Cow Creek Groundwater Conservation District

GROUNDWATER MANAGEMENT PLAN

Originally Adopted
September 7, 2004

N/A Revision, Adopted
N/A

Board of Directors

Tommy Mathews, President
Precinct 4
W. K. "Skip" Shumpes, Vice-President
Precinct 2
Bill Hass, Secretary
Precinct 3
Dalton F. Neill, Treasurer
At Large
Stan Scott, Asst. Secretary/Treasurer
Precinct 1

Board of Directors

Tommy Mathews, President
Precinct 4
W. K. "Skip" Shumpes, Vice-President
Precinct 2
Bill Hass, Secretary
Precinct 3
Dalton F. Neill, Treasurer
At Large
Stan Scott, Asst. Secretary/Treasurer
Precinct 1

General Manager

Currently Vacant

Cow Creek Groundwater Conservation District
P. O. Box 1783
Boerne, Texas 78006

c/o Micah Voulgaris
(830) 249-9343 ext. 251

This Page Left Intentionally Blank

GROUNDWATER MANAGEMENT PLAN

REVISION RECORD

Date Adopted	Effective Date	Affected Sections or General Comments
9/7/04	9/7/04	Original Adoption, CCGCD Board Resolution 090704-1

This Page Left Intentionally Blank

TABLE OF CONTENTS

Section ..... **Page #**

List of Tables

This Page Left Intentionally Blank

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon adoption by the Cow Creek Groundwater Conservation District Board of Directors (Board) and subsequent certification by the Texas Water Development Board (TWDB). This plan incorporates a planning period of ten years in accordance with 31TAC §356.5(a). After five years, the plan will be reviewed for consistency with the applicable Regional Water Plans and the State Water Plan and shall be readopted with or without amendments. The plan may be revised at anytime in order to maintain such consistency or as necessary to address any new or revised data, Groundwater Availability Models, or District management strategies.

DISTRICT MISSION

The Cow Creek Groundwater Conservation District (CCGCD or District) was created for the purpose of conserving, preserving, recharging, protecting and preventing waste of groundwater from the aquifers within Kendall County. The District will conduct administrative and technical activities and programs to achieve these purposes. The District will collect and archive water well and aquifer data, regulate water well drilling and production from permitted, non-exempt wells, promote the capping or plugging of abandoned wells, provide information and educational material to local property owners, interact with other governmental or organizational entities, and incorporate other groundwater-related activities that may help meet the purposes of the District. The Texas Hill Country Area, which includes Kendall County, was declared a Critical Groundwater Area by the then Texas Water Commission in 1990. This declaration, now known as the Hill Country Priority Groundwater Management Area (PGMA), gave notice to the residents of the area that water availability and quality will be at risk within the next 50 years.

