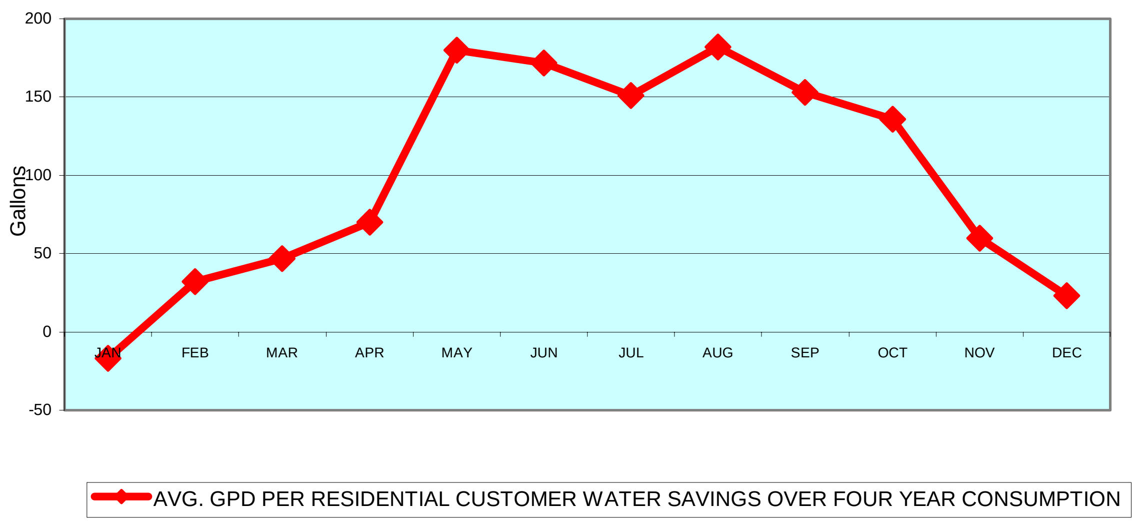
Outdoor Water Savings

SAWS estimates that landscape irrigation constitutes 25% of total water use, and as much as 50% in summer months. Two significant water-saving approaches are analyzed here for the potential to save water in South Central Texas: residential irrigation audits and replacement of residential turf with non-irrigated landscape materials.

For homes with automatic irrigation systems, water is lost through leaking systems and inefficient water distribution. Properly audited and maintained systems save water by correcting these leaks and distribution inefficiencies. To estimate the amount of water saved by residential irrigation audits, it was assumed that 10% of all residential accounts would participate, and each household would save an average of 18,250 gallons per year (gpy) per household (BMP Guide, 2004). The bulk of the water savings is in the summer, when demand is highest.

Even greater water savings could be achieved if the turf replacement programs developed in Region L imitate those administered by El Paso, Texas, and Las Vegas, Nevada. These programs provide financial rebates for replacing turfgrass with low-water-demand plants or non-living material, have stricter rules for receipt of rebates, and require that rebates be refunded to the utility if water use increases after the turf is removed. An evaluation of El Paso residential programs showed an average savings of 36,035 gpy per household with the bulk of those savings achieved between May and October.

Chart 1. El Paso Turf Replacement Program
AVG. GPD PER RESIDENTIAL CUSTOMER WATER SAVINGS



Source: El Paso Water Utility, 2004

Other landscape water conservation programs that could be implemented include:

- Requiring Evapotransporation Controllers on all irrigation systems;
- Prohibiting spray irrigation on median strips or buffer areas less than 8' in width
- Requiring that automatically irrigated turfgrass areas in new construction not abut the curb, but rather, must have a buffer of non-irrigated, or hand-irrigated landscaping material. This prevents overspray on roads and sidewalks.
- Developing landscape water budgets based on specific limits on the percentage of area that is irrigated. For example, a water budget is calculated for lots with 40% turf, 40% shrubs and trees, and 20% impervious cover. If more water is used than the budgeted amount, a surcharge is imposed.

Greywater

Greywater is usually defined as the wastewater drained from washing machines, showers, bathtubs, and bathroom sinks. The TWDB estimates 30 to 50 gpcd is produced in Texas, on average. Possible water savings depend on the amount of potable water being used for purposes that could be replaced with the available greywater. The installation of a domestic greywater system, where shower and lavatory wastewater is rerouted to toilets, ranges from $1,500 to $2,000.

