

Saratoga Underground Water Conservation District Management Plan – 2008

I. District Mission

The Saratoga Underground Water Conservation District Management Plan strives to protect and enhance the quantity and quality of useable water in the District.

This plan becomes effective upon approval by the Texas Water Development Board (TWDB) and will remain in effect until December 1, 2013, or a period of five years whichever is later. The plan may be revised at any time, or after five years when the plan will be reviewed to insure that it is consistent with the applicable Regional Water Plans and the State Water Plan.

Statement of Guiding Principles

The Saratoga Underground Water Conservation District is created and organized under the terms and provisions of Article XVI, Section 59, of the Constitution of Texas and Chapter 36 (formerly Chapters 50 & 52) of the Texas Water Code, Vernon's Texas Civil Statutes, and the District's actions are authorized by, and consistent with this constitutional and statutory provision, including all amendments and additions. The Act under which the Saratoga Underground Water Conservation District is created prevails over any provision of general law that is in conflict or inconsistent with this Act. The District was created for the purpose to protect and enhance the quantity of useable quality water by conserving, preserving, preventing waste, recharging, controlling subsidence, protecting and preventing waste and as far as practicable to minimize the draw-down of the water table and the reduction of artesian pressure of the Trinity and Other Aquifers within the District boundaries. In order to carry out its constitutional and statutory purposes, the District has all the powers authorized by Article XVI, Section 59, of the Texas Constitution, and Chapter 36 of the Texas Water Code, Vernon's Texas Civil Statutes, together with all amendments and additions.

The District's purposes and powers are implemented through promulgation and enforcement of the District's regulations. These regulations are adopted and revised under the authority of Subchapter E, Chapter 36, Texas Water Code, and are incorporated herein as a part of the District's management plan.

The District is governed by a board of five directors composed of a member from each of the county's precincts and an at-large member from Lampasas County, Texas. The chairman of the board of directors is elected by the board after each general election. The District is also served with at least six ex-officio directors; one from each commissioner precinct in the County; at least one at-large member; and at least one advisory member.

History

The need for a local underground water conservation district to properly manage water from the Trinity and Other Aquifers in Central Texas was first identified in the late 1980's. At the request of many concerned area citizens, our local State Representative and State Senator were contacted by our County Judge, with the approval of the Lampasas County Commissioners' Court, with an approach to create and enact an Act to form a water district. During Regular Session of the 71st Legislature, H.B. No. 3122 passed unanimously both in the House and the Senate in May, 1989. Be it enacted by the Legislature of the State of Texas on June 14, 1989 with a confirmation election to be held and approved by the registered voters of Lampasas County, Texas. Such election was held in November 1989 and approved by a majority of the voters thereby officially establishing the Saratoga Underground Water Conservation District effective January 1, 1990.

The leadership of the District transferred from the Commissioners Court and the County Judge to an appointed Board of Directors in September 2005 with the passage of HB 3539 enacted on September 1, 2005. The new board members continue to represent the four precincts of Lampasas County with an at-large member making up the fifth board membership. The

General election of 2006 confirmed three of the new directors with four-year terms of office. The remaining two members will be elected during the 2008 general election thereby composing the Board of all elected officials.

Location and Extent

The Saratoga Underground Water Conservation District is located in Central Texas. The District comprises an area of 714 square miles or 456,960 acres, all located within the boundary of Lampasas County, Texas. Principal municipalities and communities in our District include Lampasas, Lometa, Kempner, Adamsville, Izoro, Moline, and a part of Copperas Cove, with the city of Lampasas being the County Seat. County population in 2000 was 17,762.

Topography

The District is within the Brazos River Basin and the Colorado River Basin. The County/District line between San Saba and Lampasas Counties is the Colorado River. The Lampasas River, as well as numerous creeks dissects the District. Sulphur Creek is the major creek in the District and its main source of water is from springs. Drainage is typically from west to east.

II. Water Resources

The Saratoga Underground Water Conservation District lies in several aquifers, but the Trinity aquifer being the primary source of ground water of interest in our area. Water from this aquifer is used for irrigation, public water supply, industrial, stock, and domestic needs of the people and entities served.

Other aquifers include, but are not limited to, Marble Falls, Alluvium and Travis Peak Formation, Quaternary Alluvium, Alluvium and Terrace Deposits, Cretaceous System, Glen Rose Limestone, Glen Rose (lower), Sligo, Hensell, and Hosston within the District boundaries that meet the limited needs of individuals.

These aquifers occur in parts of many counties all the way up to a northern region of the state, but mostly in Central Texas. The primary source of ground water in the Travis Peak Formation is rainfall on the outcrop area. The District's altitude ranges from 800 to 1700 feet. Surface water seepage from lakes, creeks, and rivers, such as the Lampasas River located on the outcrop, is also a source of ground water to the formation. Another source of ground water is seepage from unlined earthen tanks and ponds, and the effluent water used in the irrigation of crops on the outcrop. Ground water in the Hensell and Hosston Members of the Travis Peak Formation occurs under both water table and artesian conditions.