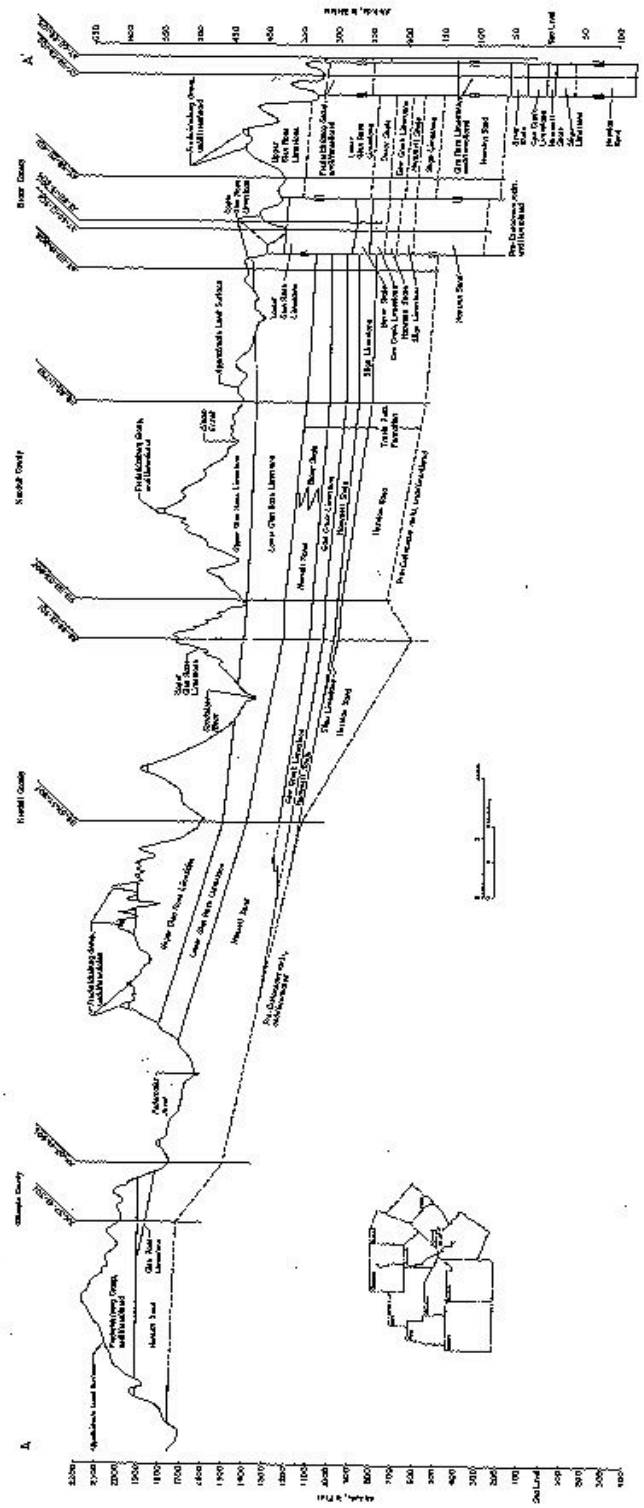
STATEMENT OF GUIDING PRINCIPLES

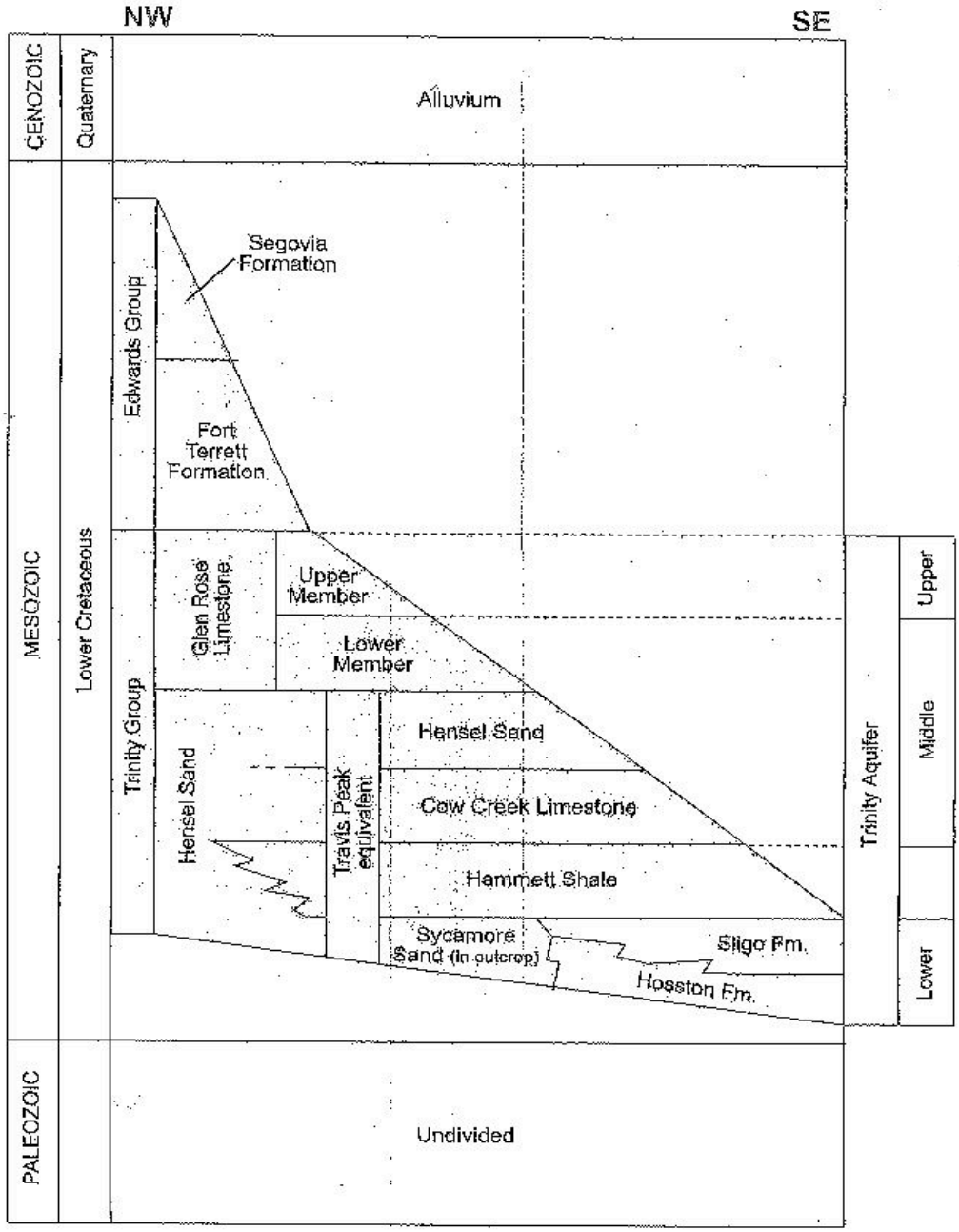
The CCGCD was created in order that appropriate groundwater management techniques and strategies could be implemented at the local level to address groundwater issues or problems within the District. The District has incorporated both the TWDB's Trinity Aquifer Groundwater Availability Model (TWDB Report 353) and the best and most current site-specific data available to the District in the development of this plan. This plan serves as a guideline the District can follow to ensure greater understanding of local aquifer conditions, development of groundwater management concepts and strategies, and subsequent implementation of appropriate groundwater management policies.

COMMITMENT TO IMPLEMENT GROUNDWATER MANAGEMENT PLAN

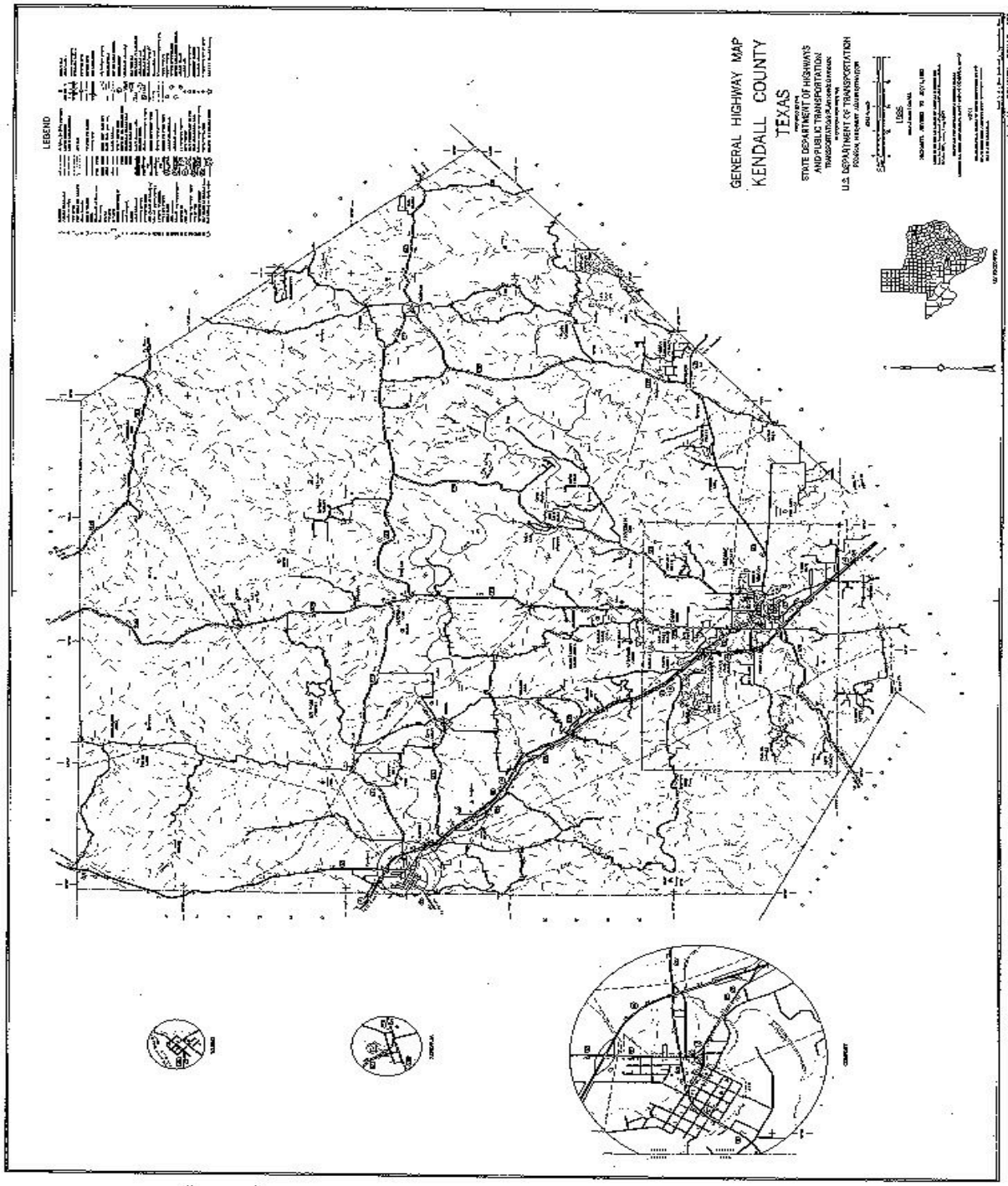
To address potential groundwater quantity and quality issues, the District is committed to, and will actively pursue, the groundwater management strategies identified in this groundwater management plan. The management plan will be coordinated with District Rules, policies, and activities in order to effectively manage and regulate the drilling of wells, production of groundwater within the District, and the possible transfer of water out of the District, encourage conservation practices and efficient water use within the District. To the greatest extent practical, the District will cooperate with and coordinate its management plan and regulatory policies with adjacent groundwater districts, Regional Water Planning Groups, and adjacent counties with similar aquifers and/or groundwater usage.