Efficient Clothes Washers

According to a residential end-use study conducted by the American Water Works Association Research Foundation (AWWARF) in 2000, efficient clothes washers reduce indoor water use by an average of 4.5 gpcd. Current federal energy regulations require that all new clothes washers manufactured and sold in the United States after 2007 meet a new energy standard. Reports indicate that the market share of efficient clothes washers is 5% in the State of Texas, and this share is anticipated to increase dramatically after 2007. Since efficient clothes washers have only been on the market for approximately seven years, a simple linear projection of market share indicates that they should represent at least 50% of the market in the year 2060. With aggressive promotion, including incentives, the participation rate can be accelerated rapidly. It is reasonable to assume that within the next 50 years, water-efficient clothes washers will not only dominate the market, but, like ULF toilets, will become the only type of clothes washer available.

The Effect of Price

Price elasticity studies in the state of Texas have shown on average that a 10% increase in the price of water leads to a reduction in consumption of around 2% (Whitcomb, 1999). In an 11-year study of seven western urban areas, *Effectiveness of Residential Water Conservation Price and Nonprice Programs,* the highest demand water utilities could expect was a 20% decrease in water use with a doubling of water rates (Michelsen, et al, 1998).

The 2002 State Water Plan failed to account for the effects of new investment and increased costs for water on customer behavior. It is likely that as water rates increase due to the development of high-cost projects, there will be a corresponding reduction in demand that eliminates the need for the project. This is an important aspect of integrated resource planning. For example, the San Antonio's per capita water demand in the year 2000 was far lower than projected in the 2002 State Water Plan. Some combination of price and water conservation education is most likely the cause for this discrepancy. It is important that for purposes of the State Water Plan planning process that future demand is projected more accurately.

Irrigation Conservation

System Substitution

The Region L approach in 2002 and the current draft proposals for agricultural conservation underestimate the potential for conservation. Due to the unique characteristics of the Edwards Aquifer and the rules under SB 1477, water can be transferred economically from agricultural irrigation to municipal use through a market transfer, thus benefiting both users. Specifically, the rules of the Edwards Aquifer Authority allow transfers *in excess* of the 1 AF per acre rule if the surplus water is a result of conservation efforts. The Water Conservation Best Management Practices (BMP) Guide produced by the TWDB provides effective water conservation measures recommended for the principle water user groups in Texas. For agricultural irrigation, one of the BMPs describes installing a low-pressure center-pivot (LPCP) sprinkler irrigation system where less efficient irrigation systems have been used traditionally.

Under this approach, a municipal water user would pay for the irrigation equipment such as an LPCP system in exchange for the water saved. One advantage of this approach is that the water conservation occurs year after year, wet or dry conditions, due to reduced evaporation and percolation losses. An advantage to the rural communities is that agricultural economies are preserved. Both the state and federal government offer low-interest loans to assist in the financing of such equipment; including this approach in the Regional Plan would make this approach available for state funding.

SAWS hired Westland Resources to conduct and prepare a study, published in January 2000, on water conservation through irrigation substitution in Bexar, Medina, and Uvalde counties. The method of irrigation substitution evaluated for SAWS involves replacing furrow and flood irrigation with a center-pivot system. According to the study, there are many advantages to this form of conservation. These advantages include:

- A relatively inexpensive cost per AF of water;
- Minimal economic impact on participating farmers and employment in the agricultural area;
- A positive impact on the agri-business community; and
- Little or no impact on the local economy or local government income.

Despite these various advantages, SAWS has not aggressively incorporated irrigation substitution into its overall conservation plan.

Low Elevation Spray Application (LESA) Center Pivot Irrigation System (Photo: Dr. Clay Robinson)

Surface or furrow irrigation is a less

efficient irrigation system than an LPCP system sprinkler because of its lack of uniform water distribution, excessive runoff, and water loss resulting from deep percolation and evaporation.. The BMP Guide also advocates combining the installation of an LPCP system with field management practices that prevent runoff due to irrigation and moderate rainfall, such as tailwater capture, and furrow dikes. The total amount of furrow-irrigated land in the western portion of the Edwards Aquifer (Bexar, Medina, and Uvalde counties) available for conversion to center-pivot irrigation estimated by the SAWS report was 41,435 acres.

