Sterling County Underground Water Conservation District

Management Plan

2010 - 2020

Adopted: November 9, 2010

Sterling County Underground Water Conservation District

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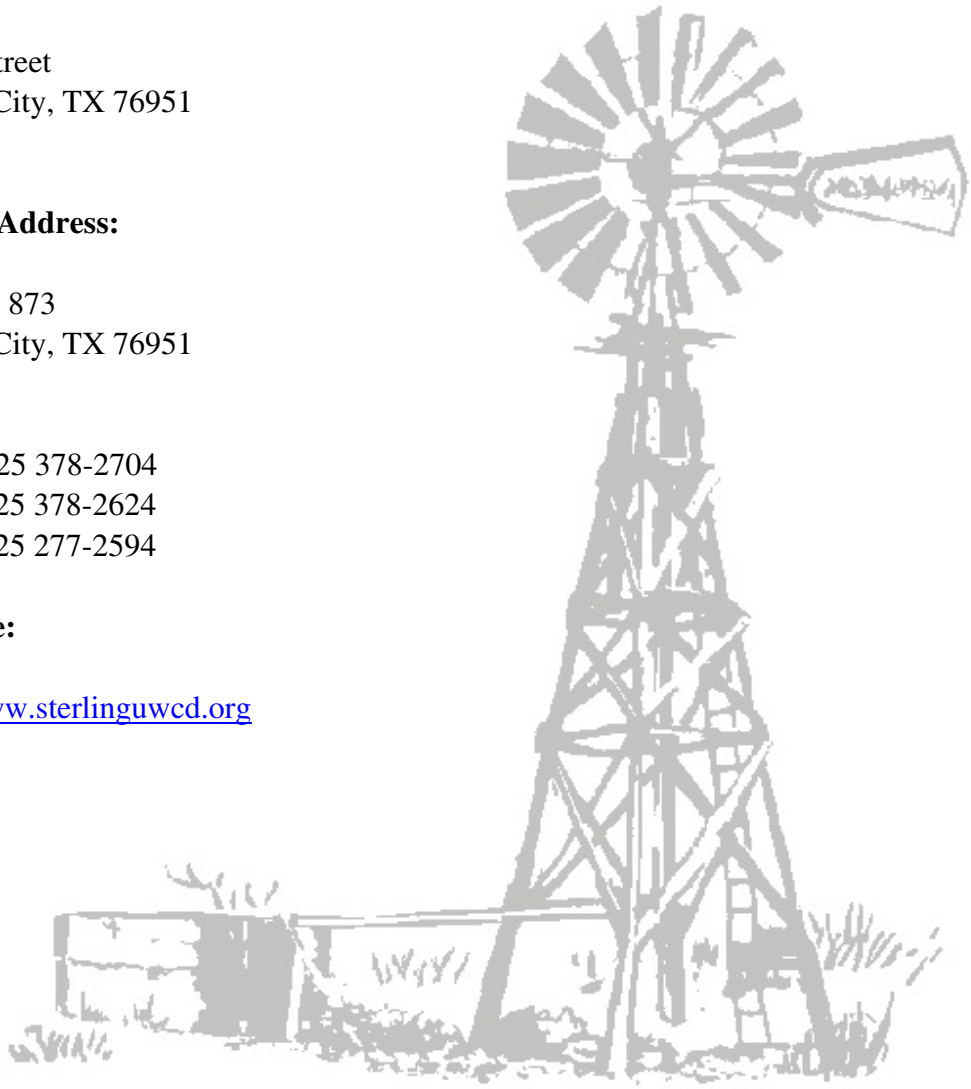

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District Mission

The Sterling County Underground Water Conservation District strives to conserve, preserve, and protect groundwater supplies, to protect and enhance recharge, to prevent waste and pollution, and to effect the efficient, beneficial and wise use of groundwater resources for the benefit of both current and future residents and the economy of the District. This is accomplished by monitoring water quality, water levels, promoting conservation and striving to maintain local control of the management of those resources. The District also strives to maintain groundwater ownership and rights of the landowners and their lessees as provided in the Texas Water Code §36.002.

Time Period for this Plan

This plan becomes effective upon adoption by the Board of Directors and approval by the Texas Water Development Board. The plan remains in effect for ten years with the required review and re-adoption, with or without revisions, every five years.

Statement of Guiding Principles

The District recognizes that groundwater resources are of the utmost importance for the economy for all groundwater users, first for the residents of the District, and then the region. Also recognized is the importance of understanding the aquifers and aquifer characteristics for proper management of these resources. Integrity and ownership of groundwater are also recognized as important for the management of this precious resource.

The primary goal of the District is to preserve the integrity of the groundwater in the district from all potential contamination sources, mainly oil and gas production and related activities. This is accomplished as the District sets objectives to provide for the conservation, preservation, protection, recharge, prevention of waste and pollution, and efficient use of water including:

- Acquiring additional hydrogeologic data for the aquifers within the District;
- Protecting the landowner's right to the beneficial use of groundwater resources beneath his land;
- Promulgating rules for the protection of all users while maintaining adequate future supplies;
- Cooperation with other local GCD's to manage shared groundwater resources.

These objectives are best achieved through guidance from the locally elected board members who understand the local conditions and can manage the resource for the benefit of the residents of the district and region. The District shall seek to ensure that maximum groundwater withdrawals do not exceed amounts that would be significantly detrimental for future residents of the District.

General Description

History

The citizens of Sterling County, accepting the importance of protecting the integrity of groundwater from potential contamination from the vast amount of oil and gas production and associated activities

and the necessity of local control of groundwater resources, introduced legislation in the 70th Regular Legislative Session (1987) for creation of the District. The District was confirmed the same year. Government of the District is by a five member locally elected board serving staggered four year terms.

Individual landowners, who already owned land in the District, recognized the benefit of having all their property included in a groundwater conservation district petitioned the District to annex the remainder of their land in Tom Green County. The Board of Directors accepted and approved these petitions expanding the territory of the District.

Government of the District is by a five member locally elected board with four single member precincts, based on County Precincts, and one member At Large. The directors serve staggered four year terms.

Location and Extent

The Sterling County UWCD has an areal extent of 616,101 acres (963 square miles) in Sterling and Tom Green Counties located in the west-central part of Texas. Elevation ranges from approximately 2,200 to 2,700 feet above mean sea level. Total population is approximately 1,530 including the County Seat, Sterling City (population 1006).

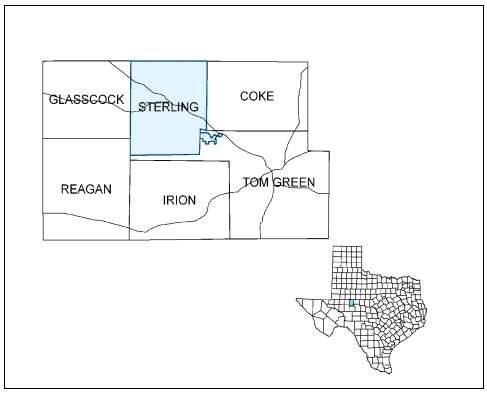

Figure 1 Sterling County UWCD

The majority of the District overlies the Edwards-Trinity (Plateau) Aquifer. Minor aquifers of Dockum and Lipan are also present. The District is included in the Upper Colorado Region of the Colorado River Basin, Region F, Regional Water Planning Group and Groundwater Management Area 7.

Regional Cooperation and Coordination

West Texas Regional Groundwater Alliance

Since 1988 the District has been involved in coordination of district activities with other GCD's managing the Edwards-Trinity (Plateau) Aquifer. In 1988, four groundwater conservation districts; Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD signed an original Cooperative Agreement. As new districts were created, they too signed the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted and the West Texas Regional Groundwater Alliance was created.

The regional alliance consists of seventeen locally created and locally funded groundwater conservation districts covering all or part of twenty-two counties, that encompass approximately 18.2 million acres or 28,368 square miles, of West Central Texas. This West Texas region is as diverse as the State of Texas. Due to the diversity of this region, each member district provides it's own unique programs to best serve its constituents.

Current member districts are:

Coke Co. UWCD
Glasscock GCD
Hill Country UWCD
Kimble Co. GCD
Lone Wolf GCD
Middle Pecos GCD
Plateau UWC & SD
Sterling County UWCD
Wes-Tex GCD
Crockett Co. GCD
Hickory UWCD # 1
Irion Co. WCD
Lipan-Kickapoo WCD
Menard County UWD
Permian Basin UWCD
Santa Rita UWCD
Sutton County UWCD

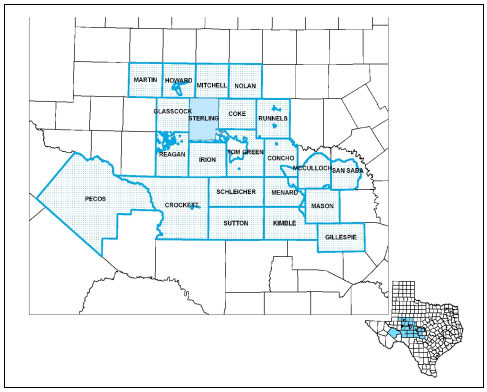

Figure 2 West Texas Regional Groundwater Alliance

This Alliance was created because the local districts have a common objective: to facilitate the conservation, preservation and protection of groundwater supplies, protection and enhancement of recharge, prevention of waste and pollution, and beneficial use of water and related resources. Local districts monitor water-related activities which include but are not limited to the State's largest industries of farming, ranching and oil and gas production. The alliance provides coordination essential to the activities of these member districts as they monitor these activities in order to accomplish their objectives.