Stratigraphic and Hydrostratigraphic Section of the Texas Hill Country Area





Stratigraphic and hydrostratigraphic section of the Hill Country area (after Ashworth, 1983; Barker and others, 1994).


GENERAL HIGHWAY MAP
KENDALL COUNTY
TEXAS
LEGEND

GENERAL DESCRIPTION OF THE DISTRICT

The Cow Creek Groundwater Conservation District includes all of Kendall County and encompasses roughly 670 square miles (428,800 acres). The CCGCD was created in accordance with Chapter 36 and HB 3544 and SB 2 of the 77th Legislature. On November 5, 2002, Kendall County voters approved the creation of the District and elected five Directors to govern the District. The proposed ad valorem taxing authority and rate was not approved by the voters. The District is currently funded through permit, production, and other administrative fees. The District's authority and duties are derived primarily from Chapter 36 of the Texas Water Code, Vernon's Texas Civil Statues.

The Board of Directors (as of Fiscal Year 2004) is comprised of Tommy Mathews - Precinct 4 and Board President, W. K. "Skip" Shumpes - Director of Precinct 2 and Board Vice President, Bill Hass - Director of Precinct 3 and Board Secretary, Dalton F. Neill - Director At Large, and Stan Scott, Asst. Secretary/Treasurer - Director of Precinct 1.. The District General Manager position is currently vacant.

The Initial Board adopted Current District rules in 2002.

Kendall County's current economy is best characterized as a service oriented, bedroom community tied closely to San Antonio, the Interstate 10 corridor, and to a lesser extent, U.S. 281 and Interstate 35. Originally considered a county relying primarily on an agricultural-based economy, Kendall County still retains that same rural flavor, but may be even better known for its shopping, antique stores, restaurants, small industries, and tourist facilities. Wildlife hunting, some fishing, and other outdoor activities also contribute significantly to the local economy. Tourists visiting nearby State Parks and other attractions contribute significant revenues to the local economy.

Over the past few decades, Kendall County and other Hill Country counties in close proximity to the cities of Austin or San Antonio have seen growth in population due to subdivision of large tracts of land into smaller acreage.

Two cities are located in the District, Boerne and a part of Fair Oaks Ranch. The small communities of Comfort, Sisterdale, Waring, Bergheim, Kendalia, and Welfare are also located in Kendall County.

Kendall County lies primarily within the Guadalupe River basin, for statewide water planning purposes it is part of the South Central Texas Regional Water Planning Group (Region L).

Topography and Drainage

Kendall County's primary watershed is the Guadalupe River, which flows through and drains the central part of the county. Other watersheds drain small portions of the county. Cibolo Creek drains most of the southeastern part of the county, small portions of the county to the north and northeast are part of the Blanco and Pedernales river basins, and a very small part of the southwestern corner of the county drains into the Medina River watershed. Surface drainage within the District is generally from west to east except along the northern and southern county boundaries.

The topography of Kendall County is predominantly rough and hilly.. The primary geologic feature in Kendall County, the Edwards Plateau, is dominated by stream-dissected hills grading into rolling terrain and shallow valleys. This is an elevated structure made up of Cretaceous age limestone, dolomite and marl. The Edwards Plateau extends westward from the Balcones Fault Zone and covers many West Texas counties. Kendall County lies near the southeastern edge of the Plateau.

Elevation within the District ranges from a low of approximately 1,020 feet above sea level where the Guadalupe River leaves southeastern Kendall County to approximately 2,080 feet above sea level in the

western part of the county.

WATER RESOURCES WITHIN THE COW CREEK GROUNDWATER CONSERVATION DISTRICT

Groundwater Resources and Usage in Kendall County

Estimated groundwater usage in Kendall County Between 1980 and 2001 has been compiled by the Texas Water Development Board and is shown in table 1.

Estimated Groundwater Use
Cow Creek Groundwater Conservation District
Kendall County

Year	Aquifer	Groundwater Use (acre-feet)						
		Municipal	Manufacturing	Steam	Mining	Irrigation	Livestock	Total
				Elect. Power				
1980	Trinity	1,110	0	0	0	200	441	1,751
1984	Trinity	1,610	7	0	0	282	330	2,229
1985	Trinity	1,521	9	0	0	132	326	1,988
1986	Trinity	1,574	8	0	0	176	228	1,986
1987	Trinity	1,412	2	0	0	176	249	1,839
1988	Trinity	1,607	2	0	0	440	276	2,325
1989	Trinity	1,792	2	0	0	369	274	2,437
1990	Trinity	1,672	2	0	0	274	312	2,260
1991	Trinity	1,469	2	0	6	274	319	2,070
1992	Trinity	1,526	7	0	6	274	410	2,223
1993	Trinity	1,730	9	0	6	808	407	2,960
1994	Trinity	1,913	8	0	6	718	386	3,031
1995	Trinity	2,048	0	0	6	808	374	3,236
1996	Trinity	2,201	6	0	6	808	303	3,324
1997	Trinity	2,694	5	0	6	808	298	3,811
1998	Trinity	2,769	8	0	6	808	302	3,893
1999	Trinity	2,899	9	0	6	808	360	4,082
2000	Trinity	2,519	9	0	6	286	357	3,177
2001	Trinity	3,381	8	0	6	665	354	4,414

Source: TWDB Water Use Survey Database 8/2/2004

Within the CCGCD there are two primary aquifers, the Trinity and the Edwards-Trinity, which provide groundwater to county residents. Well depths vary from shallow, hand-dug wells 20-30 feet deep to drilled wells that are up to 1200 feet deep. Depths are highly variable even within the same aquifer and depend entirely on site-specific topography and geology. Water quality and water quantity also vary greatly throughout the District. Water quality within a specific aquifer can often be defined or characterized in a general sense, but can still be affected by local geology and hydrology. The two Kendall County aquifers are listed in Table 1 along with the current estimated groundwater availability for each aquifer based on information derived from the following two sources:

- Volume I Chapter 4 Tables 4-14 of the Region L Water Supply Plan for the South Central Texas Regional Water Planning Group (January 2001 Region L Plan), (see Table 3 of this document), and
- September 2000 TWDB report on "Groundwater Availability of the Trinity Aquifer, Hill Country Area, and Texas: Numerical simulations through 2050" by Robert E. Mace, et. al.

The District will review future and/or updated calculations being investigated and prepared by TWDB's Dr. Robert Mace using the Trinity aquifer Groundwater Availability Model (GAM 2000). The District will consider this and other new data as it becomes available and will amend this plan as appropriate.