Low-pressure center-pivot irrigation systems have an average water use efficiency of 88%, as compared to furrow and flood irrigation systems, which are about 60% efficient. In addition, the shape of land watered by a center-pivot system is circular, whereas most fields are rectangular. The corners left un-irrigated by a center-pivot system make up approximately 21% of a square field. These corners could be planted with dryland crops such as wheat.

Fields irrigated by center-pivot systems (Photo: Carl Guell)

Conversion to center-pivot systems in Bexar, Medina, and Uvalde counties could save an average of 0.9 AF per acre, only 0.1 AF per acre less than the water rights that SAWS could use if it leased or purchased these lands. Water that was received by funding irrigation substitution projects would be significantly less expensive than the cost of purchased or leased water rights. Additionally, the impact of irrigation substitution on the local agriculture economy would be positive, due to the fact that the farmers would continue to purchase farm supplies and produce crops at a slightly lower cost because of a reduction in water use and soil erosion. Purchasing or leasing the water rights instead of irrigation substitution would require taking the land out of production, thus negatively impacting the local economy and the local government income.

Water Savings

Water savings were calculated in the Westland Resources report using the following assumptions:

- The farms included in the study use the full amount of their water right of 2 AF per acre;
- Farms smaller than 100 acres were not considered in the calculations;
- Furrow irrigation is 60% water efficient;
- Center-pivot irrigation is 88% water efficient;

- The corners of a square field are not covered by center-pivot irrigation, therefore water savings in these areas will be 100%;
- In a square field, the amount of water saved by irrigation substitution will be 0.9 AF per acre; and
- The total amount of furrow-irrigated land available for conversion to center-pivot irrigation in the study area is 41,435 acres.

The Westland Resources report calculated that the total amount of water that could be saved by center-pivot installations in Bexar, Medina, and Uvalde counties is 37,291 AFY. The amount of irrigation water conservation projected by the 2002 Region L Water Plan for Bexar, Medina, and Uvalde counties was only 12,963 AFY. This suggests that 24,428 AFY of potential conserved irrigation water were unaccounted for in the last report for these three counties. If this study were expanded to include the remainder of the counties in Region L, the amount of water conserved through irrigation substitution could be significantly higher. With careful consideration for the effects of relocating pumping stresses in the Aquifer, the water that is conserved by irrigation substitution could be purchased or leased to municipal users in San Antonio. This could reduce the need for new and more costly water sources. Alternatively, this water could be used to maintain streamflow and/or springflow in Region L.

Projected Costs

The cost of purchasing the water saved by irrigation substitution is estimated to be $366 per AF. This would make the total cost of the project $13,650,000. However, it is likely that many farmers will prefer to have the water user group purchase new irrigation equipment rather than directly leasing the water. Although the equipment will require replacement every 15 to 20 years, the average cost per AF of water saved though equipment purchases is significantly less than the cost of directly leasing the water, from $50 to $100 per AF, depending on the size of the farm. If all 37,291 AFY were acquired through farming equipment purchases, the cost would be less than $3,729,100. Considering that a combination of both methods will probably be necessary, the actual cost for the project will likely somewhere within the range of the two described project costs.

Time Needed to Implement

Installing a new center-pivot system on land previously serviced by furrow irrigation takes several weeks to several months to complete. The center-pivot irrigation equipment must be replaced every 15 to 20 years, but the replacement process is faster and less expensive than the original installation.-

BMA District 1 – Canal Improvements

The Bexar-Medina-Atascosa Counties Water Control and Improvement District 1 (BMA District) supplies 34,330 acres of farmland eligible for irrigation water. Created in 1911, the system serves irrigation water users in Medina, Bexar, and Atascosa counties, and consists of four reservoirs and more than 250 miles of irrigation canals. The BMA District has a permit to withdraw 66,000 AFY from Medina Lake. The water is initially diverted near Medina Lake and is delivered through an irrigation system of 57 miles of main canal, and more than 230 miles of smaller laterals and field ditches. This 94-year-old irrigation system has become increasingly inefficient. The main canal loses about 35% of the water it receives due to seepage and evapotranspiration. On-farm delivery of irrigation water is estimated to be 55% efficient.

