Hays Trinity Groundwater Conservation District

Groundwater Management Plan

Adopted: August 4, 2005

Board of Directors
Andrew Backus, Member
Doug Wierman, Member
Mark Hemingway, Member
Joe Day, Member
Jack Hollon, Member

General Manager
Stefani Campbell
manager@haysgroundwater.com

Prepared by the Hays Trinity Groundwater Conservation District with valuable assistance from River Systems Institute - Texas State University and Turner, Collie and Braden.

PO Box 1648
Dripping Springs, Texas 78620
(512) 858-9253 Phone
(512) 858-2384 Fax

http://www.haysgroundwater.com

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TIME PERIOD FOR THIS PLAN

This plan complies with the requirements of Texas Administrative Code (TAC): Title 31 Natural Resources and Conservation, Part 10 Texas Water Development Board, Chapter 356 Groundwater Management, Subchapter A Groundwater Management Plan Certification 31 TAC §356. This plan becomes effective upon adoption by the Hays Trinity Groundwater Conservation District Board of Directors (District or Board) and certification as administratively complete by the Texas Water Development Board (TWDB). This plan will be in effect for ten years from the date of TWDB certification in accordance with 31 TAC §356.5(a). After five years, this plan will be reviewed for conflict 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 any time in order to avoid conflict or as necessary to address any new or revised data, Groundwater Availability Model updates, or District management strategies.

DISTRICT MISSION

Given the critical importance of water to life and of that part of the water cycle called groundwater to local families, agriculture, commerce, stream flows and wildlife habitat, the Hays Trinity Groundwater Conservation District works to conserve, preserve, recharge and prevent waste of groundwater within western Hays County. To help accomplish these goals the District is charged to gather information needed for sound decisions, to provide that information to citizens and local agencies, and to insure that groundwater is used efficiently and at sustainable rates.

GENERAL DESCRIPTION OF THE DISTRICT

The Hays Trinity Groundwater Conservation District (District or HTGCD) is a political subdivision of the State of Texas. It was created in Chapter 1331, Acts of the 76th Legislature, Regular Session, 1999 and in Act of May 27, 2001, 77th Legislature, Regular Session, Chapter 966, Part 3, 2001 Texas General Laws 1880 (S.B. 2); (collectively, enabling legislation). The District was confirmed by popular election on May 3, 2003. The District's enabling legislation and Texas Water Code Chapter 36 authorize the District to make and enforce rules that are reasonably consistent with this management plan and the district's guiding principles. The HTGCD encompasses the western 54.4%, approximately 370 square miles, of western Hays County (Figure 1). The District is divided into five single member districts for Board of Directors' representation, each with a population of approximately 5,000 (Figure 2).

The Board of Directors in fiscal year 2005 is composed of:

- Doug Wierman, Board Vice President: Represents Single Member District 1 (term expires May 2006)
- Mark Hemingway, Board Treasurer / Secretary: Represents Single Member District 2 (term expires May 2007)
- Andrew Backus, Board President: Represents Single Member District 3 (term expires May 2006)
- Joe Day: Represents Single Member District 4 (term expires May 2007)
- Jack Hollon: Represents Single Member District 5 (term expires May 2006)