Current groundwater availability in Kendall County has been developed by Region L during the regional water planning process. The groundwater availability data has been recently reviewed as part of the

second 5 year planning cycle and is ready to be included in the upcoming Region L revised plan. This data is shown in Table 1. (Table 1 has been excerpted from Table 3 for easy reference.)

For District management and planning purposes, the groundwater availability listed for the aquifers identified in the Region L Plan will be utilized until more accurate data can be obtained. It should be noted that there are only a few Kendall County wells producing groundwater from the Edwards-Trinity (Plateau), and most are low volume wells for local domestic or livestock use. The Edwards-Trinity (Plateau) in Kendall County is of small areal extent, less than 250 feet thick and located on hilltops and ridges. Therefore, we do not expect the total estimated 905 acft/yr to remain a valid quantity as additional data is developed.

Table 2

(From Appendix A)

Current Groundwater Availability by Aquifer

Basin	Aquifer	2000	2010	2020	2030	2040	2050	2060
Available								
Colorado	Edwards-Trinity	207	207	207	207	207	207	207
Guadalupe	Edwards-Trinity	698	698	698	698	698	698	698
Colorado	Trinity	51	51	51	51	51	41	41
Guadalupe	Trinity	3,023	3,023	3,023	3,023	3,023	2,479	2,479
San Antonio	Trinity	861	861	861	861	861	706	706
Total Available		**4,840**	**4,840**	**4,840**	**4,840**	**4,840**	**4,131**	**4,131**
Estimated Demands								
Colorado	Edwards-Trinity	96	96	96	96	96	96	96
Guadalupe	Edwards-Trinity	31	31	31	31	31	31	31
Colorado	Trinity	12	12	12	12	12	12	12
Guadalupe	Trinity	1,747	1,897	1,891	1,884	1,878	1,872	1,866
San Antonio	Trinity	861	861	861	861	861	706	706
Total Estimated Demand		**2,747**	**2,897**	**2,891**	**2,884**	**2,878**	**2,717**	**2,711**
Remaining Ground water Available to meet Future Demands		**2,093**	**1,943**	**1,949**	**1,956**	**1,962**	**1,414**	**1,420**

Aquifer Descriptions

The Trinity aquifer in Kendall County is comprised primarily of the Upper Glen Rose (Upper Trinity), Lower Glen Rose Limestone, Hensell Sand, and the Cow Creek Limestone (Middle Trinity), and to a lesser extent, the Hosston and Sligo Formations (Lower Trinity). It extends across the majority of Kendall County. The Trinity aquifer is recharged primarily from local precipitation on its outcrop and through fracturing and porosity in the overlying units where the Trinity is in the subsurface. Some recharge may originate from areas outside Kendall County and flow down gradient into Kendall County. Well yields vary greatly and are highly dependent on local subsurface hydro geological characteristics. Yields are generally low, less than 20 gpm, but can occasionally be higher, with yields of 200-275 gpm being reported. Production from Trinity wells is primarily used for municipal, rural domestic, and livestock demands. A small amount of irrigation occurs for nurseries, vegetables, hay crops, peaches, pecans, grapes and grains.

The Edwards-Trinity (Plateau) aquifer within Kendall County is located at higher elevations along

ridges in the northern and southwestern portions of the county. It is comprised of relatively thin layers of limestone and dolomite that is an extension of the Edwards Plateau into Kendall County from the west. In general, yields from the aquifer are probably low (less than 20 gpm) and the water is used occasionally for rural domestic and livestock demands. The Edwards-Trinity (Plateau) aquifer in Kendall County exists in an unconfined condition. Recharge is solely from local precipitation occurring over the outcrop. Water not pumped from wells will generally discharge from small seeps and springs at the base of the Edwards outcrop and provides some base flow to small streams within the county.

Surface Water Resources and Usage in Kendall County

Groundwater supplies in Kendall County are augmented by several other water sources. Appendix A (from Table 4-14 Region L Plan – currently under revision) shows that the City of Boerne has a firm, drought supply allocation of 506 acft/yr of surface water (with an additional 327 acft/yr available in non-drought conditions for a maximum of 833 acft/yr) from Boerne Lake and 1,861 acft/yr of surface water from Canyon Lake (GBRA). Fair Oaks Ranch has 193 acft/yr of surface water from Canyon Lake (GBRA), and also claims 34 acft/yr of groundwater from the Trinity Aquifer in Comal County. Rural water systems (Tapatio Springs Service Company and Cordillera Ranch) supplies have a total of 1500 acft/yr of surface water from Canyon Lake (GBRA). Local usage of surface water and groundwater for livestock watering or limited irrigation from small ponds is termed "local supply" in the Region L Plan and totals approximately 446 acft/yr annually. Some small-scale irrigation "run of the river" diversions from surface streams total approximately 187 acft/yr annually. These local surface water impoundments consist of relatively small ponds and a few small dams on the Guadalupe River, Blanco River, Cibolo Creek, and their tributaries.

In summary, annual surface water availability in Kendall County totals approximately 4,026 acft/yr annually (with an additional 327 acft/yr available in non-drought conditions). Comal County Trinity groundwater totals 34 acft/yr annually.

Projected Total Water Supply in Kendall County

As shown in Table 4, the projected total water supply in Kendall County currently stands at about 7,254 acft/yr (which includes groundwater, surface water, and Trinity groundwater from Comal County). This total water supply is supplied and/or allocated to water users through existing infrastructure. As future demands increase, changes in the infrastructure will be necessary. It is expected that the greatest demand on water resources will be from rural domestic users who will rely primarily on groundwater. The majority of infrastructure improvements necessary to service these new groundwater users will be provided by either local property owners or by small public water supply companies. Therefore, it is anticipated that the amount of water supplied at any given time will be primarily related to rural growth patterns.

Projected Population and Water Demands in Kendall County

Population and water demand projections for Kendall County were originally given in the January 2001 Region L Plan. Subsequently, the 2000 Census has provided new population data. This data has been accepted and incorporated by Region L and the TWDB for an upcoming revision of the Region L Plan. Tables 3 and 4 incorporate those revisions and provide updated Kendall County populations and water demand projections for every ten years beginning in 2000 and ending with 2060.

Growth Patterns and Groundwater Impacts in Kendall County

Between 2000 and 2060, total county-wide water demand is estimated to increase approximately 322%, from 4,110 acft/yr to 13,237 acft/yr. In Table 2, the estimated amount of groundwater currently available within the county is approximately 4,840 acft/yr per year. By 2060, this is expected to drop to 4,131 ac/ft per year.

The Total Kendall County Surplus/Shortage section of Table 4 indicates that, in the absence of new surface water sources, groundwater may have to be completely allocated to partially meet increased demands and water shortages that will occur in Kendall County sometime between 2010 and 2060. As the demand increases, aquifers with areas of low production capability will probably experience a stressed condition sooner than anticipated and may not be able to meet higher demands. This may be particularly true in those areas where development is more intense.