Improving the BMA District irrigation delivery system is a viable alternative water strategy. The U.S. Federal Government has already conducted an Environmental Impact Study on improving the BMA District irrigation system. In 1997, the Natural Resources Conservation Service (NRCS) recommended a complete renovation of the irrigation canal system, in addition to on-farm irrigation water conservation strategies (National Resources Conservation Service, 1997). Standard procedures for reducing on-farm water waste include lining field ditches, installing underground pipelines, tailwater recovery systems, precision land leveling, and implementation of proper irrigation water management strategies. As of 2004, a minimal amount of canal improvements had been made. In 2002, the BMA District lined the first one-half mile of the main canal with rubber. The BMA District has also spent a significant amount to remove vegetation and maintain the canal ditches.[1]

An overgrown section of the canal system

Canal water losses are mainly due to seepage, but evapotranspiration also accounts for losses. Installing a fixed lining of impervious material will reduce main canal water losses due to seepage and evapotranspiration, and deliver water at higher transportation velocities. Replacing ditches with gated or flexible pipes can reduce conveyance losses to a negligible level. Other causes of water loss include erosion, canal sloughing, and canal breaching. A complete renovation of the irrigation canal system will result in more efficient delivery of water, reduce maintenance costs, prevent erosion, canal sloughing and breaching, and conserve water.

[1] Personal conversation with Brian Sullivan, field manager of the BMA District.

Irrigation canal lining is an important part of agricultural conservation efforts in other Texas regions. Two of the Texas Regional Water Planning Groups, Region M (Rio Grande) and Region O (Llano Estacado), included canal improvements as a potential water management strategy in the 2002 TWDB State Water Plan. Region M has already initiated a canal renovation project that, when finished, will save almost 160,000 AFY in a drought year and almost 211,000 AFY in a normal-rainfall year.

Costs

The total cost for the proposed canal improvements are estimated at $48,789,650 by the NRCS. The total installation cost is estimated at $55,770,560. (SeeTable 1.)

Table 1. Estimated Costs / Water Savings

	Cost (2003 dollars)	**Water Saved** (AFY)	**$/AFY**
Canal Improvements	$48,789,650	27,796	$137
Increased Reservoir Storage	$2,800,890	1,995	$109
On-farm Improvements	$4,180,020	3,927	$83
TOTAL	$55,770,560	33,718	$129
Cost per acre-foot amortized over 30 years at 6% interest.			

Water Savings

Lining the main canal with impervious material will save 18,195 AFY. The total quantity of water saved by canal improvements and increased reservoir storage will be 29,791 AFY. (See Table 2.)

Table 2. Potential Water Savings by Canal Improvement Area

Area of Improvement	**Water Saved** (AFY)
Main Canal Lining	18,195
D Canal Piping	4,060
Natalia Canal Piping and major earthen canal improvements	3,852
Minor earthen canal improvements and pull ditch piping	1,689
Off-canal storage reservoirs	1,649
Increased canal storage	346
TOTAL:	29,791

The BMA is proceeding with some of the recommendations of the Environmental Impact Study, but the entire project will cost a considerable sum. One possibility for the BMA is to sell or lease saved water as a means of generating revenue to pay for canal and distribution system improvements. Another approach being considered by the BMA is to apply for recharge credits under EAA rules, and use such credits as a means of funding needed repairs. It is unclear at this time whether this second option is viable. In either case, it will be a benefit to the region if the anticipated upgrades are accomplished and this annual supply of conserved water is added to regional resources.

Land Impacts

The canal system is already in place, so the proposed canal improvements will impact a minimal amount of land. The area that will be affected is predominantly un-maintained brush land. There are 109 total miles of canals and laterals that will be replaced by concrete lining or piping or otherwise improved. Expansion of the Pearson Reservoir will cover 67 acres of abandoned cropland. The construction of the Natalia Reservoir will cover 1 acre of old cropland field. The 68 acres covered by these reservoirs will have little or no impact on farmland currently in use.