West Texas Weather Modification Association

In 1996, in response to the resident landowners of seven groundwater conservation districts, the West Texas Weather Modification Association was formed for the purpose of providing weather modification (cloud seeding) for rainfall and recharge enhancement throughout the geographical region of its members. The target area of the Association includes all of seven counties and part of another for a total area of over 6.4 million acres or 10,000 square miles of West Central Texas.

Current membership includes:

City of San Angelo
Crockett Co GCD
Glasscock County UWCD
Irion County WCD
Santa Rita UWCD
Sterling County UWCD
Sutton County UWCD
Plateau UWC & SD

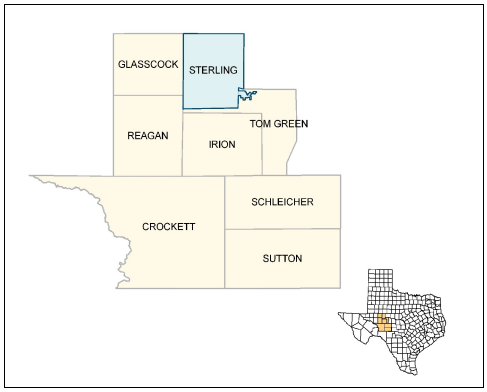

Figure 3 West Texas Weather Modification Association.

Recognizing the importance of rainfall in the region, this Association was formed to provide benefits from enhanced rainfall which includes a reduction of groundwater withdrawals, increase in runoff, increase in agricultural productivity with the resulting economic impact for the region, provide additional recharge, and increase spring flow. These benefits are not only realized within the region but also downwind and down stream of the target area.

Regional Water Planning

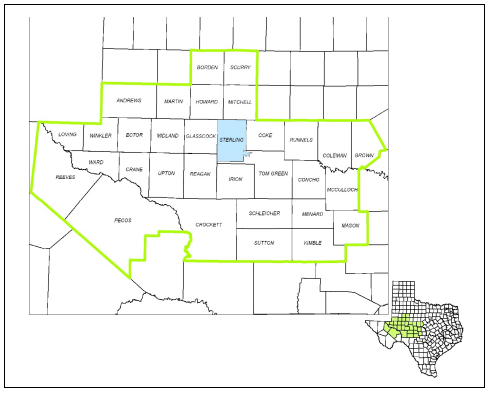

Figure 4 Region F Water Planning Area

The District has been active in the Region F, Regional Water Planning Group Meetings to provide input in developing and adopting the 2001, 2006 and 2011 Regional plans. As the Regional Planning Group moves toward adopting future Regional Plans the District will continue to participate in the planning process.

Groundwater Management Area

Groundwater Management Area 7 covers all or part of thirty-three counties and includes twenty groundwater conservation districts. These GCD's manage groundwater resources at the local level in all or part of twenty-four counties within GMA 7 and surrounding areas. The District continues to actively participate in meetings and discussions to determine a feasible future desired condition of the aquifers within the management area and district.

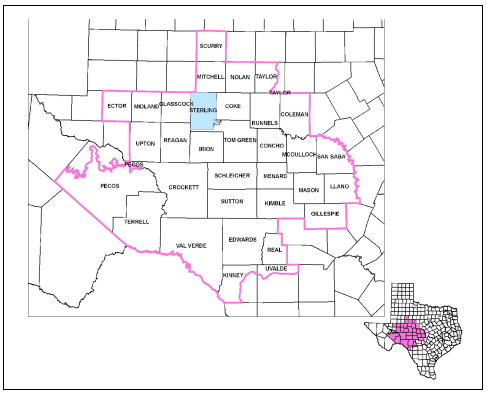

Figure 5 Groundwater Management Area 7

Edwards-Trinity (Plateau) Aquifer

Edwards-Trinity (Plateau) Aquifer is a major aquifer extending across much of the southwestern part of the state. The water-bearing units are composed predominantly of limestone and dolomite of the Edwards Group and sands of the Trinity Group. Although maximum saturated thickness of the aquifer is greater than 800 feet, freshwater saturated thickness averages 433 feet. Water quality ranges from fresh to slightly saline, with total dissolved solids ranging from 100 to 3,000 milligrams per liter, and is characterized as hard within the Edwards Group. Water typically increases in salinity to the west within the Trinity Group. Elevated levels of fluoride in excess of primary drinking water standards occur within Glasscock and Irion counties. Springs occur along the northern, eastern, and southern margins of the aquifer primarily near the bases of the Edwards and Trinity groups where exposed at the surface. San Felipe Springs is the largest along the southern margin. Of groundwater pumped from this aquifer, more than two-thirds is used for irrigation, with the remainder used for municipal and livestock supplies. Water levels have remained relatively stable because recharge has generally kept pace with the relatively low amounts of pumping over the

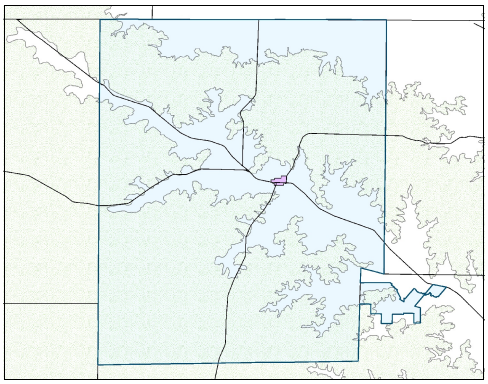

Figure 6 Edwards/Trinity (Plateau) Aquifer

extent of the aquifer. The planning groups recommended water management strategies that use the Edwards-Trinity (Plateau) Aquifer, including the construction of a well field in Kerr County and public supply wells in Real County.[1]

Dockum Aquifer

The Dockum Aquifer is a minor aquifer found in the northwest part of the state. It consists of sand and conglomerate interbedded with layers of silt and shale. The water quality in the aquifer is generally poor—with fresh water in outcrop areas in the east to brine in the western subsurface portions of the aquifer—and very hard. Naturally occurring radioactivity from uranium present within the aquifer has resulted in gross alpha radiation in excess of the state's primary drinking water standard. Radium-226 and -228 also occur in amounts above acceptable standards. Groundwater from the aquifer is used for irrigation, municipal water supply, and oil field water-flooding operations, particularly in the southern High Plains. Water level declines and rises have occurred in different areas of the aquifer. The planning groups recommended several water management strategies that use the Dockum Aquifer, including new wells, desalination, and reallocation.[2]

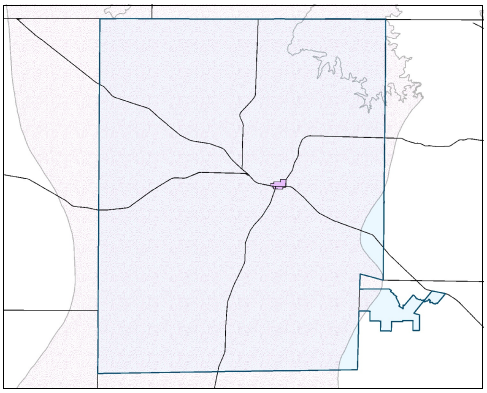

Figure 7 Dockum Aquifer

Lipan (Alluvium) Aquifer

In the 2007 State Water Plan, the TWDB revised the Lipan Aquifer boundaries. The boundaries of the Lipan now include the Alluvium in Irion County. The Lipan Aquifer is a minor aquifer found in parts of Coke, Concho, Glasscock, Irion, Runnels, Schleicher, Sterling, and Tom Green counties in west central Texas. The aquifer includes water bearing alluvium and older, underlying strata. The alluvium includes up to 125 feet of saturated sediments of the Leona Formation. The underlying strata include the San Angelo Sandstone of the Pease River Group and the Choza Formation, Bullwagon Dolomite, Vale Formation, Standpipe Limestone, and Arroyo Formation of the Clear Fork Group. Groundwater in the alluvial deposits and the upper parts of the older rocks is hydraulically connected; therefore, most wells in the area are completed in both units. Groundwater in the alluvium ranges from fresh to slightly saline, containing between 350 to 3,000 milligrams per liter of total dissolved solids and is very hard. Water in the

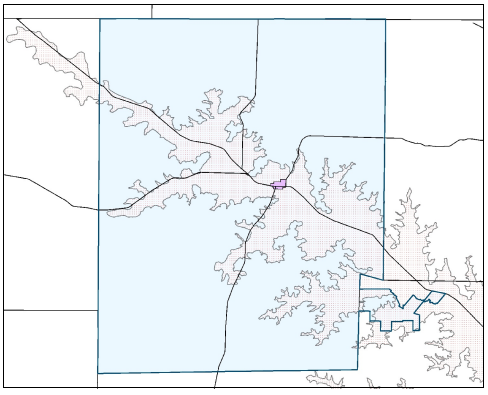

Figure 8 Lipan (Alluvium) Aquifer

[1] Water For Texas 2007, Volume II

[2] Ibid

underlying parts of the Choza Formation and Bullwagon Dolomite tends to be moderately saline with total dissolved solids in excess of 3,000 milligrams per liter. The aquifer is primarily used for irrigation but also supports livestock, municipal, domestic, and manufacturing uses. Due to drought and heavy irrigation pumping in the late 1990s, water levels decreased significantly in some areas, and the aquifer could not be pumped through the entire irrigation season. In other areas, however, the aquifer could be pumped but at a reduced rate. The planning groups did not recommend any water management strategies using the Lipan Aquifer.[3]

District Groundwater Resource Estimates

Estimates of groundwater availability, usage, supplies, recharge, storage, and future demands are from data supplied in the Region F Regional Water Plan, January 2006 (the same data is included in the January 2011 Plan), Water For Texas 2007, Texas Water Development Board, U.S.G.S., and District information. Use of TWDB estimates does not constitute endorsement by the District.