The lower sands and shale of the Travis Peak are geologically and hydraulically continuous with the basal sands of the Antlers and both formations have a common piezometric surface and same quality of water.

In the outcrop area, the sands and gravels of the Travis Peak Formation are not completely water saturated, and water table conditions prevail. Ground water found in one area of the outcrop may not be found in another due to localized sand and shale facies as well as channel-like sand bodies' characteristic of this formation. In addition, perched water tables and artesian conditions occur locally in the outcrop area due to sand lenses interbedded with shale within the Travis Peak Formation.

Artesian conditions exist down dip as a result of the Hensell and Hosston aquifers being overlain by the Glen Rose Formation and the Pearsall Member of the Travis Peak Formation.

Recharge

Most of the recharge to the Antlers and Travis Peak Formations occurs in the outcrop area, which covers 1,732 square miles. The exact amount is unknown, but can be approximated by planimetry of the areal extent of the outcrop areas, which provide recharge, compiling rainfall records of the area, and estimating infiltration rates. This will represent the outcrop area potentially contributing recharge to the aquifers within the District. The average annual rainfall for the District is 29.80 inches.

The outcrop soils generally consist of permeable sand and sandy clay loams. The terrain is characterized by gentle sloping plains with moderate relief. These conditions are excellent for recharge from rainfall, seepage from lakes, creeks, and rivers, and infiltration resulting from the irrigation of crops. The actual amount is undetermined, but indications are that recharge does occur in the outcrop. An estimate of three (3) percent of the average annual precipitation, as applied to the outcrop area, is assumed available as recharge. This is approximately 0.1 foot per year and amounts to 110,840-acre feet per year that is available as recharge to the entire Travis Peak Formation. However, due to small streams dissecting the formations and preventing down dip movement of the ground water, this amount is reduced to about 88,400-acre feet per year. After subtracting the municipal, industrial, and irrigation pumpage that occurs shortly down dip from the dissecting streams, a net amount of approximately 82,400-acre feet is available to move down dip in the Travis Peak Formation. Much of this available recharge is discharged naturally from the formations in the outcrop area by springs, seeps, and evapotranspiration.

In the Saratoga U.W.C.D. and Lampasas County, the subsurface units of the Travis Peak Formation are well cemented and the outcrop soils are tight, reddish-brown clay loams and sandy clays. The terrain consists of tabular divides, small limestone capped mesas, and valleys of moderate relief. These conditions suggest that there is comparatively little recharge in this area which also includes Burnet, Mills, and Brown Counties. Ground water moves slowly down dip. Water level measurements indicate the present gradient of the piezometric surface is 10 to 25 feet per mile east-southeast in most of the region.

Additional recharge through feasible methods could be obtained if a brush control management program was implemented in Lampasas County. Other benefits realized are reduction in precipitation interception and infiltration. The following table illustrates the water balance differences exhibited in the Texas Agricultural Station in Sonora, Texas.

	100% Grass	70% Grass 12% Oak 18%Juniper	40% Grass 24% Oak 36% Juniper
Rainfall	22.6	22.6	22.6
Interception Loss	3.0	6.3	9.6
Water Reaching the Soil	19.6	16.3	13.0
Runoff	0.2	0.2	0.2
Water Going in the Soil	19.4	16.1	12.8
Evapotranspiration	15.7	15.8	12.8
Deep Drainage	3.7	0.3	0.0

3.7 inches of deep drainage/year = 100,500 gallons/acre/year
(All measurements are in inches)

Using the results from the brush management experiment in Sonora (Thurrow and Hester, 1997)¹, and assuming Lampasas County contains a composition of 40% grass, 24% oak, and 36% juniper, the following additional recharge may be possible if the District implements a brush management plan to change the composition to 70% grass, 12% oak, and 18% juniper.

Rainfall:

Lampasas County = 29.8 inches per year

Sonora = 22.6 inches per year

Percent increase in rainfall from Sonora to Lampasas County:

$$29.8 \text{ (inches/year)} - 22.6 \text{ (inches/year)} = 7.2 \text{ (inches/year)}$$

$$(7.2 \text{ inches/year}) / 22.6 \text{ (inches/year)} = 0.318 \text{ (00\%)} = 32\% \text{ increase in rainfall per year}$$

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

Deep Drainage:

Sonora = 0.3 inches/year

0.3 inches of deep drainage/year = 8,148.7 gallons/acre/year

32% increase in Lampasas County from 0.32 = 0.096

0.096 (increase in Lampasas County per year in inches/acre/year) + 0.30 (deep drainage in inches/acre/year) = 0.40 in/acre/year deep drainage

If: 0.3 inches/acre/year = 8,148.7 gallons

Then: 0.4 inches/acre/year = (8,148.7) (0.4)/0.3
= 10,864.9 gallons

If: 1 acre-foot = 325,851 gallons

And if: 10,864.9 gallons/acre/year in Lampasas County

Then: 10,864.9 (gallons/acre/year)/325,851 (gallons/acre/foot) = 0.033 (acre-feet)/ (acre/year)

Groundwater Availability Model run 08-40

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 groundwater management plans include:

- (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.