Time Needed to Implement

The NRCS suggested that installation of canal improvements will take seven years to complete, and on-farm irrigation strategies will need 10 years to fully implement. This timeline is flexible and could be accelerated with adequate funding, or could be stretched over a longer period.

Drought Management

The projected municipal water demands in the Region L Water Plan are inflated due to the assumption that water supply is restricted by drought, but water demand is projected based upon an assumption that drought restrictions are not in place and being implemented during a drought. In other words state and regional water planning in Texas is done with the goal of providing sufficient water supplies to meet **all** normal water uses during a repeat of a drought as severe as the "drought of record" (the level of drought reached in the 1950s).

Under current state law, however, all Texas municipalities are required to plan and implement drought restrictions during times of water shortage. Unless a regional water plan takes into consideration anticipated reductions in water use during times of drought as a result of the implementation of those restrictions, the regional plan is quite likely to ***overestimate*** water demands, leading to identification of water management strategies to provide volumes of water supply far *in excess of actual need*. **A much more realistic water planning approach is to incorporate drought management into the regional water plan as an actual water management strategy or to adjust projected demand to reflect the anticipated impact of implementing drought restrictions**.

The regional planning process calculates future demand by determining per capita consumption and multiplying it by projected population growth. In order to calculate the potential demand reduction from drought measures, the Sierra Club used a similar approach. The first step in calculating new gpcd values was to calculate the approximate amount of water saved using various drought ordinances.

A study conducted on the effects of drought ordinances in various Colorado cities in the summer of 2002 yielded an estimate of water saved by implementing lawn-watering restrictions (Kenney, et al, 2004). Water savings were evaluated for the growing period of May 1 through August 31, 2002. The average amount of net water use reduction in a city under an ordinance allowing watering only once every three days was 3% during the four-month study period. The average amount of net water use reduction in a city under an ordinance allowing watering only twice a week was 24%, and once a week restrictions resulted in a 46% net water use reduction.

The average net water use reduction percentages from the Colorado study were applied to estimate potential savings from drought restrictions in nine Region L cities (San Antonio, San Marcos, Schertz, Victoria, Lockhart, New Braunfels, Port Lavaca, Uvalde, and Seguin). The data used to estimate the drought savings were provided by the TWDB's Annual Water Use Survey database and consisted of monthly water use data for each city in the year 2000 (except for Seguin, which only had monthly water use data from 1999 in the TWDB database). Due to the difference in peak pumping months between Colorado and Texas, the months used to represent summer use in Region L were June through September, rather than May through August. When peak pumpage was less than twice the winter average use, the calculated savings from once–a-week watering restrictions produced water usage that was less than the lowest monthly winter water usage. To correct this, the lowest monthly winter water use value was substituted for the calculated value in all cities. This correction was also made for calculating savings from twice-a-week restrictions for all cities except Seguin and Uvalde.[2]

The potential water savings in the nine cities from imposing the three different drought measures is reported below in Table 1. At the low end of the spectrum, watering restrictions of once every third day are estimated to save more than 5,000 AFY in the nine cities examined, while once-a-week watering restrictions could be expected to reduce demand by more than 47,000 AFY in 2060. Since the regional planning scenario estimates supply during the drought of record, this latter number, the once-a-week watering schedule should be used to estimate demand in 2060.

Table 3. AFY Savings – Drought Management

Watering restricted to:	2010	2020	2030	2040	2050	2060
Once every three days	3,199	3,721	4,208	4,634	5,038	5,408
Twice a week	23,433	27,242	30,801	33,905	36,857	39,574
Once a week	28,083	32,583	36,847	40,610	44,225	47,616

The projected savings here are conservative in nature, due to intentional reduction of the estimated potential savings from SAWS, the largest of the Region L municipal water user groups. During a part of 2000, San Antonio's critical period management plan was in effect. As a result the potential savings from the most stringent of the drought management scenarios (one day per week watering) was reduced by 5 gpcd, or 25% of its potential savings. (Using the Kinney study, San Antonio's water use was projected to be 129; this report uses 134 gpcd.)

SAWS' recently released "Water Resource Plan 2005 Update" also attempts to determine drought demand reductions resulting from existing critical period management water use restrictions (SAWS, 2005). The results show that in the year 2000, restrictions relating to landscape watering reduced dry-year demand over a nine-month period by 9.9% from 1984 levels. As a result of these findings, SAWS now plans to reduce demand predictions by 5 percent in order to conservatively incorporate the successful results of drought management plans.