Estimate of the Managed Available Groundwater (expressed as acre-feet)

The passage of HB 1763, 79th Regular Session of the Texas Legislature, required groundwater conservation districts (GCD) to establish a desired future condition (DFC) of aquifers within the groundwater management areas (GMA) by September 1, 2010. The Texas Water Development Board (TWDB) would then establish the managed available groundwater (MAG) for each GCD.

A type of DFC was established in the Region F Regional Water Plan, January 2001 was included in the Region F Regional Water Plan, January 2006. The same data is used in the Region F Regional Water Plan for 2011. The region is divided into three availability categories:

1) annual effective recharge;
2) annual recharge plus an annual amount equal to 75 percent of the retrievable storage over 50 years; and
3) annual recharge plus an annual storage depletion equal to 75 percent of the retrievable storage over 100 years.

[3] Ibid

Sterling County UWCD Estimated Managed Available Groundwater				
Sterling County				
River Basin	**Aquifer**	**Drought* (acre-feet)**	**Supply From Storage (acre-feet)**	**Annual Availability (acre-feet)**
Colorado	Edwards-Trinity	5,168	0	5,168
Colorado	Dockum	0	0	0
Colorado	Lipan	N/A	N/A	N/A
Tom Green County				
Colorado	Edwards-Trinity	14,373	664	129
Colorado	Dockum	0	54	0
Colorado	Lipan	24,916	12,570	N/A***

data from Region F Regional Water Plan, January 2006, Table 3.1-1 Groundwater Availability in Region F

* Drought recharge equals one half annual average recharge

** Availability adjusted to reflect the 0.86% of Tom Green County covered by the District

*** Domestic and Livestock use would only account for an estimated 1 ac/ft or less assuming the wells are all completed in the Lipan

Since the adoption of the Region F 2006 Regional Water Plan, the District now recognizes that depending solely on recharge is not a viable method for determining sustainable availability. The District understands the importance of maintaining groundwater resources for current and future residents and to maintain spring flow. To accomplish this the District continues to gather data in order to sustain availability without substantial detrimental change in storage. Currently the District collects water level and rainfall data to obtain more accurate recharge and storage estimates.

Groundwater Management Area 7 adopted DFC's for all aquifers located within the District boundaries on July 29, 2010 and have submitted them to the TWDB. However, no MAG has been calculated by the TWDB and petitioners have a year after adoption to file a petition. GMA 7 adopted a 7 foot average drawdown for the entire Edwards-Trinity (Plateau) Aquifer (6 foot average within the District) and declared both the Dockum and Lipan Aquifers non relevant within the District.

Since pumpage in the Dockum and Lipan aquifers is domestic and livestock use and the District does not foresee any future development of these aquifers that would require district permits therefore a DFC is non relevant for either aquifer.

To manage the adopted Edwards-Trinity (Plateau) DFC the District will continue to monitor water levels in selected wells. In addition the District will continue collecting data from the rainfall network including both yearly reports from individuals and self recording rain gages. The district has thirty monitor wells, three wells with transducers and sixteen self recording rain gage locations for data collection.

Pending receipt of the MAG from the TWDB, the District considers the current Region F 2011Regional

Water Plan groundwater availability estimates as the Managed Available Groundwater estimates for the District.

Current Groundwater Use (expressed as acre-feet)

Current use within the district varies depending on which data is quoted. Following is the TWDB 2007 Water Use Survey Summary Estimates for Region F, Sterling County and Tom Green County. Use is broken out by category and use within the Sterling County Underground Water Conservation District. The portion of Tom Green County contained within the District is ranch land has no Municipal, Manufacturing or Steam Electric use. The Livestock use estimates were adjusted by the percentage (0.86%) of the county within the District. No domestic use category was listed but there is domestic use from exempt wells.

Sterling County UWCD Estimated 2007 Use (expressed as acre-feet per year)					
Use	**Sterling County**	**Tom Green County Estimated**	**District Use***	**Total District Estimated Use**	**Region F Estimated Use**
Municipal	179	15,561	0	179	110,061
Manufacturing	0	1,998	0	0	12,396
Mining	0	0	0	0	5,215
Steam Electric	0	0	0	0	3,944
Irrigation	447	74,120	0	477	408,888
Livestock	322	1,128	10	332	14,689
Total	**948**	**92,807**	**10**	**988**	**555,193**

* adjusted to reflect the 0.86% of Tom Green County within the District

The following table reflects Sterling County Underground Water Conservation District 2007 Water Use Estimates when compared to the 2007 Water Use Estimates of Region F. These estimates indicate that the District uses only **0.17%** of the Regional Use Estimates and has 0.2% of the population. The portion of Tom Green County contained within the District is ranch land with no Municipal, Manufacturing, Mining or Steam Electric so only the Livestock/Domestic number was adjusted.

With only 0.2% of the population and 0.17% total water use, the District has virtually no impact on Regional Water use. Even if the water was available, a five fold increase in total water use is necessary to equal 1%.of the regional estimated use. A lot of time and effort is expended to prepare this management plan for no more water use or population represented. In times where government is to be transparent in providing the public with information on district expenditures, it is hard to justify the time and effort to regurgitate numbers back to the TWDB. As stated in the "Statement of Guiding Principals", the primary goal of the District is to preserve the integrity of the groundwater. Bottom line is that the District has neither the population nor water use to affect regional use.

Region F 2007 Water Use Summary Estimates in Acre-Feet			
	Region F	SCUWCD	% of Region F Use
Population	589,910	1,205*	0.20%
Municipal	110,061	179	0.16%
Manufacturing	12,396	0	0.00%
Mining	5,215	0	0.00%
Steam Electric	3,944	0	0.00%
Irrigation	408,888	477	0.12%
Livestock**	14,689	332	2.26%
Total Water Use	**555,193**	**988**	**0.17%**

* adjusted to reflect persons living in the portion of Tom Green County within the District

** use adjusted to reflect the 0.86% of Tom Green County within the District.

The Sterling County Underground Water Conservation District current use estimates are derived from multiple data sources. Municipal data came from the TWDB Municipal Water Use Survey for the Calendar Year 2009 as reported by the City of Sterling City. Mining data is the projected demand in the 2011 Region F Regional Water Plan. Irrigation data is from the TWDB 2008 Irrigation Water Use Data sent to the District. There is no distinction between irrigation from surface water and groundwater. The irrigation data is incomplete since not all irrigated acreages are reported because some residents choose not to participate in government programs. While the TWDB has data for livestock use there is no category for domestic use. Groundwater use in the District is primarily domestic and livestock. All exempt use should be considered in the total water budget. An estimate for domestic and livestock use was calculated by multiplying the number of wells in the TWDB database by 1ac/ft.

Sterling Co UWCD Estimated Current Use	
Use Category	**Acre-Feet/Year**
Municipal from 2009 TWDB Water Use Survey	239
Mining	560
Irrigation	795
Domestic and Livestock*	572
Total	**2,166**

* use adjusted to reflect the 0.86% of Tom Green County within the District.

The portion of the District within Tom Green County is ranch land and has only domestic and livestock use.

2007 State Water Plan Projected Water Demand (District Specific)		
Water Use Group	**County**	**Acre-Feet/Year**
Sterling City	Sterling	302
County Other	Sterling	49
Mining	Sterling	560
Irrigation	Sterling	648
Livestock	Sterling	503
Subtotal	**Sterling**	**2,062**
Livestock*	Tom Green	17
Subtotal	**Tom Green**	**17**
	Total	**2,079**

* adjusted to reflect the 0.86% of Tom Green County within the District

Spring Flow Demands (expressed as acre-feet)[4]

Spring flow demand was determined by utilizing permitted surface water rights by the Texas Commission on Environmental Quality. No allowances or adjustments were made for any loss, gain, or rainfall variances which might affect the surface flow from the springs. Three surface water rights holders in Sterling County hold a total of 168 ac/ft per year. An additional 82 ac/ft per year is estimated for the flow of the North Concho and Sterling Creek for an estimated total spring flow demand of 250 ac/ft per year.

Projected Groundwater Demands (expressed as acre-feet)

The primary use within the District is for domestic and livestock. Drought conditions proportionally effect livestock use. As drought conditions worsen, livestock numbers decline, therefore decreasing demand. With limited projected population growth for the district and livestock use directly proportional to drought conditions, a modest 1% increase per year was used to project future municipal demands and 0.5% for domestic and livestock. Mining and Irrigation demands should remain fairly stable and no increase was added.

[4] Texas Commission on Environmental Quality, San Angelo, TX.

Sterling County UWCD Projected Groundwater Demands			
Use	**Current (acre-feet)**	**2020 (acre-feet)**	**2030 (acre-feet)**
Municipal	239	263	289
Mining	560	560	560
Irrigation	795	795	795
Domestic and Livestock*	572	601	631
Total	**2,166**	**2,219**	**2,275**

** use adjusted to reflect the 0.86% of Tom Green County within the District.

Estimated Available Groundwater Supply (expressed as acre-feet)

Projected available groundwater supply is the estimated sustainable annual yield with no significant change in storage. The District follows the principle that demand should not be detrimental to long term storage amounts in order to maintain dependable and sufficient groundwater supplies for spring flow and future generations. The District continues to monitor water levels to determine changes in storage.

Figuring a worst case scenario with recharge only as drought recharge, half of normal average recharge, the district would have enough groundwater resources to meet the needs of the residents and also meet spring flow demands without detriment to long term storage. Although spring flow and pumpage would be maintained during this period of low recharge from storage, these storage deficits would be recovered during years of normal or near normal average recharge. Sustained over pumpage for any use would result in significant storage deficits that could not recover without a reduction in the pumpage.