The purpose of this model run is to provide information to the Saratoga Underground Water Conservation District for its groundwater management plan. The groundwater management plan for the Saratoga Underground Water Conservation District is due for approval by the executive administrator of the Texas Water Development Board before December 29, 2008.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the northern part of the Trinity Aquifer. Table 1 summarizes the groundwater availability model data required by statute for the Saratoga Underground Water Conservation Districts groundwater management plan.

The Llano Uplift aquifers, which include the Marble Falls, Hickory, and Ellenburger-San Saba aquifers, also underlie the Saratoga Underground Water Conservation District. Groundwater availability models have not yet been completed for these minor aquifers. If the district would like information for the Llano Uplift aquifers, they may request it from the Groundwater Technical Assistance Section of the Texas Water Development Board.

METHODS:

We ran the groundwater availability model for the northern part of the Trinity Aquifer and (1) extracted water budgets for each year of the 1980 through 1999 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 Trinity Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

We used version 1.01 of the groundwater availability model for the northern part of the Trinity Aquifer for this run. See Bené and others (2004) for assumptions and limitations of the model. The model includes seven layers, representing the Woodbine Aquifer (Layer 1), the Washita and Fredericksburg Series (Layer 2), the Paluxy Aquifer (Layer 3), the Glen Rose Formation (Layer 4), the Hensell Aquifer (Layer 5), the Pearsall/Cow Creek/Hammett/Sligo Formation (Layer 6), and the Hosston Aquifer (Layer 7). The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the four main aquifers in the model (Woodbine, Paluxy, Hensell, and Hosston) for the calibration and verification time periods (1980 to 2000) ranged from approximately 37 to 75 feet. The root mean squared error was less than ten percent of the maximum change in water levels across the model (Bené and others, 2004). We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output results.

RESULTS:

A groundwater budget summarizes the 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 calibrated portion of the model run (1980 to 1999). The components of the modified budgets shown in Table 1 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 Table 1. 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.

Table 1: Summarized information needed for the Saratoga Underground Water Conservation District’s groundwater management plan. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot. Negative values indicate water is leaving the aquifer system using the parameters or boundaries listed in the table.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Woodbine Aquifer	0
	Washita and Fredericksburg Series	6,030
	Paluxy Aquifer	11,303
	Glen Rose Formation	23,485
	Hensell Aquifer	1,446
	Pearsall/Cow Creek/Hammett/Sligo Formation	0
	Hosston Aquifer	5,040
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Woodbine Aquifer	0
	Washita and Fredericksburg Series	0
	Paluxy Aquifer	0
	Glen Rose Formation	-2,059
	Hensell Aquifer	0
	Pearsall/Cow Creek/Hammett/Sligo Formation	0
	Hosston Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Woodbine Aquifer	0
	Washita and Fredericksburg Series	238
	Paluxy Aquifer	24
	Glen Rose Formation	265
	Hensell Aquifer	1,015
	Pearsall/Cow Creek/Hammett/Sligo Formation	2
	Hosston Aquifer	870
Estimated annual volume of flow out of the district within each aquifer in the district	Woodbine Aquifer	0
	Washita and Fredericksburg Series	0
	Paluxy Aquifer	-116

	Glen Rose Formation	-483
	Hensell Aquifer	-1,935
	Pearsall/Cow Creek/Hammett/Sligo Formation	-3
	Hosston Aquifer	-1,846
Estimated net annual volume of flow between each aquifer in the district	Woodbine Aquifer to Washita and Fredericksburg Series	0
	Washita and Fredericksburg Series to Paluxy Aquifer	-24
	Paluxy Aquifer to Glen Rose Formation	-144
	Glen Rose Formation to Hensell Aquifer	-877
	Hensell Aquifer to Pearsall/Cow Creek/Hammett/Sligo Formation	-973
	Pearsall/Cow Creek/Hammett/Sligo Formation to Hosston	-971

Water Levels & Storage

The sands within the calcareous facies of the Travis Peak Formation in west-central Texas exhibit extremely low permeability due to cementation. Pumping tests conducted in the calcareous facies area indicate that coefficients of permeability range from 1 to 20 gpd/ft². The low coefficients of permeability and the relatively thin sand thickness' combine to produce very low coefficients of transmissibility that range from 0 to 1,000 gpd/ft.

In the remainder of the region, excluding the northwest outcrop and calcareous facies areas, ground water within the Hensell and Hosston Members of the Travis Peak Formation is under artesian conditions. Test data indicate that coefficients of permeability of the Hosston range from approximately 17 to 171 gpd/ft². In general, permeability in the vicinity of Balcones Fault Zone appears to be low. This could be due to the faults causing decreases in permeability. Thus, the average coefficient of permeability for the Hosston is about 77 gpd/ft². The artesian storage coefficients for the Hosston range from 0.000028 to 0.000077.

Test data for the Hensell Member in the down dip region, show coefficients of permeability ranging from 26 to 126 gpd/ft². The Hensell thins and becomes shaly down dip; therefore a range in coefficients of transmissibility from approximately 0 to 15,000 gpd/ft could be expected in the region. Lack of test data prohibits assigning a coefficient of storage range for the Hensell Member; however, storage values should be somewhat less than those of the Hosston Member.