Much of the growth now occurring in Kendall County is focused on the southern end of the county. This area is served primarily by private water wells producing from various stratigraphic units of the Trinity Aquifer. This aquifer is well known for low yield wells (5-20 gpm seems to be the average) as well as some water quality concerns involving hardness and other factors. TWDB PGMA studies and the Trinity GAM indicate that with continued growth, this particular aquifer will be over extended of the next 50 years to the point where quantity and quality problems are likely.

The Edwards-Trinity (Plateau) aquifer is located in areas that are expected to slowly undergo extensive development. The Edwards-Trinity (Plateau) aquifer will be unlikely to provide enough water to support extensive growth. Therefore, any growth that does occur during the 50 year planning horizon will more than likely have to rely on some other water source such as the Trinity, and may have to take in consideration the associated water quantity or quality problems.

Table 3

Kendall County Population Projections

(From Table 2-2, Region L)

Kendall County Population Projections (based on 2000 Census)	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total	**14,589**	**23,743**	**35,720**	**50,283**	**65,752**	**78,690**	**89,312**	**99698**

Table 4

Kendall County Projected Water Demands, Supplies, and Needs Projections

(From Appendix A)

		Projections					
	2000	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Kendall County Demand	**(acft)**	**(acft)**	**(acft)**	**(acft)**	**(acft)**	**(acft)**	**(acft)**
Municipal	3,262	4,649	6,370	8,142	9,610	10,888	12,139
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	396	714	699	685	671	658	646
Mining	6	6	6	6	6	6	6
Livestock	446	446	446	446	446	446	446
Total County Demand	4,110	5,815	7,521	9,279	10,733	11,998	13,237

Total Kendall County Supply							
Municipal	6,426	6,406	6,408	6,408	6,410	6,259	6,260
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	401	592	563	557	549	534	549
Mining	6	6	6	6	6	6	6
Livestock	421	421	421	421	421	418	418
Total County Supply	7,254	7,405	7,398	7,392	7,386	7,217	7,213
Total Kendall County Surplus/Shortage							
Municipal	3,164	1,757	38	-1,734	-3,200	-4,629	-5,879
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	5	-142	-136	-128	-122	-124	-117
Mining	0	0	0	0	0	0	0
Livestock	-25	-25	-25	-25	-25	-25	-25
Total County Surplus/Shortage	3,144	1,590	-123	-1,887	-3,347	-4,781	-6,024

Recharge of Groundwater in Kendall County

The annual natural recharge occurring in Kendall County is thought to be primarily through percolation of rainfall. More localized recharge, along with potentially higher rates of recharge, is probably occurring in the beds of rivers, creeks, and tributaries, particularly if associated with cave entrances or fracture zones. Recharge also occurs from flow through fracturing and porosity in the overlying units where the Trinity is in the subsurface. Some recharge may originate from areas outside Kendall County and flow down-gradient into Kendall County. The District is currently unaware of any significant recharge feature in Kendall County that may be providing a major avenue for recharge, although some of the localized recharge sites mentioned about may warrant further investigation.

While some studies have been made on the Trinity Aquifer as a whole, the District is unaware of any scientific study on recharge rates or aquifer capabilities specific to Kendall County. Most recently, a calculated annual recharge coefficient of approximately 4% of annual rainfall was developed in the September 2000 TWDB report on "Groundwater Availability of the Trinity Aquifer, Hill Country Area, and Texas: Numerical simulations through 2050" by Robert E. Mace, et. al. Although the actual coefficients presented in Figure 28 of that report vary from 3% to 4.5%, it seems reasonable for the District to assume a 4% average for Kendall County Trinity aquifer recharge, (Mace, et. al. have done this for the Trinity Aquifer as a whole). John Ashworth also developed a similar annual effective recharge coefficient (also 4% of average annual rainfall…about 30 inches) for the Trinity aquifer in the Texas Department of Water Resources Report 273, Ground-Water Availability of the Lower Cretaceous Formations in the Hill Country of South-Central Texas, January 1983. However, the amount of recharge estimated using this method appears to be unrealistically high and fails to take into account other factors effecting recharge flow into and out of the Trinity aquifer in Kendall County. In Table 5 provides a flow budget for Kendall County based on the Hill Country Trinity aquifer model. Table 5 addresses some of the flow variables that affect recharge calculations.

Table 5

County flow budget from the Hill Country Trinity Aquifer Model (Mace and others, 2000) for the steady state model in 1975.

County	Recharge	Rivers	GHB	Lakes	Wells	X-flow in	X-flow out	Z-flow
Kendall	9,900	-13,400	0	0	-200	4,800	-9,200	8,200

Notes:

1. Units are in acre-ft/yr.
2. **GHB** refers to flow out of the Hill Country area to the south and east.
3. **X-flow in** refers to lateral flow into the county.
4. **X-flow out** refers to lateral flow out of the county.
5. **Z-flow** refers to flow into the Middle Trinity aquifer (downward cross-formational flow).
6. **Wells** is for 1975 pumping.
7. A negative sign refers to flow out of the county.
8. A positive sign refers to flow into the county.
9. Values greater than 100 acre-ft are rounded to the nearest 100 acre-ft and values less than 100 acre-ft are rounded to the nearest 10 acre-ft.
10. Because the table only represents the Middle Trinity aquifer, recharge may be zero or very small if the Middle Trinity sediments are not exposed at land surface.

Mace, R. E., Chowdury, A. H., Anaya, R., and Way, S.-C., 2000, Groundwater availability of the Middle Trinity aquifer, Hill Country area, Texas- Numerical simulations through 2050: Texas Water Development Board Final Report, 169 p.

Estimated maximum annual recharge for the Edwards-Trinity (Plateau), the Upper Glen Rose, and the Middle Trinity aquifers in Kendall County based on Mace's flow budge (see Table 5) is shown in Table 6. The District will review future and/or updated calculations being investigated and/or prepared by

TWDB for the Trinity aquifer model. The District will consider this and other new data as it becomes available and will amend this plan as appropriate.

Table 6

Kendall County Aquifers	Estimated Maximum Annual Recharge
Edwards-Trinity (Plateau)	6,200 acft/yr
Upper Glen Rose	27,000 acft/yr
Middle Trinity	16,800 acft/yr
TOTAL	**49,900 acft/yr**

Estimated recharge and estimated groundwater availability clearly need further study and refinement. The calculated recharge potential for the Upper Glen Rose and Middle Trinity aquifers may be deceptively high when viewed in terms of groundwater actually available for well production. The same might be said for the Edwards-Trinity (Plateau) aquifer, particularly since its recharge is almost exclusively limited to direct rainfall events.

These recharge potentials are not to be confused with "recoverable" groundwater. Not all groundwater is recoverable. Some is lost to spring flow and seeps, some is used by plant life while the water is still near the surface, while some is almost permanently retained within the rock itself. For instance, much of the Trinity is a rather "tight" formation, particularly in the vertical direction. The Trinity is known for its low porosity and permeability, limited fracturing and faulting, and a complicated stratigraphy that includes layers of rock that reduce transmissivity and retard downward-moving recharge water. As a result, individual well yields are often quite low and, though large quantities of water may be present in the subsurface in specific local sites and in certain wells, much of the groundwater in Kendall County as a whole may be unrecoverable due to local hydro geologic conditions.