Sterling County UWCD Estimated Available Groundwater Supply			
	Current (acre-feet)	**2010 (acre-feet)**	**2020 (acre-feet)**
Drought Recharge	5,168	5,168	5,168
Less Groundwater Demand	(2,166)	(2,219)	(2,275)
Less Spring Flow Demand	(250)	(250)	(250)
Total	**2,752**	**2,699**	**2,643**

Enhancement of Availability and Storage

The District supports both rainfall enhancement and brush control as management practices to maintain and improve groundwater availability and storage both within the District and region. Benefits from

both management practices can be summed up in a study done by Texas Tech University: "Private benefits include enhanced crop yields, livestock production due to forage increases and reduced irrigation cost. Social benefits include enhanced runoff and increased reservoir levels, downwind beneficiaries, secondary regional benefits (multiplier impact), improved water quality and reduced aquifer depletion." [5]

Weather Modification

Recharge of the aquifers is achieved through rainfall infiltration and can be enhanced by increasing the amount of precipitation received annually through weather modification. Weather modification was conducted by the Colorado River Municipal Water District, located in Big Spring, with documented average 23% rainfall increase.[6] The City of San Angelo conducted a program from 1985-1989 which resulted in a 26% rainfall increase.[7]

In 1996 the District participated in forming the West Texas Weather Modification Association to perform rainfall enhancement for a target area covered by seven groundwater conservation districts and portions of Tom Green County (6,426,757 acres). During the2010 seeding season (March 8 - September 12) the District received an average of an additional 2.82 inches, or a 16% increase, of normal rainfall for a 17.55" average total[8]. Since 2002 evaluations by Active Influence & Scientific Management indicate that the district has received not less than a 10% increase in rainfall each year. This would equate to an extra year of normal rainfall over a 10-year period.

Under ideal conditions with 100% grass cover, 16% of rainfall absorbed into the ground surface infiltrates beyond the root zone for potential recharge.[9] Type and amount of ground surface covered by brush, rainfall event type (slow soaking or hard), and amount of rainfall per event will alter the amount of estimated recharge. The average rainfall for the District is 18.38 in/yr and 9.98" in the growing season[10] from May through September when weather modification activities occur. A modest 10% increase (one inch) of rainfall during the growing season would provide in a reduction of pumpage for all users, potential increase in runoff, increased productivity of crops and rangeland (thus improving the economy of the district and region), provide additional moisture infiltration below the root zone available for recharge, and increased spring flow.

The District collects water levels and rainfall data to be used for determining approximate recharge and

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[5] Weather Modification: Private and Social Benefits and Costs, Texas Tech University, Lubbock, TX, August 1996, by James E. Jonish, Rasheed Al-Hmoud, and David Yoskowitz.

[6] "1995 Weather Modification Program", Colorado River Municipal Water District, Report 95-1.

[7] "Three Rainfall Augmentation Programs in Texas", by Don A. Griffith, The Journal of Weather Modification, April 1987.

[8] West Texas Weather Modification Association Annual Evaluation Report 2010, Active Influence & Scientific Management

[9] "How an Increase or Reduction in Juniper Cover Alters Rangeland Ecology" and Justin W. Hester, 1997 Juniper Symposium, Technical Report 97-1, Texas A&M Research and Extension Service , by Thomas L. Thurow.

[10] U.S. Department of Agriculture, Soil Conservation Service - Soil Survey of Sterling County Texas.

storage change estimates. It is the belief of the district that there is a direct correlation between rainfall events (amount, duration, and intensity) and actual recharge potential. Calculating recharge estimates solely by a percentage of total annual rainfall does not take into account individual rainfall events, soil moisture, amount of brush cover, or other limiting factors. Many small rainfall events are not sufficient enough to provide any runoff or infiltration past the root zone for potential recharge and therefore should not be considered in recharge calculation. Observation of increased water levels following rainfall events indicate that for significant recharge there needs to be sustained runoff. Also the amount of moisture in the soil profile effects the amount of percolated moisture available for recharge.

Brush Control

Brush control can be accomplished by mechanical control, prescribed burn, chemical application, or combination of these methods. The control of mesquite and juniper, and other undesirable plants would allow more rainfall to reach the soil surface. Benefits would include more rainfall absorption into the soil profile, increased productivity of rangeland (and resulting economic impact), and increased amount of moisture available to infiltrate as recharge.

A large mature juniper has an evapotranspiration rate of about 33 gal/day. [11] This same mature juniper only allows approximately 25% of rainfall to reach the soil surface due to canopy and litter interception. A modest coverage equal to 5 mature junipers per acre would use 60,225 gallons/acre/year.

A stand of 12 foot high mesquite at a density of 120 trees per acre uses 13 gallons/tree/day.[12] Assuming that mesquite will actively transpire water 180 days each year (May through October) an estimated water use can be calculated. Assuming a coverage of 90 trees per acre using 15 gallons/tree/day, the estimated water use per acre would be 243,000 gallons/acre/season (90 trees X 15 gallons X 180 days). Note that fewer trees per acre use more water because of increased canopy area and less competition.

Combining the estimated use for juniper and mesquite would equal 303,225 gallons/acre/year use. This does not take into consideration other brush use, mainly prickly pear. It is not unrealistic to assume that brush accounts for up to one acre foot of water use per acre per year.

Brush removal allows more rainfall to reach the soil surface increasing available moisture for absorption into the soil profile and potential increase of deep infiltration and recharge. The District is located within the State of Texas Brush Control Program, Upper Colorado/Twin Buttes Reservoir Watershed. In cooperation with the Upper Colorado River Authority, the district continues to monitor water levels and provide data for their Brush Control Research Program on the North Concho River.

Management of Groundwater Supplies

The District will monitor groundwater resources within the District to promote the conservation,

[11] "Biology and Ecology of Redberry Juniper", 1997 Juniper Symposium, Technical Report 97-1, Texas A&M Research and Extension Service , by Darrell N. Uehert.

[12] *The Cattleman* magazine, June 2005, "How Much of a Water Thief is Mesquite?" by R. James Ansley.

preservation, protection, enhanced recharge, prevention of waste and pollution, and ensure efficient use of the resource while seeking to maintain its integrity and the economic viability of all resource user groups, public and private. In consideration of the economic and cultural activities occurring within the District, the District will identify and engage in such activities and practices, that if implemented would result in a reduction of groundwater use and/or enhanced recharge and storage. The District will employ all technical resources at its disposal and within budget constraints to evaluate the resources available within the District and to determine the effectiveness of management or conservation measures.

Actions, Procedures, Performance and Avoidance for Plan Implementation

The District will implement and utilize the provisions of this plan as a guide for determining the direction and/or priority for District activities. Operations of the District and all agreements entered into by the District will be consistent with the provisions of this plan.

The District has adopted rules for the management of groundwater resources and will amend those rules as necessary pursuant to TWC Chapter 36 and the provisions of this plan. Rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available. Current rules are available at http://www.sterlinguwcd.org/SCUWCDRules.pdf.

The District shall treat all residents with equality. Residents may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local character. In granting discretion to any rule, the Board shall consider the potential for adverse effect on adjacent landowners. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board. The District will seek cooperation in the implementation of this plan and the management of groundwater supplies within the District.

Methodology for Tracking Progress

The methodology that the District will use to trace the progress in achieving the management goals will be as follows: the District holds a regular monthly Board Meeting for the purpose of conducting District business. Each month the Managers Report will continue to reflect meetings attended, water samples collected and analyzed, water levels monitored, fluid injection permit applications, reports on any school or civic group programs, resulting action regarding potential contamination or remediation of actual contamination, and other matters of district importance.

Required Estimates for the Management Plan

Estimates of groundwater availability, usage, supplies, recharge, storage, and future demands are from data supplied by the Texas Water Development Board. Use of these TWDB estimates does not constitute endorsement by the District. All values are expressed as acre-feet.

31 TAC, Chapter 356, §356.5 and Texas Water Code, Chapter 36, §36.1071, as amended, list the required estimates and contents of a groundwater conservation district management plan unless explained as either non applicable or not cost-effective.

Estimates required by §356.5(A)-(G) include:

(A). Managed Available Groundwater based on Desired Future Condition of the aquifer pursuant to §36.108.

Groundwater Management Area 7 adopted DFC's for all aquifers located within the District boundaries on July 29, 2010 and have submitted them to the TWDB. However, no MAG has been calculated by the TWDB and petitioners have a year after adoption to file a petition. GMA 7 adopted a 7 foot average drawdown for the entire Edwards-Trinity (Plateau) Aquifer (6 foot average within the District) and declared both the Dockum and Lipan Aquifers non relevant within the District.

Since pumpage in the Dockum and Lipan aquifers is domestic and livestock use and the District does not foresee any future development of these aquifers that would require district permits therefore a DFC is non relevant for either aquifer.

Pending receipt of the MAG from the TWDB, the District considers the current Region F 2006 Regional Water Plan, and the Initially Prepared Region F Water Plan for 2011, groundwater availability estimates as the Managed Available Groundwater estimates for the District.

(B). Amount of groundwater being used within the district on an annual basis.

The amount of groundwater being used within the district on an annual basis was obtained from the "Sterling County UWCD Management Plan Data EXPORT 07-20-10 " management plan data workbook, "GCD Historical Water Usage"tab as provided to the District by the Texas Water Development Board.

Historical Water Use Estimate Summary- Sterling County UGCD-Specific Data

Unit: Acre Feet (ACFT)

Disclaimer: No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. District personnel must review these data and correct any discrepancies in order to ensure the approval of their management plans. These data are available on the internet from the Historical Water Use Information-Historical Water Usage Estimates web page (http://www.twdb.state.tx.us/wushistorical/DesktopDefault.aspx?PageID=1). Please do not hesitate to call either Rima Petrossian (512-936-2420) or Stephen Allen (512-463-7317) with questions concerning these datasets.