The coefficients of transmissibility and storage may be used to predict future drawdown of water levels caused by pumping from the Hensell and Hosston Members of the Travis Peak Formation. Wells show water level fluctuations which are seasonal in nature. The water level

declines correlate with the large irrigation pumpage in the summer months, and in the fall and winter water levels are recovering due to small withdrawals and recharge of the permeable sands by rainfall.

Managed Available Groundwater

The managed available groundwater (MAG) estimates for Lampasas County were derived through the joint planning process outlined in HB 1763, 79th Legislature, 2005. The Managed Available Groundwater estimates for Lampasas County, hence the Saratoga Underground Water Conservation District, listed below are the only estimates that were available at the time of the 2009 management plan date of adoption.

Aquifer	County	GMA	RWPG	Managed Available Groundwater (acre-feet)	Source
Northern Trinity - Paluxy	Lampasas	8	G	13	GAM Run 08-84mag
Northern Trinity - Glen Rose	Lampasas	8	G	774	GAM Run 08-84mag
Northern Trinity - Hensell	Lampasas	8	G	885	GAM Run 08-84mag
Northern Trinity – Hosston	Lampasas	8	G	1,446	GAM Run 08-84mag

The adopted Desired Future Conditions for Lampasas County upon which the model run for the MAG estimates was based are listed below:

Lampasas County

(1) From estimated year 2000 conditions, the average drawdown of the Paluxy Aquifer should not exceed approximately 0 feet after 50 years.

(2) From estimated year 2000 conditions, the average drawdown of the Glen Rose Aquifer should not exceed approximately 1 foot after 50 years.

(3) From estimated year 2000 conditions, the average drawdown of the Hensell Aquifer should not exceed approximately 12 feet after 50 years.

(4) From estimated year 2000 conditions, the average drawdown of the Hosston Aquifer should not exceed approximately 23 feet after 50 years.

Source: GAM Run 08-84mag, TWDB

(5) Marble Falls Aquifer: “Lampasas County should maintain approximately 90 percent of the saturated thickness after 50 years.”

Source: Desired Future Conditions Submittal Adopted by GMA 8: May 19, 2008.

(6) Ellenburger-San Saba Aquifer: “Lampasas County should maintain approximately 90 percent of the saturated thickness after 50 years.”

Source: Desired Future Conditions Submittal Adopted by GMA 8: May 19, 2008.

(7) Hickory Aquifer: “Brown, Lampasas, Mills, Travis and Williamson Counties should maintain approximately 90 percent of the available draw down after 50 years.”

Source: Desired Future Conditions Submittal Adopted by GMA 8: May 19, 2008.

Projected Water Supplies, Ground Water Usage, and Demands

The projected estimate of surface water supplies is:

**2007 State Water Plan Projected Surface Water Supplies
Lampasas County**

RWP G	Water User Group	County	River Basin	Source Name	2000	2010	2020	2030	2040	2050	2060
G	Lampasas	Lampasas	Brazos	Brazos River Authority Little River System	1,792	1,870	1,859	1,853	1,848	1,845	1,841
G	Lometa	Lampasas	Colorado	Colorado River Combined Run- of-River - LCRA Supply Reallocation	0	78	84	88	91	93	95
G	Manufacturing	Lampasas	Brazos	Brazos River Combined Run-of- River Manufacturing	0	18	18	18	18	18	18
G	Irrigation	Lampasas	Brazos	Brazos River Combined Run-of- River Irrigation	0	1,255	1,255	1,255	1,255	1,255	1,255
G	Livestock	Lampasas	Brazos	Livestock Local Supply	0	537	537	537	537	537	537
G	Livestock	Lampasas	Colorado	Livestock Local Supply	0	151	151	151	151	151	151
G	Copperas Cove	Lampasas	Brazos	Brazos River Authority Little River System	0	47	47	47	47	47	47
G	Lometa	Lampasas	Brazos	Colorado River Combined Run- of-River - LCRA Supply Reallocation	0	52	57	59	61	62	64
G	Kempner	Lampasas	Brazos	Brazos River Authority Little River System	0	300	366	411	446	467	482
G	Kempner WSC	Lampasas	Brazos	Brazos River Authority Little River System	0	3,235	3,210	3,192	3,177	3,166	3,158
Total Projected Surface Water Supplies (acre-feet per year) =					1,792	7,543	7,584	7,611	7,631	7,641	7,648

An estimate of projected total water demand (from all sources) for the year 2010 is 5,679 acre-feet; and, for the year 2060 is 7,290 acre-feet as verified in the following TWDB chart:

**2007 State Water Plan Projected Total Water Demands
Lampasas County**

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
G	Lampasas	Lampasas	Brazos	1,224	1,594	1,640	1,662	1,673	1,683	1,669
G	Lometa	Lampasas	Colorado	72	80	89	95	100	103	104
G	Lometa	Lampasas	Brazos	49	54	60	64	67	69	70
G	Copperas Cove	Lampasas	Brazos	15	23	32	39	43	46	48
G	Kempner	Lampasas	Brazos	238	305	376	427	465	490	506
G	Kempner WSC	Lampasas	Brazos	1,053	1,311	1,583	1,780	1,927	2,023	2,083
G	County Other	Lampasas	Brazos	951	1,099	1,255	1,368	1,452	1,507	1,542
G	County Other	Lampasas	Colorado	65	76	86	94	100	104	106
G	Maunufacturing	Lampasas	Brazos	108	129	142	153	164	174	187
G	Mining	Lampasas	Brazos	114	90	85	82	80	77	76
G	Mining	Lampasas	Colorado	79	62	59	57	55	54	52
G	Irrigation	Lampasas	Brazos	34	34	33	33	32	32	32
G	Irrigation	Lampasas	Colorado	136	134	133	131	130	128	127
G	Livestock	Lampasas	Brazos	537	537	537	537	537	537	537
G	Livestock	Lampasas	Colorado	151	151	151	151	151	151	151
Total Projected Water Demands										
(acre-feet per year) =				4,826	5,679	6,261	6,673	6,976	7,178	7,290

Source: Volume 3, 2007 State Water Planning Database

The basis for projected underground water availability and Desired Future Conditions for the Saratoga Underground Water Conservation District used data from the following chart of historically surveyed groundwater pumpage data from the TWDB Water Use Survey. Supply data and information is furnished by Texas Water Development Board, Water Supplies Section and Water Resources Planning Division. Lampasas underground water usage has ranged from an estimated low of 610 acre feet in 1988 to 1872 acre feet in 2000.

Historical Groundwater Pumpage Summary by County

Unit: Acre Feet (ACFT)

LAMPASAS COUNTY								
Year	Aquifer	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1980	OTHER	41	0	0	0	0	21	62
1980	TRINITY	661	0	0	0	27	458	1,146
	Total	702	0	0	0	27	479	1,208
1984	OTHER	35	0	0	0	0	15	50
1984	TRINITY	757	0	0	0	36	337	1,130
	Total	792	0	0	0	36	352	1,180
1985	OTHER	68	0	0	0	0	14	82
1985	TRINITY	814	0	0	0	36	304	1,154
	Total	882	0	0	0	36	318	1,236
1986	OTHER	57	0	0	0	0	13	70
1986	TRINITY	897	0	0	0	38	279	1,214
	Total	954	0	0	0	38	292	1,284
1987	OTHER	67	0	0	0	0	13	80
1987	TRINITY	266	0	0	0	32	293	591
	Total	333	0	0	0	32	306	671
1988	OTHER	39	0	0	0	58	14	111
1988	TRINITY	158	0	0	0	35	306	499
	Total	197	0	0	0	93	320	610
1989	OTHER	23	0	0	0	54	14	91
1989	TRINITY	146	0	0	82	33	302	563
	Total	169	0	0	82	87	316	654
1990	OTHER	94	0	0	0	54	15	163
1990	TRINITY	378	0	0	95	33	315	821
	Total	472	0	0	95	87	330	984
1991	OTHER	96	0	0	0	70	15	181
1991	TRINITY	385	0	0	95	124	322	926
	Total	481	0	0	95	194	337	1,107
1992	OTHER	45	0	0	0	70	22	137
1992	TRINITY	420	0	0	95	124	470	1,109
	Total	465	0	0	95	194	492	1,246
1993	OTHER	0	0	0	0	70	19	89
1993	TRINITY	504	0	0	25	123	412	1,064
	Total	504	0	0	25	193	431	1,153
1994	OTHER	0	0	0	0	70	17	87
1994	TRINITY	543	0	0	25	123	378	1,069
	Total	543	0	0	25	193	395	1,156
1995	OTHER	0	0	0	0	70	17	87
1995	TRINITY	530	0	0	29	123	385	1,067
	Total	530	0	0	29	193	402	1,154
1996	OTHER	0	0	0	0	70	15	85
1996	TRINITY	582	0	0	29	123	349	1,083
	Total	582	0	0	29	193	364	1,168

1997	OTHER	0	0	0	0	70	15	85
1997	TRINITY	549	0	0	29	123	356	1,057
Total		549	0	0	29	193	371	1,142
1998	OTHER	0	0	0	0	70	14	84
1998	TRINITY	525	0	0	56	123	341	1,045
Total		525	0	0	56	193	355	1,129
1999	OTHER	0	0	0	0	70	15	85
1999	TRINITY	730	0	0	28	123	363	1,244
Total		730	0	0	28	193	378	1,329
2000	OTHER	0	0	0	0	45	42	87
2000	TRINITY	700	0	0	1	78	1,006	1,785
Total		700	0	0	1	123	1,048	1,872
2001	OTHER	0	0	0	0	71	15	86
2001	TRINITY	157	0	0	0	122	347	626
Total		157	0	0	0	193	362	712
2002	OTHER	0	0	0	0	45	16	61
2002	TRINITY	510	0	0	0	77	382	969
Total		510	0	0	0	122	398	1,030
2003	OTHER	0	0	0	0	45	11	56
2003	TRINITY	275	0	0	0	77	253	605
Total		275	0	0	0	122	264	661

Source: TWDB, Water Use Survey

Water use from all sources (surface and groundwater) for Lampasas County from the TWDB *Water Use Survey* for 2006 is as follows:

Region	County	Population Estimates ²⁾	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock
G	LAMPASAS	20,461	3,035	106	0	0	337	646

Projected Water Management Strategies

The Projected Water Management Strategies for the District are located in Appendix A as required in statute. These strategies have been extracted from the 2007 State Water Plan.