As previously mentioned, considerable amounts of water recharging the Trinity aquifer will be lost, some through biologic uptake and a significant amount through discharge at springs and seeps that provide relatively reliable base flow to local rivers and tributaries. Thus, much of the annual recharge may enter the ground, only to leave it again as base flow to surface streams. This is water that the aquifer rejects on an average annual basis and is potentially available and can theoretically be retrieved (at least on a short-term basis) without diminishing the average volume of groundwater being recharged to storage or, in other words, without creating a mining situation within the aquifer. However, if extensive pumping of this available water occurs, then base flow to area springs and streams will be greatly reduced and the effects of this reduction may be undesirable. Extensive pumping will also reduce the pressure head and may result in a significantly smaller quantity of recharge water actually percolating downward through the complex geology before providing deeper aquifer recharge that would be available for more reliable, long-term well production. Once pumping exceeds average annual recharge, then an aquifer mining condition will clearly exist and groundwater availability will decline. Until further studies can provide more accurate estimates of average annual recharge, management strategies for the Trinity aquifer will rely on the 3,935 acft/yr of Trinity groundwater and the 905 acft/yr of the Edwards-Trinity (Plateau) groundwater that was estimated as available for production by the Region L plan.

Recharge Enhancement Potential

The District is just beginning operations and has yet to assess potential recharge projects in Kendall County. The District will solicit ideas and information and will investigate any potential recharge enhancement opportunities, natural or artificial, that is brought to the District's attention. Such projects may include, but are not limited to: cleanup or site protection projects at any identified significant recharge feature, encouragement of prudent brush control practices, non-point source pollution

mitigation projects, aquifer storage and recovery projects, development of recharge ponds or small reservoirs, and the encouragement of appropriate and practical erosion and sedimentation control at construction projects located near surface streams.

GROUNDWATER MANAGEMENT POLICIES
(Actions, Procedures, Performance and Avoidance for Plan Implementation)

The District will manage the supply of groundwater within the District based on the District's best available data and its assessment of water availability and groundwater storage conditions. The Groundwater Availability Model (GAM 2000 and any subsequent updates) developed by the TWDB for the Trinity Aquifer will also aid in the decision making process by this District in the management of Kendall County groundwater.

The District shall promulgate Rules that will require the permitting of wells and groundwater production limits for non-exempt wells within the District consistent with this Groundwater Management Plan, the provisions of Chapter 36.113 and other pertinent sections of Chapter 36.

The District is in agreement with the commonly accepted groundwater management principle that opposes the mining of groundwater. Therefore, it shall be the policy of the District to limit withdrawal of groundwater from non-exempt wells producing from Kendall County aquifers to no more than the current groundwater availability volumes indicated for the individual aquifers in the Region L Plan (January 2001, and its Plan update scheduled for 2005). These volumes are listed in Tables 2 and Appendix A of this Groundwater Management Plan. Development or analysis of new or existing groundwater or aquifer data may result in changes to the groundwater availability volumes, with a corresponding change in production limits from the affected aquifers.

The District shall promulgate Rules that will regulate the spacing of wells and the production of groundwater consistent with the provisions Chapter 36.116. The District wishes to emphasize that in regulating or limiting groundwater production, it shall be the policy of the District to preserve historic use to the greatest extent practical and consistent with this plan.

The District will implement and utilize the provisions of this groundwater management 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 in which the District may participate will be consistent with the provisions of this plan. The District's current and future Rules will be promulgated pursuant to the provisions of Texas Water Code Chapter 36 shall be based on the best technical evidence available, and will address, implement, and be consistent with the provisions and policies of this plan.

The District shall review and re-adopt this plan, with or without revisions, at least once every five years in accordance with Chapter 36.1072(e). Any amendment to this plan shall be in accordance with Chapter 36.1073.

The District shall treat all citizens with equality. Citizens may apply to the District for discretion in enforcement of the Rules on grounds of adverse economic effect or unique local conditions. In granting of 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 constructed as limiting the power of the Board.

The District will seek cooperation and coordination in the development and implementation of this plan, management of groundwater resources, and appropriate District activities with the appropriate state, regional or local water management or planning entities.

The District will monitor groundwater conditions through its water level and water quality monitoring programs that are currently in place and will continue to maintain and update the District's database, which was established in 2004.

The District will encourage cooperative and voluntary Rule compliance, but if Rule enforcement becomes necessary, the enforcement will be legal, fair, and impartial. The promulgation and enforcement of the Rules will be based on the best technical evidence available.

METHODOLOGY FOR TRACKING PROGRESS IN ACHIEVING MANAGEMENT GOALS

The District will use the following methodology to track its progress toward achieving its management goals:

The District General Manager, Board President, or a Contracting Consultant will present an annual report to the Board of Directors on District performance and progress in achieving management goals and objectives at the last regular Board meeting of the fiscal year (September meeting) beginning in Fiscal Year 2005.

GROUNDWATER MANAGEMENT GOALS

1.0 Implement management strategies that will provide for the most efficient use of groundwater.

1.1 Management Objective

Implement and maintain a program of issuing well operating permits for non-exempt wells within Kendall County.

Performance Standards

Ongoing program of issuance or re-issuance of one or more well operating permits each year.

1.2 Management Objective

Incorporate well spacing requirements in District Rules to help reduce or prevent interference between nearby wells. Spacing requirements will be coordinated with Kendall County subdivision regulations and the Water Well Drillers Rules (16 Texas Administrative Code Chapter 76).

Performance Standards

Annual report submitted to the Board regarding suitability of current District well spacing rules and their compatibility with Kendall County subdivision regulations and the Water Well Drillers Rules.

2.0 Implement strategies that will control and prevent waste of groundwater.

2.1 Management Objective

Each year the District will provide to local newspapers at least one article describing a 5-7 day summer watering schedule and water efficient practices available for implementation by groundwater users during summer months.

Performance Standards

Number of summer watering articles submitted to local newspapers each year.

2.2 Management Objective

Provide to the public, upon request, water efficient literature handouts.

Performance Standards

Each year provide water efficient literature handouts on at least one occasion.

2.3 Management Objective

Provide either a speaker at a local club or organization or a display booth at public events twice each year.

Performance Standards

Number of speaking engagements or booth displays each year.

3.0 Implement strategies that will control and prevent subsidence.

The rigid geologic framework of the region precludes significant subsidence from occurring. Therefore, this goal is not applicable to the operations of this District.

4.0 Implement management strategies that will address conjunctive surface water management issues.

4.1 Management Objective

Meet once a year with Kendall County Commissioners Court regarding water availability reports and County subdivision requirements.

Performance Standard

Number of meetings with Kendall County Commissioners Court and the CCGCD regarding groundwater availability reports and County subdivision requirements.

4.2 Management Objective

Determine if studies may be warranted regarding possible need to develop correlations between spring flow, surface stream elevations/flows, rainfall, and groundwater levels.