GW = groundwater; SW = surface water

Sterling County

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
2000	GW	324	0	0	637	560	292	1,813
2000	SW	0	0	0	0	0	73	73
	Total	**324**	**0**	**0**	**637**	**560**	**365**	**1,886**
2001	GW	292	0	0	681	560	368	1,901
2001	SW	0	0	0	0	0	93	93
	Total	**292**	**0**	**0**	**681**	**560**	**461**	**1,994**
2002	GW	289	0	0	717	560	322	1,888
2002	SW	0	0	0	0	0	81	81
	Total	**289**	**0**	**0**	**717**	**560**	**403**	**1,969**
2003	GW	262	0	0	613	0	197	1,072
2003	SW	0	0	0	0	0	49	49
	Total	**262**	**0**	**0**	**613**	**0**	**246**	**1,121**
2004	GW	262	0	0	496	0	202	960
2004	SW	0	0	0	0	0	51	51
	Total	**262**	**0**	**0**	**496**	**0**	**253**	**1,011**

TOM GREEN COUNTY

Year	Source	Livestock[1]	Total
2000	GW	2	2
2000	SW	15	15
	Total	**17**	**17**
2001	GW	1	1
2001	SW	13	13
	Total	**14**	**14**
2002	GW	2	2
2002	SW	15	15
	Total	**17**	**17**
2003	GW	1	1
2003	SW	13	13
	Total	**14**	**14**
2004	GW	1	1
2004	SW	11	11
	Total	**12**	**12**

The portion of Tom Green County within the district has only domestic and livestock use. The percentage of historic use derived by the TWDB is 0.86%

(C)(D)(E). Amount of annual recharge from precipitation, natural discharge to springs, volume of flow into and out of the district and between aquifers for each aquifer if groundwater availability model is available.

GAM Run 10-026
by Eric Aschenbach
Texas Water Development Board
Groundwater Availability Modeling Section
August 24, 2010

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator in conjunction with any available site-specific information provided by the district and acceptable to the executive administrator. Information derived from groundwater availability models that shall be included in groundwater management plans include:

(1) the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;

(2) for each aquifer within the district the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and

(3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report supersedes GAM Run 08-13 dated April 8, 2008. A groundwater availability model was not previously completed for the Dockum Aquifer, but a model that includes the Sterling County Underground Water Conservation District was released in January 2009. In addition, a groundwater availability model for the Lipan Aquifer was not included in the previous report. The purpose of this model run is to provide information to the Sterling County Underground Water Conservation District needed for its groundwater management plan. The groundwater management plan for the Sterling County Underground Water Conservation District is due for approval by the executive administrator of the Texas Water Development Board before January 25, 2011.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for theLipan Aquifer,the Edwards-Trinity (Plateau) Aquifer, and the Dockum Aquifer. Tables 1 through 3 summarize the groundwater availability model data required by the statute, and figures 1 through 3 show the area of each model from which the values in the respective tables were extracted.

Table 1 : Summarized information for the Lipan Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Lipan Aquifer	102
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lipan Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Lipan Aquifer	277
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	443
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

Table 2 : Summarized information for the Edwards-Trinity (Plateau) Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	10,236
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	6,097 [A]
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	1,704
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	4,461
Estimated net annual volume of flow between each aquifer in the district	Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer	1,170

Footnote:

A — Approximately 75% of this flow may be going to the non-modeled portion of the Lipan Aquifer either directly or indirectly.

Table 3:Summarized information for the Dockum Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	439
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Docicum Aquifer	224
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	7,073
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	5,741
Estimated net annual volume of flow between each aquifer in the district	Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer	1.170 [B]

Footnote:
B - The net outflow from the General Head Boundary (GHB) in the Edwards-Trinity (Plateau) Aquifer should be used instead of the value from the Dockum Aquifer (see "Parameters and Assumptions- section of this report).

(F). Projected surface water supply according to most recently adopted state water plan.

2007 State Water Plan - Projected Surface Water Supplies
Sterling County Underground Water Conservation District
Groundwater Conservation District Specific - Surface Water Data

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Sterling County

RWPG	Water User Group	County	River Basin	Source Name	2000	2010	2020	2030	2040	2050	2060
F	Irrigation	Sterling	Colorado	North Concho River Combined Run-of-River Irrigation	0	48	48	48	48	48	48
F	Livestock	Sterling	Colorado	Livestock Local Supply	99	74	74	74	74	74	74
Total Projected Surface Water Supplies (acre-feet per year) =					**99**	**122**	**122**	**122**	**122**	**122**	**122**

Source: Volume 3, 2007 State Water Planning Database (http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp

Tom Green County

RWPG	Water User Group	County	River Basin	Source Name	2000	2010	2020	2030	2040	2050	2060
F	Livestock	Tom Green	Colorado	Livestock Local Supply	17	14	14	14	14	14	14
Total Projected Surface Water Supplies (acre-feet per year) =					**17**	**14**	**14**	**14**	**14**	**14**	**14**

Source: Volume 3, 2007 State Water Planning Database http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

* Since the District does not cover all of Tom Green County, it is recommended that the Projected Surface Water Supply estimates presented in the management plan be based on (reduced by) a proportional area percentage unless more accurate data is available to the District. This percentage can be derived by dividing the amount of acres or square miles covered by the District by the total number of acres or square miles contained within Tom Green County. The percentage derived by the T.W.D.B. is 0.86% (i.e. 0.0086; see the 'Area' tab), but any estimate that the District provides is preferable.

Sterling County UWCD Management Plan Data EXPORT 07-20-10, GCD Water Demands

Portions of Tom Green County covered by the District include individual ranches. The only surface water use within the portions of Tom Green County in the District is for livestock.

(G). Projected total demand in the district according to the most recently adopted state water plan.

Both Total County Water Demand Data and District specific date are included for reference purposes.

2007 State Water Plan Projected Water Demands

Total County Water Demands Data

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Sterling County

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
F	Sterling City	Sterling	Colorado	275	302	332	344	348	339	343
F	County Other	Sterling	Colorado	49	54	59	61	62	60	61
F	Mining	Sterling	Colorado	560	590	600	605	610	615	620
F	Irrigation	Sterling	Colorado	637	648	621	595	569	543	518
F	Livestock	Sterling	Colorado	365	503	503	503	503	503	503
Total Projected Water Demands (acre-feet per year) =				**1,886**	**2,097**	**2,115**	**2,108**	**2,092**	**2,060**	**2,045**

Source: Volume 3, 2007 State Water Planning Database http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

Tom Green County

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
F	San Angelo	Tom Green	Colorado	16,048	21,117	22,195	22,878	23,256	23,556	23,623
F	Concho Rural WSC	Tom Green	Colorado	473	736	953	1,090	1,167	1,227	1,241
F	Millersview-Doole WSC	Tom Green	Colorado	217	246	280	318	361	411	467
F	County Other	Tom Green	Colorado	1,225	1,794	1,768	1,729	1,678	1,617	1,542
F	Manufacturing	Tom Green	Colorado	1,861	2,226	2,498	2,737	2,971	3,175	3,425
F	Steam Electric Power	Tom Green	Colorado	566	543	777	909	1,069	1,264	1,502
F	Mining	Tom Green	Colorado	59	73	80	85	90	95	99
F	Irrigation	Tom Green	Colorado	30,415	104,621	104,362	104,107	103,852	103,593	103,338
F	Livestock	Tom Green	Colorado	1,886	1,978	1,978	1,978	1,978	1,978	1,978
Total Projected Water Demands (acre-feet per year) =				**52,750**	**133,334**	**134,891**	**135,831**	**136,422**	**136,916**	**137,215**

Source: Volume 3, 2007 State Water Planning Database http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

Sterling County UWCD Management Plan Data EXPORT 07-20-10, County Water Demands

2007 State Water Plan Projected Water Demands

Sterling County UWDC-specific data

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Sterling County

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
F	Sterling City	Sterling	Colorado	275	302	332	344	348	339	343
F	County Other**	Sterling	Colorado	49	54	59	61	62	60	61
F	Mining**	Sterling	Colorado	560	590	600	605	610	615	620
F	Irrigation**	Sterling	Colorado	637	648	621	595	569	543	518
F	Livestock**	Sterling	Colorado	365	503	503	503	503	503	503
Total Projected Water Demands (acre-feet per year) =				**1,886**	**2,097**	**2,115**	**2,108**	**2,092**	**2,060**	**2,045**

Source: Volume 3, 2007 State Water Planning Database (http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

** Since the District covers all of Sterling County no proportional estimate is necessary. Total county-wide data are sufficient.

Tom Green County

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
F	**Livestock***	Tom Green	Colorado	**16**	**17**	**17**	**17**	**17**	**17**	**17**
Total Projected Water Demands (acre-feet per year) =				**16**	**17**	**17**	**17**	**17**	**17**	**17**

Source: Volume 3, 2007 State Water Planning Database (http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

* Since the District does not cover all of Tom Green County, it is recommended that all estimates presented in the management plan be based on (reduced by) a proportional area percentage unless more accurate data is available to the District. This percentage can be derived by dividing the amount of acres or square miles covered by the District by the total number of acres or square miles contained within Tom Green County. The percentage derived by the T.W.D.B. is 0.86% (i.e. 0.0086; see the 'Area' tab), but any estimate that the District provides is preferable.

‡ Location unknown. No utility or public water system maps available online.

Sterling County UWCD Management Plan Data EXPORT 07-20-10, GCD Water Demands

The portion of Tom Green County within the district has only domestic and livestock use. The percentage of predicted demand derived by the TWDB is 0.86%

§356.5(a)(7) Consideration of water supply needs and water management strategies included in the adopted state water plan.

2007 State Water Plan Projected Water Needs
Total County Water Needs Data

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Positive values reflect a water surplus; negative values reflect a water need.