[2] The resulting summer water use values were combined with the original water use of the non-summer months and a new gpcd was calculated using the 2000 TWDB population estimates. The TWDB-recommended reductions in base gpcd from plumbing code savings were then applied to the new gpcd for each decade to calculate potential savings in each city for the three drought management scenarios.

Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is a practice used for managing water supplies. ASR does not constitute a new water source; rather, it is a strategy for maximizing water storage. In ASR, water is pumped through an ASR well into an aquifer to be recovered when needed. (figure 1). It has several environmental advantages over traditional reservoir storage, including no evaoporative water loss, no riparian or habitat loss in inundated lands, and no need to condemn property rights of landholders. A potential disadvantage is the displacement and potential loss of native groundwater to lateral and vertical migration. Various water sources in existing projects around the U.S. and Texas include partially treated surface water, treated wastewater that has been reclaimed, and untreated groundwater from an underlying or overlying aquifer. **As the concept is used in this document, ASR *does not* refer to the possible injection of treated wastewater into aquifers for storage—only to storage of Edwards Aquifer water in other aquifers with available capacity for storage**.

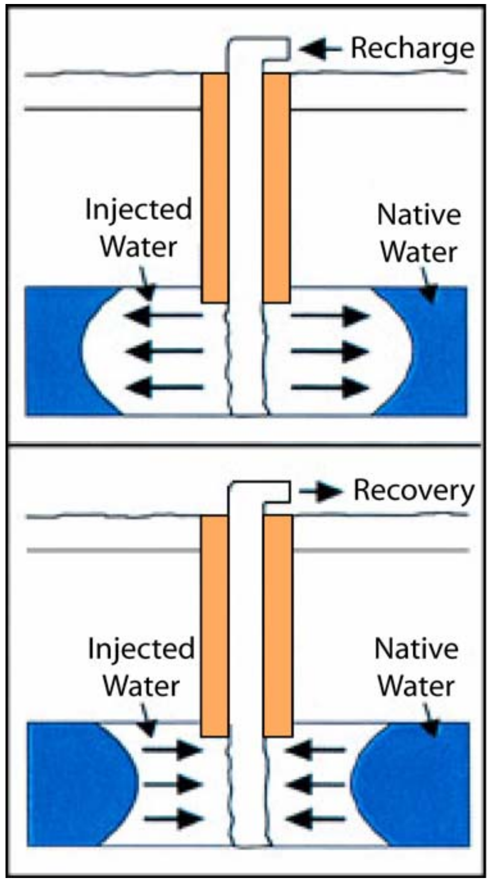


Figure 1. The two basic steps performed in ASR. (ESE Magazine)

Typical storage zones used for ASR are limestone, sandstone, or alluvial formations where water transmission rates are low and the stored water stays in the vicinity of the well. The quality of the injected water must be carefully considered and often is treated to prevent the fouling of wells through the interaction between the water chemistry of the source water and the host aquifer.

ASR is utilized or is being investigated as a water management strategy at more than 50 sites in 26 states (AWWA, 2002). Water can be stored diurnally or seasonally, or the aquifer can be used for long-term water storage and for emergency shortages.

Twin Oaks ASR and Drinking Water Treatment Plant

SAWS has already constructed a seasonal ASR facility in the Carrizo-Wilcox Aquifer, immediately south of San Antonio. This system transfers water from the Edwards Aquifer into the Carrizo-Wilcox Aquifer during wet months, to be recovered during the dry summer months. The Carrizo-Wilcox is a sand aquifer; water does not move quickly and is easy to recover, even after a long period of time. Unlike the Carrizo-Wilcox, the Edwards Aquifer is a karst aquifer and has high transmission rates.

Currently, the Twin Oaks ASR project includes 16 water wells, a drinking water treatment plant, a control center, a three million-gallon storage tank, and a 60-inch, 30-mile water delivery pipeline. The recent completion of Phase I allows SAWS to store up to 11,263 AF of water. Completed in 2005, Phase II will add 12 more wells, and double the amount of water that can be stored annually to 22,500 AF (SAWS, 2004).