Performance Standard

Annual report submitted to Board on determination of whether such studies may be warranted.

4.3 Management Objective

Investigate potential opportunities for recharge enhancement projects, either natural or artificial.

Performance Standard

Annual report submitted to Board on investigation of potential recharge enhancement opportunities, if any.

5.0 Implement strategies that will address natural resource issues which impact the use and availability of groundwater, or which are impacted by the use of groundwater.

The District is not aware of any such natural resource issues. Therefore, this goal is not applicable to the operations of the District at this time.

6.0 Implement strategies that will address drought conditions.

6.1 Management Objective

Quarterly, review applicable data to determine status of drought condition and, if necessary, report to District Board on need to implement drought contingency plan.

Performance Standards

Annual report submitted to Board on drought conditions in preceding year.

6.2 Management Objective

Provide to the public, upon request, drought-orientated literature handouts.

Performance Standards

Each year provide drought-orientated literature handouts on at least one occasion.

6.3 Management Objective

To evaluate groundwater availability each year the District will monitor water levels on selected wells representative of the Trinity aquifer within the District in accordance with the water level monitoring schedule in Table 7.

Table 7

Water Level Monitoring Schedule

Aquifer	# of Wells	Minimum Frequencies
Trinity	10	1 time per month

Performance Standard

Number of water level records measured annually.

6.4 Management Objective

By October 2006, utilizing a system of either/or rainfall, local aquifer conditions, the Palmer Drought Severity Index, or other appropriate criteria, determine, identify, and designate one or more mechanisms to trigger implementation of drought management plans.

Performance Standard

Identification and designation of trigger conditions within District aquifers by October 2004 used to indicate drought conditions and trigger subsequent implantation of emergency drought management plans.

7.0 Implement strategies that will address groundwater conservation.

7.1 Management Objective

Each year the District will provide to local newspapers at least one article identifying the importance of water conservation and various water conservation methods available for implementation by groundwater users.

Performance Standards

Each year provide water conservation oriented article to local newspapers on at least one occasion.

7.2 Management Objective

Provide to the public, upon request, conservation literature handouts.

Performance Standards

Each year provide conservation literature handouts on at least one occasion.

This Page Left Intentionally Blank

Appendix A

This Page Left Intentionally Blank

Kendall County Water Demands, Supplies, and Needs Projections

(From Table 4-14, Region L)
Projected Water Demands, Supplies, and Needs
Kendall County
South Central Texas Region

Basin	Source	Total in 2000 (acft)	Projections 2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)

Municipal Demand								
San Antonio Basin								
Boerne		1,170	1,570	2,188	2,843	3,370	3,831	4,282
Fair Oaks Ranch		152	286	296	300	305	310	316
Water Service Inc (Apex Water Ser)		37	43	53	61	69	75	81
Rural		748	1,080	1,506	1,939	2,304	2,620	2,930
Subtotal		2,107	2,979	4,042	5,143	6,048	6,836	7,609
Guadalupe Basin								
Rural		1,131	1,635	2,279	2,936	3,487	3,966	4,434
Subtotal		1,131	1,635	2,279	2,936	3,487	3,966	4,434
Lower Colorado Basin								
Rural		24	35	49	63	75	86	96
Subtotal		24	35	49	63	75	86	96
Total Municipal Demand		3,262	4,649	6,370	8,142	9,610	10,888	12,139
Municipal Existing Supply								
San Antonio Basin								
Boerne	Boerne Lake	506	506	506	506	506	506	506
	Canyon (GBRA)	1,861	1,861	1,861	1,861	1,861	1,861	1,861
	Trinity	463	446	447	448	448	368	369
Boerne Subtotal		2,830	2,813	2,814	2,815	2,815	2,735	2,736
Fair Oaks Ranch	Trinity (Comal)	39	39	39	39	39	32	32
	Canyon (GBRA)	193	193	193	193	193	193	193
Fair Oaks Ranch Subtotals		232	232	232	232	232	225	225
Water Service Inc (Apex Water Ser)	Edwards	2	2	2	2	2	2	2
Rural	Trinity	357	344	344	345	346	284	284
	Canyon (GBRA)	833	833	833	833	833	833	833
Rural Subtotal		1,190	1,177	1,177	1,178	1,179	1,117	1,117
Subtotal		4,255	4,225	4,226	4,228	4,229	4,080	4,081
Guadalupe Basin								
Rural	Edwards-Trinity	31	31	31	31	31	31	31
	Trinity	1,383	1,383	1,383	1,383	1,383	1,383	1,383
Rural Subtotals		1,414	1,414	1,414	1,414	1,414	1,414	1,414
Subtotal		1,414	1,414	1,414	1,414	1,414	1,414	1,414
Lower Colorado Basin								
Rural	Edwards-Trinity	30	30	30	30	30	30	30
Subtotal		30	30	30	30	30	30	30
Total Municipal New Supply Need		5,699	5,669	5,670	5,672	5,673	5,524	5,525
Municipal Surplus/Shortage								
San Antonio Basin								
Boerne		1,660	1,243	626	-28	-555	-1,096	-1,546
Fair Oaks Ranch		80	-54	-64	-68	-73	-85	-91
Water Service Inc (Apex Water Ser)		-35	-41	-50	-59	-67	-73	-79
Rural		442	97	-329	-761	-1,125	-1,503	-1,813
Subtotal		2,148	1,246	184	-915	-1,819	-2,756	-3,528
Guadalupe Basin								

Steam-Electric Demand								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Steam-Electric Demand		0	0	0	0	0	0	0
Steam-Electric Existing Supply								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Steam-Electric Existing Supply		0	0	0	0	0	0	0
Steam-Electric Surplus/Shortage								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Steam-Electric Surplus/Shortage		0	0	0	0	0	0	0
Steam-Electric New Supply Need								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Steam-Electric New Supply Need		0	0	0	0	0	0	0
Irrigation Demand								
San Antonio Basin		107	194	189	185	181	177	174
Guadalupe Basin		289	520	510	500	490	481	472
Lower Colorado Basin		0	0	0	0	0	0	0
Total Irrigation Demand		396	714	699	685	671	658	646
Irrigation Supply								
San Antonio Basin	Trinity	41	71	70	68	67	54	53
Guadalupe Basin	Run-of-River	187	187	187	187	187	187	187
	Trinity	188	339	332	326	319	313	307
Guadalupe Basin Subtotal		375	526	519	513	506	500	494
Lower Colorado Basin		0	0	0	0	0	0	1
Total Irrigation Supply		416	597	589	581	573	554	548
Irrigation Surplus/Shortage								
San Antonio Basin		-66	-123	-119	-117	-114	-123	-121
Guadalupe Basin		86	6	9	13	16	19	22
Lower Colorado Basin		0	0	0	0	0	0	1
Total Irrigation Surplus/Shortage		20	-117	-110	-104	-98	-104	-99
Irrigation New Supply Need								
San Antonio Basin		66	123	119	117	114	123	121
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Irrigation Need		66	123	119	117	114	123	121