Sterling County

RWPG	WUG	County	River Basin	2010	2020	2030	2040	2050	2060
F	Sterling City	Sterling	Colorado	0	0	0	0	0	0
F	County Other	Sterling	Colorado	0	0	0	0	0	0
F	Mining	Sterling	Colorado	0	0	0	0	0	0
F	Irrigation	Sterling	Colorado	0	0	0	0	0	0
F	Livestock	Sterling	Colorado	0	0	0	0	0	0
			Total Projected Water Needs (acre-feet per year) =	**0**	**0**	**0**	**0**	**0**	**0**

Source:Volume 3, 2007 State Water Planning Database (http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

Tom Green County

RWPG	WUG	County	River Basin	2010	2020	2030	2040	2050	2060
F	San Angelo	Tom Green	Colorado	-9,184	-10,025	-10,564	-10,798	-11,184	-11,469
F	County Other	Tom Green	Colorado	-41	0	0	0	0	0
F	Manufacturing	Tom Green	Colorado	-2,226	-2,498	-2,737	-2,971	-3,175	-3,425
F	Steam Electric Power	Tom Green	Colorado	-543	-777	-909	-1,069	-1,264	-1,502
F	Mining	Tom Green	Colorado	0	0	0	0	0	0
F	Irrigation	Tom Green	Colorado	-47,090	-46,831	-46,576	-46,321	-46,062	-45,807
F	Livestock	Tom Green	Colorado	0	0	0	0	0	0
F	Concho Rural WSC	Tom Green	Colorado	0	0	0	0	0	0
F	Millersview-Doole WSC	Tom Green	Colorado	0	0	0	0	-115	-164
			Total Projected Water Needs (acre-feet per year) =	**-59,084**	**-60,131**	**-60,786**	**-61,159**	**-61,800**	**-62,367**

Source:Volume 3, 2007 State Water Planning Database http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

Sterling County UWCD Management Plan Data EXPORT 07-20-10, County Water Needs

2007 State Water Plan Projected Water Management Strategies
Total County Water Strategies Data

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Sterling County

WUG	WUG County	Water Management Strategy	Source Name	Source County	2010	2020	2030	2040	2050	2060
Irrigation	Sterling	Irrigation Conservation	Conservation	Sterling	0	45	89	89	89	89
Total Projected Water Management Strategies (acre-feet per year) =					**0**	**45**	**89**	**89**	**89**	**89**

Source: Volume 3, 2007 State Water Planning Database http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp)

Tom Green County

WUG	WUG County	Water Management Strategy	Source Name	Source County	2010	2020	2030	2040	2050	2060
Steam Electric Power	Tom Green	Alternative Generation Technology	Conservation	Tom Green	0	0	0	48	243	481
Irrigation	Tom Green	Irrigation Conservation	Conservation	Tom Green	0	5,774	11,548	11,548	11,548	11,548
Irrigation	Tom Green	Subordination	Nasworthy Lake/Reservoir San Angelo System	Reservoir	3,377	3,273	3,170	3,066	2,693	2,860
Steam Electric Power	Tom Green	Subordination	Nasworthy Lake/Reservoir San Angelo System	Reservoir	1,021	1,021	1,021	1,021	1,021	1,021
San Angelo	Tom Green	Desalination	Other Aquifer	Tom Green	0	5,600	5,600	5,600	5,600	5,600
San Angelo	Tom Green	Develop Edwards Trinity Aquifer Supplies	Edwards-Trinity-Plateau Aquifer	Schleicher	0	0	0	12,000	12,000	12,000
San Angelo	Tom Green	Develop Hickory Aquifer Supplies	Hickory Aquifer	McCulloch	0	0	5,000	12,000	12,000	12,000
San Angelo	Tom Green	Develop Other Aquifer Supplies	Other Aquifer	Pecos	0	0	0	12,000	12,000	12,000
San Angelo	Tom Green	Municipal Conservation	Conservation	Tom Green	701	1,705	2,009	2,127	2,255	2,371
San Angelo	Tom Green	Rehabilitation of Pipeline	EV Spence Lake/Reservoir Non-System Portion	Reservoir	2,274	2,261	2,247	2,233	2,220	2,206
Millersview-Doole WSC	Tom Green	Subordination	Colorado River MWD System	Reservoir	64	87	1	19	0	0
San Angelo	Tom Green	Subordination	Nasworthy Lake/Reservoir San Angelo System	Reservoir	5,436	5,078	4,752	4,431	4,141	3,804
County-Other	Tom Green	Subordination	Nasworthy Lake/Reservoir San Angelo System	Reservoir	250	250	250	250	250	250
Manufacturing	Tom Green	Subordination	Nasworthy Lake/Reservoir San Angelo System	Reservoir	2,226	2,498	2,737	2,971	3,175	3,425
San Angelo	Tom Green	Subordination	OC Fisher Lake/Reservoir San Angelo System	Reservoir	3,762	3,643	3,525	3,407	3,288	3,170
San Angelo	Tom Green	Subordination	OH Ivie Lake/Reservoir Non-System Portion	Reservoir	17	-97	-211	-324	-438	-553
Millersview-Doole WSC	Tom Green	New/Renew Water Supply	Colorado River MWD System	Reservoir	0	0	0	0	359	408
San Angelo	Tom Green	Brush Control	Concho River Combined Run-of-River City of San Angelo	Tom Green	8,362	8,362	8,362	8,362	8,362	8,362
San Angelo	Tom Green	Subordination	EV Spence Lake/Reservoir Non-System Portion	Reservoir	0	0	0	0	0	0
San Angelo	Tom Green	System Optimization	San Angelo System Gain	Reservoir	0	0	0	0	0	0
San Angelo	Tom Green	New Pipeline from San Angelo Desalination Plant	Other Aquifer	Tom Green	0	0	0	0	0	0
Total Projected Water Management Strategies (acre-feet per year) =					**27,490**	**39,455**	**50,011**	**80,759**	**80,717**	**80,953**

The District promotes conservation of all water use within the District regardless of source or water use group. Although the District has participated in weather modification since 1996 no weather modification strategy was included. A discussion of district participation in weather modification is included in the "Enhancement of Availability and Storage" subsection on page 12.

None of the strategies for Tom Green County apply to the area of Tom Green County covered by the District. Use in the Tom Green County portion of the District is domestic and livestock and limited mining.

Goals, Management Objectives and Performance Standards

The District recognizes the importance of public education to encourage efficient use, implement conservation practices, prevent waste, and preserve the integrity of groundwater. Since the District was formed, in 1987, it has and will continue to provide residents with materials, programs, water analysis, and other information when requested.

Goal 1.0 - §36.1071(a)(1) Providing the Efficient Use of Groundwater

1.1. Management Objective
The District will continue to maintain the current monitor well network and measure water levels in selected wells.

1.1a. Performance Standard
Number of water levels measured.

Goal 2.0 - §36.1071(a)(2) Controlling and Preventing Waste of Groundwater

2.1. Management Objective
The District will continue to register wells drilled in the district.

2.1a. Performance Standard
Number of wells registered.

Goal 3.0 - §36.1071(a)(6) Addressing Drought Conditions

3.1.Management Objective
The District will continue to monitor the NOAA Climate Prediction Center and report to the board.

3.1a. Performance Standard
Number of times index is monitored.

3.3 .Management Objective
The District will continue to maintain the current rainfall monitor network.

3.3a. Performance Standard
Number of times rainfall network is monitored.

Goal 4.0 - §36.1071(a)(7) Addressing Conservation and Precipitation Enhancement

4.1 Management Objective - Conservation
The District will continue to be a source for all available informational materials and programs

to improve public awareness of efficient use, wasteful practices and conservation measures.

4.1a. Performance Standard
Number of informational materials and programs provided.

4.2 Management Objective - Precipitation Enhancement
The District will continue to participate in the West Texas Weather Modification Association.

4.2a. Performance Standard
Number of meetings attended.

Goal 5.0 - §36.1071(a)(8) Addressing in a Quantitative Manner the Desired Future Conditions of the Groundwater Resources

5.1 Management Objective
The District will continue to monitor the transducer data in the monitor water network.

5.1a. Performance Standard
Number of times transducer network data is monitored.

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Management Goals Determined Not-Applicable

Goal 6.0 - §36.1071(a)(3) Controlling and Preventing Subsidence
The rigid geologic framework of the region precludes significant subsidence from occurring. This management goal is not applicable to the operations of the District.

Goal 7.0 - §36.1071(a)(4) Addressing Conjunctive Surface Water Management Issues
There are no surface water management entities within the District. This management goal is not applicable to the operations of the District.

Goal 8.0 - §36.1071(a)(5) Addressing Natural Resource Issues
The District has no documented occurrence of endangered or threatened species dependent upon groundwater. This management goal is not applicable to the operations of the District.

Goal 9.0 - §36.1071(a)(7) Addressing Recharge Enhancement
The diverse topography, and limited knowledge of any specific recharge sites makes any type of recharge enhancement project economically unfeasible. This management goal is not applicable to the operation of the District.

Goal 10.0 - §36.1071(a)(7) Addressing Rainwater Harvesting
The semiarid nature of the area within the District makes the cost of rainwater harvesting projects economically unfeasible. Educational material and programs on rainwater harvesting are provided by the Texas Agrilife Extension Service. This management goal is not applicable to the operations of the District.

Goal 11.0 - §36.1071(a)(7) Addressing Brush Control
The District recognizes the benefits of brush control through increased spring flows and the enhancement of native turf which limits runoff. However, most brush control projects within the District are carried out and funded through the Natural Resources Conservation Service (NRCS) and ample educational material and programs on brush control are provided by the Texas Agrilife Extension Service. This management goal is not applicable to the operations of the District.

Definitions and Concepts

“Board” - the Board of Directors of the Sterling County Underground Water Conservation District.

“District” - the Sterling County Underground Water Conservation District.

“Effective recharge” - the amount of water that enters the aquifer and is available for development

“Groundwater” - means water percolating below the surface of the earth.