Projected Water Needs

The Projected Water Needs for the District are located below. These estimates represent the difference in projected water supplies and the projected water demand for each respective Water User Group (WUG). The following estimates were extracted from the 2007 State Water Plan.

Positive values represent projected water surpluses; negative values represent projected water needs.

RW-PG	WUG	County	River Basin	2010	2020	2030	2040	2050	2060
G	Lampasas	Lampasas	Brazos	0	0	0	0	0	0
G	Lometa	Lampasas	Colorado	0	0	0	0	0	0

G	County Other	Lampasas	Brazos	109	-18	-107	-167	-207	-791
G	County Other	Lampasas	Colorado	-31	-39	-45	-49	-53	-54
G	Manufacturing	Lampasas	Brazos	-111	-124	-135	-146	-156	-169
G	Mining	Lampasas	Brazos	-26	-25	-24	-24	-22	-23
G	Mining	Lampasas	Colorado	0	0	0	0	0	0
G	Irrigation	Lampasas	Brazos	0	0	0	0	0	0
G	Irrigation	Lampasas	Colorado	0	0	0	0	0	0
G	Livestock	Lampasas	Brazos	0	0	0	0	0	0
G	Livestock	Lampasas	Colorado	0	0	0	0	0	0
G	Copperas Cove	Lampasas	Brazos	0	0	0	0	0	0
G	Lometa	Lampasas	Brazos	0	0	0	0	0	0
G	Kempner	Lampasas	Brazos	0	0	0	0	0	0
G	Kempner WSC	Lampasas	Brazos	0	0	0	0	0	0
Total Projected Water Needs (acre-feet per year) =				-168	-206	-311	-386	-438	-1,037

Source: 2007 State Water Planning database

Tracking Methodology

The Chairman of the Board of Directors will give an activity report to the District Board of Directors at the annual meeting in November, or as needed, to insure management objectives and goals are being followed and achieved by the District. The Board will also elect its officers at that meeting. The Board will maintain the report on file for public inspection at the District office upon adoption.

III. Management Goals, Objectives, and Performance Standards

Goal 1.0 Implement management strategies that will protect and enhance the quality of useable water by encouraging the most efficient use of ground water.

Management Objective 1.1

Each year, the district will provide educational materials identifying conservation measures for the efficient use of water. Annually, two newspaper articles will be published that contain water conservation information. Handout packets with conservation literature will be provided at one annual Community Festival day, or one other water related function.

Performance Standards 1.1a and 1.1b

Number of newspaper articles published annually containing water conservation information.

Number of annual events where conservation material was provided, and upon request, at the District office.

Management Objective 1.2

Each year the District will provide at least two informative speakers to local school districts and/or civic organizations to raise public awareness to ensure wise use of ground water.

Performance Standard 1.2

Number of informative speaking appearances to promote wise water usage provided annually. Encourage rainwater harvest measures and promote rainwater harvest projects for all new governmental construction.

Goal 2.0 Implement a program to improve and protect the quality of the aquifers and to control and prevent waste and contamination.

Management Objective 2.1

Each year, continue the well water sampling program in coordination with the County Extension Agent. This sampling is available for a minimal fee and is normally conducted in the fall.

Performance Standard 2.1

SUWCD will monitor the total number of well samples turned in annually to the County Extension Agent. A sampling of 10 to 20 wells annually indicates a successful well monitor program. The total number of well samples turned in annually will be included in the District's Annual Report.

Goal 3.0 Address conjunctive surface water management issues.

Management Objective 3.1

District will lend support to a local water monitoring team that monitors Sulphur Creek, the major creek located in the District, for water quality. Our local monitoring team takes samples of water, performs various chemical testing with the water, and then individual test results and a sample of water (tested for fecal count) from each monitoring site, are delivered for final testing. The water and monitors' testing results are analyzed by a state certified laboratory for the Brazos River Authority and Texas River Watch, where permanent records are kept on the quality of water. Monitoring is performed monthly and has to take place within the same three day period every month and all monitors have to perform the testing within a three hour time frame so that test results will be more accurate.

Performance Standard 3.1

The District will furnish a supply of paper and copying services to the "Friends of Sulphur Creek" to facilitate record keeping of their continued effort to monitor the water quality of Sulphur Creek.

Management Objective 3.2

Annually meet with leaders of the incorporated cities in our District to discuss and review potential better use of surface water resources in the area. District will consult with other water districts and other informed water conservationists on water issues throughout the year to learn more efficient ways to manage surface water.