During a rainy autumn and winter, or any other low-water use period, SAWS water users do not require the full use of SAWS's Edwards Aquifer pumping rights to meet their water needs. Some of this excess water could be injected into the Carrizo-Wilcox Aquifer. Rather than using ASR for seasonal storage only, SAWS should expand its ASR efforts by capturing water from the Edwards Aquifer or streams during periods of high flow to use for long-term storage in the Carrizo-Wilcox Aquifer. The exact location and volume of storage of future regional ASR projects should be determined by the geology of the aquifer, location of existing wells, and historic drawdown of the aquifer levels.

An increased ASR strategy also necessitates a consideration for the maintenance of sufficient instream flows, existing water rights, and springflows, especially with regard to springflows at Comal and San Marcos Springs and instream flows on the Guadalupe River. To ensure that a regional ASR project is successful, the Lone Star Chapter recommends a management structure that provides adequate decision-making power by the groundwater district regulating the host aquifer.

Costs

Much of the infrastructure required for this expansion is already present. Phase I of the Twin Oaks ASR project was completed significantly under the projected budget (SAWS, 2004). The main requirement for expanding the system to incorporate long-term ASR is to build additional well fields and the pipeline to connect to existing distribution systems. The national average for building ASR systems ranges from $179/AFY to $536/AFY (Pyne, 2002).

Other Water Management Strategies Suggested for Consideration

SAWS Recycled Water Program – Phased Expansion (L-21)

The Region L Planning Group adopted this program on February 4, 2005. The unit cost is very low compared to the other water management strategies (WMSs) at $434/AFY. The intended plan is to gradually expand SAWS's already existing recycled water 36,258 AFY by the year 2060. Relatively little land or environmental impact comes with this WMS, since most potential customers are in the already urbanized area.

Rainwater Harvesting & Condensate Reuse

Another water resource alternative the Sierra Club supports is rainwater harvesting and condensate reuse. The TWDB's Best Management Practices Guide outlines the methods for capture and storage of water from both rainfall and from the condensate on cooling systems in South Central Texas. This water can be used to replace potable water currently used for irrigation, and in rural areas, can be used to replace or supplement ground or surface water sources. The TWDB publishes a Rainwater Harvesting Manual and the SAWS conservation program has provided financial incentives to customers to install cisterns that capture both rainwater and condensate. While little information exists about the regional potential for rainwater harvesting and condensate reuse at this time, it is clear that it is a viable means of augmenting existing supplies without relying on long-distance import projects.

The Rainwater Harvesting strategy (SCTN-9) proposed in the 2006 Region L Plan portrays this technique as an expensive strategy, with a high unit cost of water due to the expense of large storage tanks. However, rainwater harvesting is economically viable in areas where the availability or quality of groundwater is limited. It is also a less expensive strategy when used to supplement existing supplies, for the need for necessary storage is reduced.

Conclusion

The Sierra Club recommends that the Region L Water Planning Group consider and implement all of these suggested water supply management strategies to meet water demands projected by the 2006 plan. These strategies provide an integrated approach to water management that considers technical solutions as well as behavioral and institutional adaptations. The strategies identified here do not represent the full universe of potential water management strategies, but they are ones that the Sierra Club believes need to receive priority consideration in this round of regional water planning.Municipal Conservation strategies provide a large potential for water savings. The Region L Water Planning Group is to be commended for adopting the recommended municipal water conservation goals set forth by the State Water Conservation Implementation Task Force. The Sierra Club has included a description of several existing water conservation measures, as well as potential water conservation measures that may be adopted by municipal suppliers in the region. Adoption of these measures could allow the water saved from municipal conservation to exceed the amount projected by the plan.

Water savings from irrigation conservation practices are discussed in the Draft 2006 Region L Plan. However, there is additional potential for savings from irrigation transfers to municipal supplies. Edwards Aquifer Authority rules allow transfers *in excess* of the 1 AF per acre rule if the surplus water is a result of conservation efforts. The existing plan does not examine this opportunity. The plan also ignores any potential savings and supply generated from conservation efforts of the Bexar-Medina-Atascosa Water Control and Improvement District.