“Integrity” - means the preservation of groundwater quality.

“Ownership” - pursuant to TWC Chapter 36, §36.002, means the recognition of the rights of the owners of the land pertaining to groundwater.

“Recharge” - amount of water that infiltrates into an aquifer.

“Surface Water Entity” - TWC Chapter 15 Entities with authority to store, take divert, or supply surface water for use within the boundaries of a district.

“TCEQ” - Texas Commission on Environmental Quality.

“TWDB” - Texas Water Development Board.

"Waste" - pursuant to TWC Chapter 36, §36.001(8), means any one or more of the following:

(1) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock raising purposes;

(2) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose;

(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

(4) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of the owner of the well unless such discharge is authorized by permit, rule, or order issued by the commission under Chapter 26;

(6) groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge; or

(7) for water produced from an artesian well, “waste” has the meaning assigned by Section 11.205.

“Well” - means an artificial excavation that is dug or drilled for the purpose of producing groundwater.

#2207

FILED November 4, 2010
At 2:24 o'clock P M
SUSAN WYATT
County Clerk, Sterling County, Texas
By Kayla A. Munoz, Deputy

NOTICE OF MEETING OF THE STERLING COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

A PUBLIC HEARING will convene at 1:00 PM on the 9th day of NOVEMBER, 2010, in the Sterling County Underground Water Conservation District Office, 612 4th, Sterling City, Texas. The purpose of this hearing is to accept public comment on the proposed 2010-20 Management Plan.

The REGULAR term of the Sterling County Underground Water Conservation District meeting will convene immediately following the Public Hearing on the 9th day of NOVEMBER, 2010, the District Office, 612 4th, Sterling City, Texas, to transact the following business:

1. Public Comment - limit 5 minutes each person.
2. Approve Minutes of the previous meeting.
3. Consider and take action on Payment of Bills due.
4. Receive Manager's Report on the following topics:
   (a) Meetings attended
   (b) Well Surveillance reports
5. Consider and take action to adopt the 2010-20 Management Plan.
6. Adjourn.

Bill Humble
Scott Holland, Manager
Bill Humble, Technician

THE STATE OF TEXAS:

COUNTY OF STERLING:

This is to certify that at the time and on the date stamped thereon, this notice of a meeting, a copy of which is attached hereto, has been filed in my office under File No. 2207 and was posted on the bulletin board in the Courthouse, as is required by Chapter 551, Government Code.

Executed on November 4, 2010

Susan Wyatt, County Clerk, Sterling County, Texas

By Kayla A. Munoz, Deputy Clerk

These public hearings and meetings are available to all persons regardless of disability. If you require special assistance to attend the meeting or hearing, please contact the Sterling County UWCD at 325 378-2704 at least 24 hours in advance of the meeting.

STATE OF TEXAS
COUNTY OF STERLING

MANAGEMENT PLAN
2010-2020

WHEREAS, the Irion County Water Conservation District was created by Acts of the 70th Legislature (1987), H.B. 2587, in accordance with Article XVI, Section 59 of the Constitution of Texas and Chapter 36 of the Texas Water Code, as amended; and

WHEREAS, the District is required by Chapter 36, §36.1071 of the Texas Water Code to develop and adopt a Management Plan; and

WHEREAS, the District is required by Chapter 36, §36.1072 of the Texas Water Code to review and re-adopt the plan with or without revisions at least once every five years and to submit the adopted Management Plan to the Executive Administrator of the Texas Water Development Board for review and approval; and

WHEREAS, the District's readopted revised Management Plan shall be approved by the Executive Administrator if the plan is administratively complete; and

WHEREAS, the District Board of Directors, after reviewing the existing Management Plan, has determined that this plan should be revised and replaced with a new 10-Year Management Plan expiring in 2020; and

WHEREAS, the District Board of Directors has determined that the 10-Year Management Plan addresses the requirements of Chapter 36, §36.1071.

NOW, THEREFORE, be it resolved, that the Board of Directors of the Sterling County Underground Water Conservation District, following notice and hearing, hereby adopts this 10-Year Management Plan; and

FURTHER, be it resolved, that this new Management Plan shall become effective immediately upon adoption.

Adopted this 9th day of November, 2010, by the Board of Directors of the Sterling County Underground Water Conservation District.

Presiding Officer

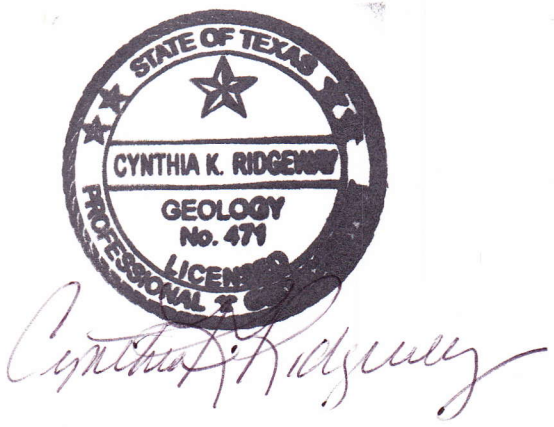
Attest:

Attesting Signature

GAM Run 10-026

by Eric Aschenbach
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-1708

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Eric Aschenbach under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on August 24, 2010.



EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, groundwater conservation districts shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

(1) the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
(2) for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
(3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report supersedes GAM Run 08-13 dated April 8, 2008. The purpose of this report is to provide information to Sterling County Underground Water Conservation District for its groundwater management plan. A groundwater availability model was not previously completed for the Dockum Aquifer, but a model that includes the Sterling County Underground Water Conservation District was released in January 2009. In addition, a groundwater availability model for the Lipan Aquifer was not included in the previous report. The groundwater management plan for Sterling County Underground Water Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before January 25, 2011.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the Lipan Aquifer, the Edwards-Trinity (Plateau) Aquifer, and the Dockum Aquifer. Tables 1 through 3 summarize the groundwater availability model data required by the statute, and figures 1 through 3 show the area of each model from which the values in the respective tables were extracted.

METHODS:

We ran the groundwater availability models for the Lipan Aquifer (1980 through 1999), the Edwards-Trinity (Plateau) Aquifer (1980 through 2000), and the Dockum Aquifer (1980 through 1997) and (1) extracted water budgets for each year of the transient model period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

Lipan Aquifer

- We used version 1.01 of the groundwater availability model for the Lipan Aquifer. See Beach and others (2004) for assumptions and limitations of the groundwater availability model for the Lipan Aquifer.

- The Lipan Aquifer model includes one layer representing the Quaternary Leona Formation, portions of the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north.

- The model extent only covers a small area along the eastern portion of the district. However, the official aquifer boundary extends through the central portion of the district. Due to this, the model under-estimates groundwater resources in the district in regards to this aquifer.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model for the Lipan Aquifer is 18 feet for the calibration period (1980 to 1989) and 17 feet for the verification period (1990 to 1999: Beach and others, 2004).

- We used Processing MODFLOW for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output.

Edwards-Trinity (Plateau) Aquifer

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of this model.

- The Edwards-Trinity (Plateau) Aquifer model includes two layers representing the Edwards Group and associated limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2). An individual water budget for the district was determined for the Edwards-Trinity (Plateau) Aquifer (Layer 1 and Layer 2 collectively).

- The General-Head Boundary (GHB) package of MODFLOW was used to represent flow out of the study area and into the Dockum Aquifer.

- The root mean square error (a measure of the difference between simulated and measured water levels) of the Edwards-Trinity (Plateau) groundwater availability model for the period of 1980 through 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2009).

- We used Processing MODFLOW for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output.

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the Dockum Aquifer. See Ewing and others (2008) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes three layers, representing (from top to bottom):

  1. younger geologic units overlying the Dockum Aquifer,
  2. the upper portion of the Dockum Aquifer, and
  3. the lower portion of the Dockum Aquifer.

  An individual water budget for the district was determined for the Dockum Aquifer (Layers 1 through Layer 3, collectively).

- The aquifers represented in Layer 1 of the groundwater availability model are only included in the model for the purpose of more accurately representing flow between these units and the Dockum Aquifer. This model is not intended to explicitly simulate flow in these overlying units (Ewing and others, 2008).

- The General-Head Boundary (GHB) package of MODFLOW was applied to the areas in Layer 1 with a high conductance in order to properly mimic water levels in these units. Where the GHB correlates with

the Ogallala Aquifer, transient head values for the GHB were taken from the historical portion of the groundwater availability model (Blandford and others, 2003; Dutton, 2004; Ewing and others, 2008). Outside of the footprint of the Ogallala Aquifer, GHB values for the Dockum Aquifer model were estimated from land surface elevation (Ewing and others, 2008; discussed in Oliver and Hutchison, 2010). Since GHB values for the portion of the model within the district are based on estimates from land surface elevations, it is believed to be more appropriate to use the GHB values from the Edwards-Trinity (Plateau) Aquifer model water budget to describe the relationship between the Edwards-Trinity (Plateau) Aquifer and the Dockum Aquifer.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) in the entire model between 1980 and 1997 is 65.0 feet and 69.6 feet for the upper and lower portions of the Dockum Aquifer, respectively (Ewing and others, 2008). This represents 2.7 and 3.0 percent of the hydraulic head drop across the model area for these same aquifers, respectively.

- The MODFLOW Drain package was used to simulate both evapotranspiration and springs. However, there were no model grid cells representing springs within the district so there was no drain flow incorporated into the surface water outflow values shown in Table 3.

- We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in tables 1 through 3. The components of the modified budget shown in tables 1 through 3 include:

- Precipitation recharge—This is the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

- Surface water outflow—This is the total water exiting the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- Flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

The information needed for the District's management plan is summarized in tables 1 through 3. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as district or county boundaries, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located (see figures 1 through 3).