Performance Standards 3.2a and 3.2b

The district will meet at least once annually with incorporated cities' representatives. The consultations with other districts will be facilitated through the GMA-8, which meets at least quarterly. Meetings with other conservationists will be facilitated at the District's Annual Report meeting held at once from November to February annually.

Goal 4.0 Controlling and Preventing Subsidence

The rigid geologic framework of the District precludes significant subsidence from occurring. **This goal is not applicable to the operations of the District.**

Goal 5.0 Addressing natural resource issues which impact the use and availability of ground water, and which are impacted by the use of ground water. **This goal is not applicable to the operations of the District.**

Goal 6.0 Addressing drought conditions.

Management Objective 6.1

Utilizing a system of either rainfall or local aquifer conditions, or other appropriate criteria determine, identify, and designate one or more mechanisms to trigger implementation of drought management plans.

Performance Standard 6.1a

Identify and designate trigger conditions within the district used to indicate drought conditions. The District will analyze the effectiveness of the designated drought condition triggers annually to continue, improve or change these measures as informative and planning implements to coordinate drought procedures within the District's sphere of influence.

Performance Standard 6.1b

Drought Condition Triggers that will be reported in the District's Annual Report:

- Palmer Drought Severity Index
- And/or lack of rain for 60 days
- And/or temperatures over 100 degrees Fahrenheit for 20 days consecutively

Management Objective 6.2

Review applicable data to determine status of drought conditions and if necessary report to the Board the need to implement drought management plan.

Performance Standard 6.2

At the monthly Board meeting during drought, report on drought and the need to implement drought management plan.

Management Objective 6.3

Each year the district will provide to the public a newspaper article on drought conditions and the need to implement drought management plans.

Performance Standard 6.3

Number of newspaper articles on drought conditions.

Management Objective 6.4

Notify water suppliers of potential groundwater resources that may be available during droughts. This is more a cooperative effort as historically, the water producers have contacted the District during times of drought.

Performance Standard 6.4

Coordinate and have at least one local water supplier at our annual meeting.

Goal 7.0 Addressing Conservation, Recharge Enhancement, Brush Control, Rainwater Harvesting, and Precipitation Enhancement.

Management Objective 7.1

The District will sponsor articles in the local newspaper on water conservation and methods for voluntary conservation.

Performance Standard 7.1

The District will produce at least one informative article on water conservation for publication in the local newspaper each year.

Management Objective 7.2

Provide the public, upon request or at a public event or forum, conservation literature.

Performance Standard 7.2

Each year provide water conservation literature at the annual Lampasas Herbfest and/or one other public function each year.

Management Objective 7.3

Encourage recharge enhancement programs such as range management and growth of native grasses to permit more recharge flow into the aquifers.

Performance Standard 7.3

Coordinate with state agencies and the County Extension program to provide recharge enhancement data to local ranchers and farmers on at least one occasion annually.

Management Objective 7.4

Encourage and determine available resources to facilitate a brush control program.

Performance Standard 7.4

Coordinate with the County Extension Agent once annually, in the spring, to determine if State funds are available for brush control and grassland management initiatives to ensure the District farmers and ranchers are apprised of these resources.

Management Objective 7.5

Encourage local government and businesses to consider rainwater harvesting for each new or renovation of public and large private construction program within the District.

Performance Standard 7.5

Coordinate with local government and business ventures when it becomes public knowledge of new construction within the District. Additionally, a District Director will attend a Lampasas City Council meeting and a Lampasas Independent School Board meeting at least annually to make the local government aware of sources for rainwater harvest projects.

The District has determined that Precipitation Enhancement is not cost effective or appropriate. Therefore, this objective is not applicable to the operations of the District.

Goal 8.0 Address in a quantitative manner the Desired Future Conditions of the District.

Management Objective 8.1

Compare annual water level measurements with previous years to determine trends, specific declines or increases in the monitor wells of the Trinity, Hickory, Ellenburger-San Saba, and Marble Falls Aquifers. The District will measure water levels in at least five monitor wells annually.

Performance Standard 8.1

The number of monitor wells sampled annually.

Management Objective 8.2

The District will determine if a serious decline in Trinity, Hickory, Ellenburger-San Saba, and Marble Falls Aquifer water levels warrant further study or action by the District Board. A report will be submitted to the District Board annually.

Performance Standard 8.1

The number of water level comparison analysis reports submitted to the District Board annually.

Management Objective 8.3

The District will conduct public hearings to make citizens of the SUWCD aware of severe changes in Trinity, Hickory, Ellenburger-San Saba, and Marble Falls Aquifer water levels.

Performance Standard 8.3

The number of public hearings conducted when severe water changes occurred will be reported in the Annual Report to the District Board.

Management Objective 8.4

The District will review new well permits and status to determine if additional conservation and public education actions are necessary. A report including the number of new well permits and any changes in status will be submitted to the District Board annually.

Performance Standard 8.4

The number of well permit and status changes analysis reports submitted to the District Board annually.