Current statute requires all Texas municipalities to plan and implement drought restrictions during times of water shortage. SAWS' updated 2005 Water Resources Plan incorporates a 5 percent reduction in demand resulting from drought restrictions. Unfortunately, the Region L Plan ignores the effects of these restrictions and does not consider drought management as a water management strategy. Instead, the Plan assumes that normal water use will be maintainedl, even during times of drought.

With careful consideration for maintenance of sufficient streamflow and existing water rights, **aquifer storage and recovery** (ASR) efforts by SAWS could be expanded from seasonal to long term storage. Such an expansion could be facilitated by a change in management structure that allows for adequate decision-making power by the groundwater district serving the area where the aquifer storage occurs.

Finally, the 2002 State Water Plan and the 2006 Region L draft have failed to account for the effects of new investment and increased costs for water on customer behavior. As water rates increase due to the development of high-cost projects, there will be a corresponding reduction in demand. Such reductions could render new projects unnecessary.

Table 4. Alternative Water Management Strategies for the 2006 South Central Texas Regjonal Water Plan

Water Management Strategy	Summary	Water Available in 2060
Municipal Conservation	Indoor and outdoor measures	72,570 AFY
Irrigation Conservation	System upgrades	37,291 AFY
BMA District 1	Canal lining	33,718 AFY
Drought Management	Enforceable restrictions on outdoor uses	47,616 AFY
Aquifer Storage and Recovery	In Carrizo-Wilcox Aquifer	Not determined
TOTAL:		> 191,195 AFY

Acronyms

AFY – acre-feet per year

ASR – aquifer storage and recharge

AWWA, AWWARF – American Water Works Association, American Water Works Association Research Foundation

BMP Guide – The Water Conservation Best Management Practices Guide (BMP Guide), published by the TWDB, offers useful, proven, cost-effective, and generally accepted conservation tips for municipal, industrial, and agricultural WUGs.

gpcd – gallons per capita per day; the number of gallons used each day in a given area divided by the population

gpy – gallons per year

HF, ULF, dual-flush toilets – High-flow (HF) toilets use at least 3.5 gallons per flush (gpf). In contrast, ultralow-flush (ULF) toilets use 1.6 gpf or less. Dual-flush toilets use 1.0 gpf or less for liquid wastes and 1.6 gpf or less for a full flush.

ICI – industrial/commercial/institutional

LF showerheads – Low-flow (LF) showerheads 2.5 gallons per minute (gpm) or less (at 80 psi). Some LF fixtures use as little as 2.2 or 1.5 gpm, while some high-volume showerheads use up to 8.0 gpm.

psig – pounds per square inch guage; psig is the technically correct term to use when referring to a pressure gauge which has been calibrated to read zero at sea level

SB1 – Senate Bill 1; passed during the 1997 Texas Legislature, SB1 created 16 regional water planning groups that consisted of approximately 450 representatives from 11 interest group categories specifically required by stature. Each group creates a regional plan that is submitted to the TWDB for inclusion in the State Water Plan

TWDB – The Texas Water Development Board (TWDB) is a government agency charged with preparing, formulating, and adopting a comprehensive State Water Plan, which is updated periodically.

WMS – water management strategy

WUG – water user group, including municipal utility districts, municipalities, water conservation districts, water supply corporations, and all other water purveyors

Glossary

Acre-foot – An acre-foot is a volume unit commonly used to measure large amounts of water. One acre-foot (AF) is the equivalent of 325,851 gallons. If the average citizen in a city uses 140 gallons of water a day (140 gpcd), then 1 AF would supply 6.4 people for a year.

Brine – salty water, containing more than 3,000 ppm total dissolved solids.

Field ditch/furrow – a small channel used for furrow irrigation.

Furrow irrigation – surface irrigation in which water is applied at the high end of a field so it flows down the slope of the land through furrows between the rows or crops.

Region L – Also known as the South Central Texas Region, Region L consists of 20 and one-half (20½) counties with a total 2000 population of 1,695,584 (2000 U.S. Census Data) and 191 WUGs. The 10 largest cities in Region L are San Antonio, Victoria, New Braunfels, San Marcos, Seguin, Schertz, Uvalde, Universal City, Port Lavaca, and Lockhart.

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