Table 1: Summarized information for the Lipan Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Lipan Aquifer	102
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lipan Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Lipan Aquifer	277
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	443
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

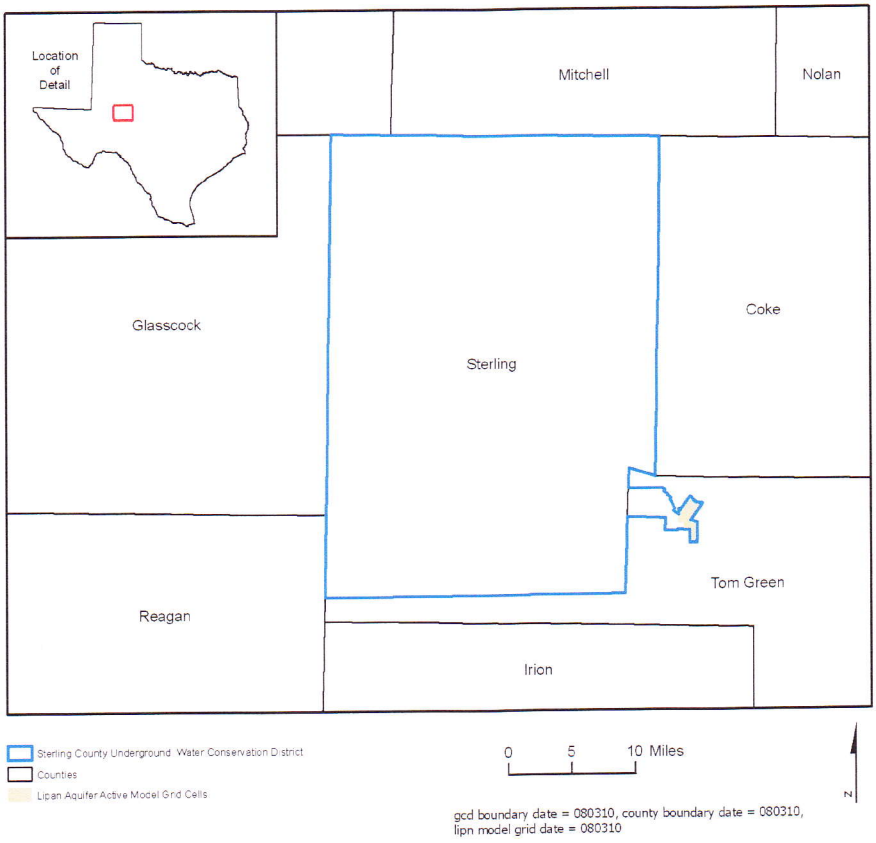


Figure 1: Area of the groundwater availability model for the Lipan Aquifer from which the information in Table 1 was extracted (the aquifer extent within the district boundary).

Table 2: Summarized information for the Edwards-Trinity (Plateau) Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	10,236
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	6,097 [A]
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	1,704
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	4,461
Estimated net annual volume of flow between each aquifer in the district	Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer	1,170

Footnote:
A – Approximately 75% of this flow may be going to the non-modeled portion of the Lipan Aquifer either directly or indirectly.

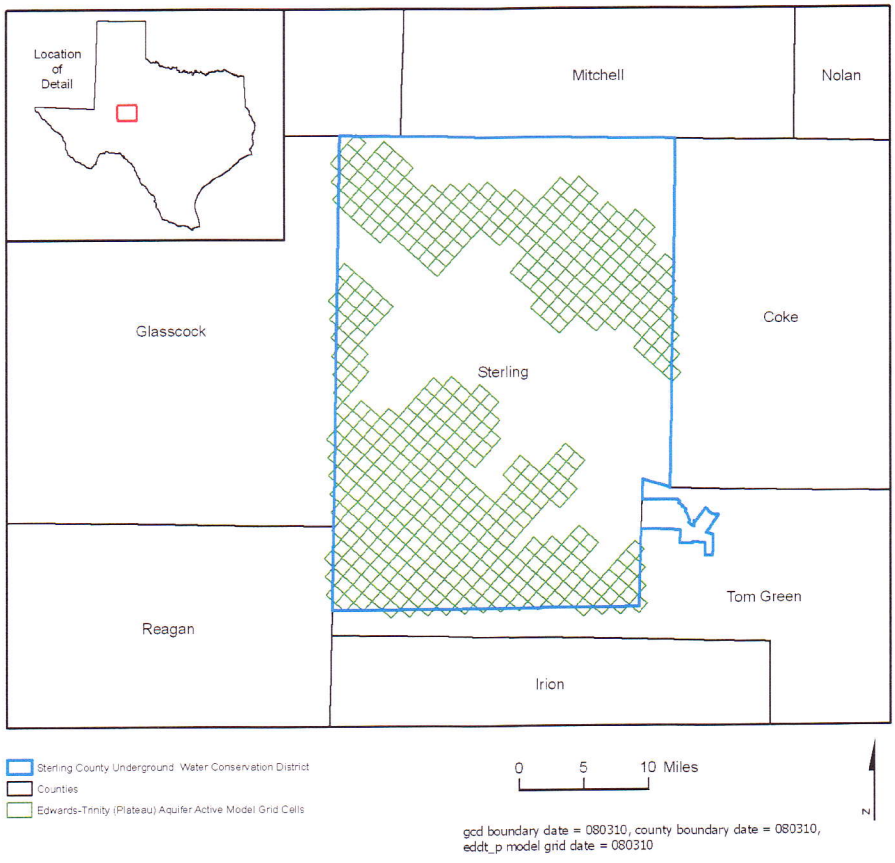


Figure 2: Area of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer from which the information in Table 2 was extracted (the aquifer extent within the district boundary).

Table 3: Summarized information for the Dockum Aquifer that is needed for Sterling County Underground Water Conservation District's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	439
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	224
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	7,073
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	5,741
Estimated net annual volume of flow between each aquifer in the district	Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer	1,170 [B]

Footnote:
B – The net outflow from the General Head Boundary (GHB) in the Edwards-Trinity (Plateau) Aquifer should be used instead of the value from the Dockum Aquifer (see "Parameters and Assumptions" section of this report).

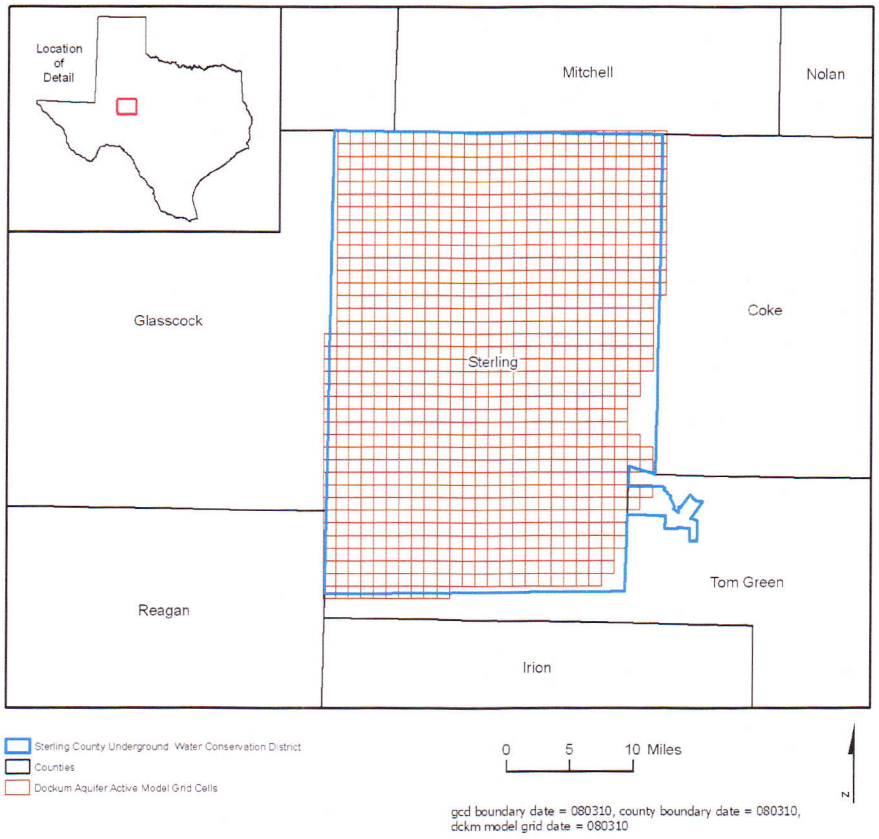


Figure 3: Area of the groundwater availability model for the southern portion of the Dockum Aquifer from which the information in Table 3 was extracted (the aquifer extent within the district boundary).

REFERENCES:

Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm.

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Blandford, T.N., Blazer, D.J., Calhoun, K.C., Dutton, A.R., Naing, T., Reedy, R.C., Scanlon, B.R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico—Numerical simulations through 2050: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 158 p., http://www.twdb.state.tx.us/gam/ogll_s/ogll_s.htm.

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 p.

Dutton, A., 2004, Adjustments of parameters to improve the calibration of the Og-N model of the Ogallala Aquifer, Panhandle Water Planning Area: Bureau of Economic Geology, The University of Texas at Austin, 9 p., http://www.twdb.state.tx.us/gam/ogll_n/ogll_n.htm.

Environmental Simulations, Inc., 2007, Guide to Using Groundwater Vistas Version 5, 381 p.

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., and Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p., http://www.twdb.state.tx.us/gam/dckm/dckm.htm.

Oliver, W., and Hutchison, W, 2010, Modification and Recalibration of the Groundwater Availability Model of the Dockum Aquifer: Texas Water Development Board, 114 p., http://www.twdb.state.tx.us/gam/dckm/Dockum_Modification_Report.pdf.