Management

The District will manage the supply of ground water within the District in order to conserve the resource while maintaining the viability of all resource user groups, public and private. The District will identify and engage in activities and practices that, if implemented, would result in reduction of ground water use. The District may require reduction of ground water withdrawals to amounts that will not cause harm to the aquifers. The District may, at the Board's discretion, amend or revoke any permits after notice and hearing to achieve this purpose. The District will consider the public benefit against individual hardship in determining permit denial or limiting ground water withdrawals after considering all appropriate testimony. The District shall treat all citizens with equality. A public or private user may appeal to the Board for discretion in enforcement of the provisions of the District's rules and regulations on grounds of adverse economic hardship or unique local conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

Actions, Procedures, Performance, and Avoidance for Plan Implementation

The District will implement and use the provisions of this plan as a guidepost for determining the direction or priority for all District activities. All operations of the District, all agreements entered into by the District, and any additional planning efforts that the District may participate in will be consistent with the provisions of this plan. The District will seek cooperation in the implementation of this plan and the management of ground water supplies within the District. All activities of the Saratoga Underground Water Conservation District will be undertaken in cooperation and coordination with the appropriate state, regional or local water entity.

The District will adopt rules relating to the permitting of wells and production of ground water. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical advice available. District Rules are contained in Appendix C.

IV. Bibliography

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine Groundwater Availability Model: contract report to the Texas Water Development Board by R.W. Harden and Associates, 391 p.

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

V. Maps and Appendices

Map of Texas Water Districts

Map of Texas Regional Water Planning Groups

Map of Groundwater Management Areas

Map of GMA-8

Appendix A – Water Management Strategies

Appendix B – SUWCD Desired Future Conditions/Current GMA-8 DFC and MAGs

Appendix C – Saratoga Underground Water Conservation District Rules

Appendix D – Trinity DFC - GAM Run 08-84 mag

STATE OF TEXAS

COUNTY OF LAMPASAS

RESOLUTION

WHEREAS, the **Saratoga Underground Water Conservation District** has posted notice of, and held the appropriate public hearing; and

WHEREAS, the **Saratoga Underground Water Conservation District** has followed the rules set forth by the Texas Water Code, (Sections 36.1071 and 36.1072); the Texas Administrative Code, (Section 356.5); and the Texas Water Development Board; and

WHEREAS, many of the comments received at the public hearing were incorporated in the Management Plan, and no public comment opposing the plan was presented.

NOW THEREFORE, BE IT RESOLVED that the **Saratoga Underground Water Conservation District** Management Plan of 2008, as changed and presented to, and revised by the Board of Directors is hereby adopted; and

THAT, the District shall send, by certified mail, return receipt requested, to the chair of the Region G Water Planning Group, a letter (with a copy of the updated plan) asking the regional water planning group to review the management plan and to specify any areas of conflict between the management plan and the regional water plan; and

THAT, after receiving comments from the Regional Water Planning Group, the District submits to the Texas Water Development Board, a copy of the revised management plan, requesting review and certification.

PASSED AND APPROVED by the Board of Directors of the Saratoga Underground Water Conservation District, Lampasas County, Texas, at a scheduled meeting held at Lampasas County Courthouse on September 14, 2009.

Randall McGuire, Chairman of Board
Saratoga Underground Water Conservation District

Attest:

Diane Seery, Clerk

September 15, 2009

Phil Ford
General Manager
Brazos River Authority
P. O. Box 7555
Waco, TX 76714-7555

Dear Mr. Ford:

Enclosed is a copy of the proposed final revision of the Saratoga Underground Water Conservation District Management Plan as required by Senate Bill No. 1.

Included in the requirements of SB1, we are required to develop this plan in coordination with surface water management entities. I ask that you please review the plan and provide copies to your board.

We had a public hearing on the Management Plan at 1:30 PM on September 14, 2009, County Commissioners Courtroom, Lampasas County Courthouse, Lampasas, Texas to adopt the revised Management Plan. If there are any concerns, we will have our next SUWCD meeting on October 13, 2009 at 1:30 in the Lampasas County Courthouse. We certainly welcome you to attend the hearing and make comments at that time.

Please contact me if you have any questions regarding this plan.

Sincerely,

Randall McGuire
Chairman
Saratoga U.W.C.D.

RM
Enclosure - Management Plan

September 15, 2009

Thomas G. Mason
General Manager
Lower Colorado River Authority
P. O. Box 220
Austin, TX 78767-0220

Dear Mr. Mason:

Enclosed is a copy of the proposed final revision of the Saratoga Underground Water Conservation District Management Plan as required by Senate Bill No. 1.

Included in the requirements of SB1, we are required to develop this plan in coordination with surface water management entities. I ask that you please review the plan and provide copies to your board.

We had a public hearing on the Management Plan at 1:30 PM on September 14, 2009, County Commissioners Courtroom, Lampasas County Courthouse, Lampasas, Texas to adopt the revised Management Plan. If there are any concerns, we will have our next SUWCD meeting on October 13, 2009 at 1:30 in the Lampasas County Courthouse. We certainly welcome you to attend the hearing and make comments at that time.

Sincerely,

Randall McGuire
Chairman
Saratoga U.W.C.D.

RM
Enclosure - Management Plan