Mining Demand								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		6	6	6	6	6	6	6
Total Mining Demand		6	6	6	6	6	6	6
Mining Supply								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin	Trinity	6	6	6	6	6	6	6
Lower Colorado Basin Subtotal		6	6	6	6	6	6	6
Total Mining Supply		6	6	6	6	6	6	6
Mining Surplus/Shortage								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Mining Surplus/Shortage		0	0	0	0	0	0	0
Mining New supply Need								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Mining Need		0	0	0	0	0	0	0
Livestock Demand								
San Antonio Basin		80	80	80	80	80	80	80
Guadalupe Basin		353	353	353	353	353	353	353
Lower Colorado Basin		13	13	13	13	13	13	13
Total Livestock Demand		446	446	446	446	446	446	446
Livestock Supply								
San Antonio Basin	Local	80	80	80	80	80	80	80
Guadalupe Basin	Local	353	353	353	353	353	353	353
Lower Colorado Basin	Local	13	13	13	13	13	13	13
Total Livestock Supply		446	446	446	446	446	446	446
Livestock Surplus/Shortage								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Livestock Surplus/Shortage		0	0	0	0	0	0	0
Livestock New supply Need								
San Antonio Basin		0	0	0	0	0	0	0
Guadalupe Basin		0	0	0	0	0	0	0
Lower Colorado Basin		0	0	0	0	0	0	0
Total Livestock Need		0	0	0	0	0	0	0

Total Kendall County Demand							
Municipal	3,262	4,649	6,370	8,142	9,610	10,888	12,139
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	396	714	699	685	671	658	646
Mining	6	6	6	6	6	6	6
Livestock	446	446	446	446	446	446	446
Total County Demand	4,110	5,815	7,521	9,279	10,733	11,998	13,237
Total Kendall County Supply							
Municipal	5,699	5,669	5,670	5,672	5,673	5,524	5,525
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	416	597	589	581	573	554	548
Mining	6	6	6	6	6	6	6
Livestock	446	446	446	446	446	446	446
Total County Supply	6,567	6,718	6,711	6,705	6,698	6,530	6,525
Total Kendall County Surplus/Shortage							
Municipal	2,437	1,020	-700	-2,470	-3,937	-5,364	-6,614
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	20	-117	-110	-104	-98	-104	-98
Mining	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0
Total County Surplus/Shortage	2,457	903	-810	-2,574	-4,035	-5,468	-6,712
Total Basin Demand							
San Antonio							
Municipal	2,107	2,979	4,042	5,143	6,048	6,836	7,609
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	107	194	189	185	181	177	174
Mining	0	0	0	0	0	0	0
Livestock	80	80	80	80	80	80	80
Total San Antonio Basin Demand	2,294	3,253	4,311	5,408	6,309	7,093	7,863
Guadalupe							
Municipal	1,131	1,635	2,279	2,936	3,487	3,966	4,434
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	289	520	510	500	490	481	472
Mining	0	0	0	0	0	0	0
Livestock	353	353	353	353	353	353	353
Total Guadalupe Basin Demand	1,773	2,508	3,142	3,789	4,330	4,800	5,259
Lower Colorado							
Municipal	24	35	49	63	75	86	96
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Mining	6	6	6	6	6	6	6
Livestock	13	13	13	13	13	13	13
Total Lower Colorado Basin Demand	43	54	68	82	94	105	115

Total Basin Supply							
San Antonio							
Municipal	4,255	4,225	4,226	4,228	4,229	4,080	4,081
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	41	71	70	68	67	54	53
Mining	0	0	0	0	0	0	0
Livestock	80	80	80	80	80	80	80
Total San Antonio Basin Supply	4,376	4,376	4,376	4,376	4,376	4,214	4,214
Guadalupe							
Municipal	1,414	1,414	1,414	1,414	1,414	1,414	1,414
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	375	526	519	513	506	500	494
Mining	0	0	0	0	0	0	0
Livestock	353	353	353	353	353	353	353
Unallocated Groundwater Supply	2,119	1,969	1,975	1,982	1,988	1,450	1,456
Total Guadalupe Basin Supply	4,261	4,262	4,261	4,262	4,261	3,717	3,717
Lower Colorado							
Municipal	30	30	30	30	30	30	30
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	1
Mining	6	6	6	6	6	6	6
Livestock	13	13	13	13	13	13	13
Unallocated Groundwater Supply	222	222	222	222	222	212	212
Total Lower Colorado Basin Supply	271	271	271	271	271	261	262
Total Basin Surplus/Shortage							
San Antonio							
Municipal	2,148	1,246	184	-915	-1,819	-2,756	-3,528
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	-66	-123	-119	-117	-114	-123	-121
Mining	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0
Total San Antonio Basin Surplus/Shortage	2,082	1,123	65	-1,032	-1,933	-2,879	-3,649
Guadalupe							
Municipal	283	-221	-865	-1,522	-2,073	-2,552	-3,020
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	86	6	9	13	16	19	22
Mining	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0
Unallocated Groundwater Supply	2,119	1,969	1,975	1,982	1,988	1,450	1,456
Total Guadalupe Basin Surplus/Shortage	2,488	1,754	1,119	473	-69	-1,083	-1,542
Lower Colorado							
Municipal	6	-5	-19	-33	-45	-56	-66
Industrial	0	0	0	0	0	0	0
Steam-Electric	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	1
Mining	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0
Unallocated Groundwater Supply	222	222	222	222	222	212	212
Total Lower Colorado Basin Surplus/Shortage	228	217	203	189	177	156	147

Notes:
1 There is insufficient groundwater available in the county to meet all of the projected livestock demands.

Groundwater Supplies								
Basin	**Aquifer**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Available								
Colorado	Edwards-Trinity	207	207	207	207	207	207	207
Guadalupe	Edwards-Trinity	698	698	698	698	698	698	698
Colorado	Trinity	51	51	51	51	51	41	41
Guadalupe	Trinity	3,023	3,023	3,023	3,023	3,023	2,479	2,479
San Antonio	Trinity	861	861	861	861	861	706	706
Total Available		**4,840**	**4,840**	**4,840**	**4,840**	**4,840**	**4,131**	**4,131**
Estimated Demands								
Colorado	Edwards-Trinity	96	96	96	96	96	96	96
Guadalupe	Edwards-Trinity	31	31	31	31	31	31	31
Colorado	Trinity	12	12	12	12	12	12	12
Guadalupe	Trinity	1,747	1,897	1,891	1,884	1,878	1,872	1,866
San Antonio	Trinity	861	861	861	861	861	706	706
Total Estimated Demand		**2,747**	**2,897**	**2,891**	**2,884**	**2,878**	**2,717**	**2,711**
Remaining Groundwater Available to Meet Future Demands		**2,093**	**1,943**	**1,949**	**1,956**	**1,962**	**1,414**	**1,420**

Cow Creek Groundwater Conservation District

P. O. Box 1783
Boerne, Texas 78006

c/o Micah Voulgaris
(830) 249-9343 ext. 251