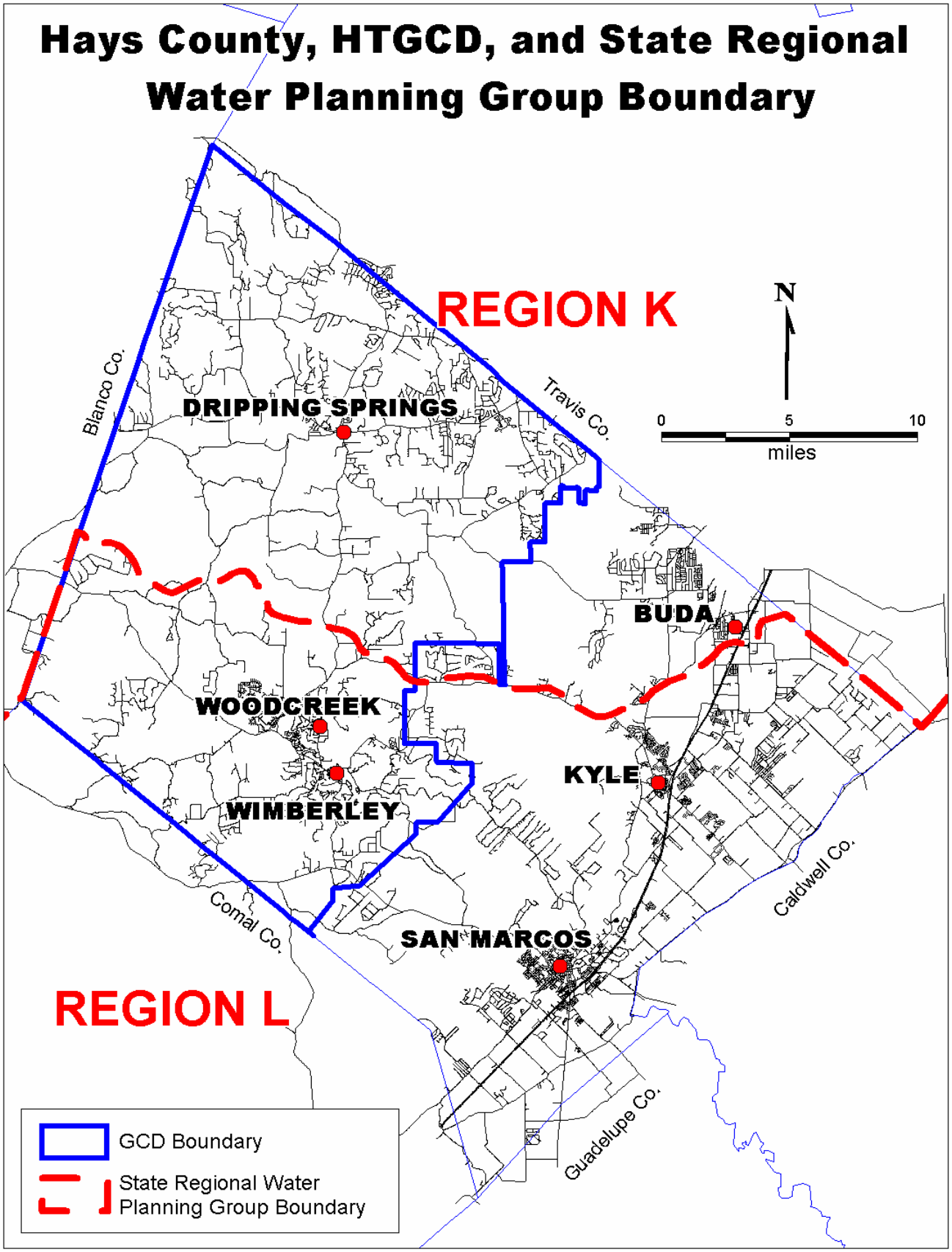

Figure 1: Hays County, HTGCD, and State Regional Water Planning Group Boundaries

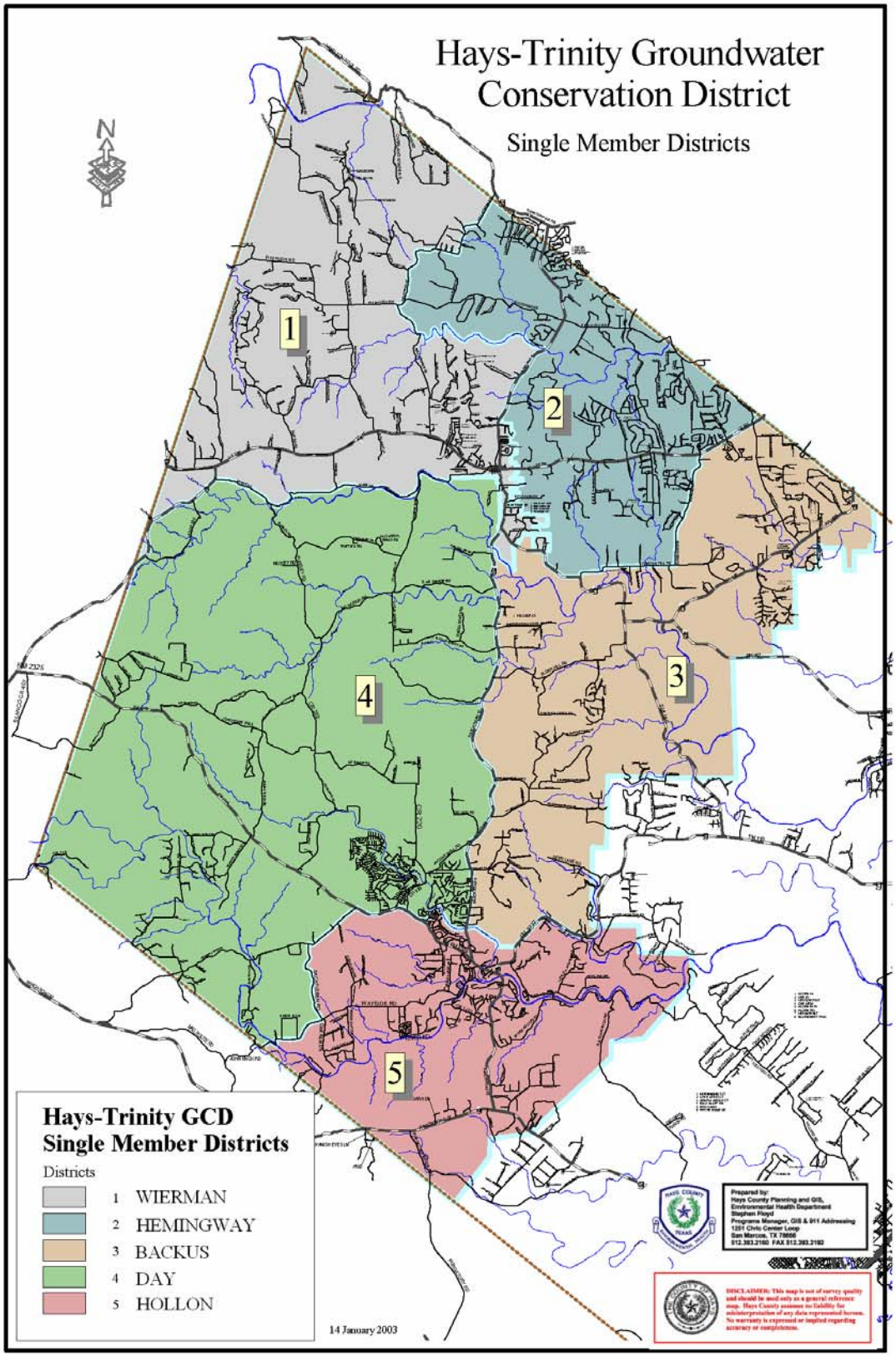

Figure 2: HTGCD Single Member Districts

STATEMENT OF GUIDING PRINCIPLES

The District has a goal of sustainable management to maintain 90% of the Trinity Aquifer contribution to stream leakage and stream/spring base-flow during a repeat of the drought of record and, in critical depletion areas, a rate of stream/spring base-flow that maintains a sound ecological environment. The guiding principles will serve as a basis for the possible development and adoption of District policies and rules to achieve this goal. Guiding principles include but may not be limited to:

- Manage the use of the aquifers for the benefit of the people of the District while maintaining sufficient quantity of water in the aquifers to maintain spring and stream flows during periods of drought,
- Maintain and prevent degradation of water quality in surface water and groundwater,
- Consider preservation of historic use of groundwater,
- Prevent waste of groundwater,
- Minimize the reduction of artesian pressure,
- Promote the conservation of groundwater drought response actions through voluntary measures for wells not regulated by the District,
- Encourage the use of rainwater collection systems,
- Cooperate with surface water providers to facilitate the sustainable management of groundwater resources and the equitable distribution of surface and groundwater resources,
- Consider mandatory conservation and drought response actions for wells regulated by the District ("non-exempt wells"),
- Promote artificial recharge of the aquifers though such means as proper brush management, re-establishing deep rooted native grasses and creation of surface water runoff collection/infiltration dams, and
- Continue to develop water production limits based on uniform principals as authorized by Chapter 36 and the District's enabling legislation

ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE NECESSARY TO EFFECTUATE THE GROUNDWATER MANAGEMENT PLAN

The District shall use this plan as a guidepost for policies and actions undertaken by the District. 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 District Rules, policies, and activities will be coordinated with the management plan in order to effectively manage and regulate:

- The drilling and spacing of wells;
- Water quality in surface water and groundwater;
- Production of groundwater within the District, and;
- The potential transfer of water out of the District.

In following this management plan the District may develop rules, policies and activities to:

- Encourage conservation practices and efficient water use;
- Guide the development of drought contingency and management plans;
- Provide for the District's management and regulation of identified critical groundwater depletion areas within the District, and;

- Promote the development and use of rainwater systems to relieve pressure on groundwater.

To the greatest extent practical, while upholding the intent of the District's Mission, Management Plan and Rules, the District will strive to cooperate with and coordinate its management plan and regulatory policies with adjacent groundwater districts, Regional Water Planning Groups, TWDB, Hays County, local municipalities, and adjacent counties with aquifers that are hydraulically connected to aquifers within the District's jurisdiction.

REGIONAL AND DISTRICT WATER SUPPLY PLANNING

The 75th Texas Legislature's passing of Senate Bill 1 in 1997 established a new method for water planning in Texas. The State water supply planning process was changed to include public participation at each phase of the process. Sixteen Regional Planning Groups were formed, with representatives having a broad array of interests, to develop regional water plans. Local and regional decisions are the building blocks to produce water plans. Groundwater conservation districts (GCDs) were required to develop groundwater management plans. The regional water planning groups must consider the GCD groundwater management plans when developing a regional water plan. The sixteen regional water plans collectively form the State Water Plan. This planning process is controlled by TWDB rules. GCD groundwater management plans specifications are given in 31 TAC §356. The specifications for regional water plans are given in 31 TAC §357 and §358.

The TWDB's Regional Planning Approach

Demand Projections

Each of the 16 Regional Water Planning Groups in the State of Texas is charged with developing a new regional water plan every five years. The regional water planning cycle begins with an estimate of the changes in population since the last water plan was prepared. Standardized per capita daily use estimates are applied to the updated population estimate to develop the municipal, county and other water user groups (WUGs) water demand projection. Similar estimated water use rates are applied to the various other categories of water users that are considered in the regional water plans to develop a water demand projection. Water demand projections represent the need for water; however, no specification is made whether the demand will be served by surface water or groundwater. The estimates of projected water demand for each WUG considered in the regional water plan is presented in the Exhibit B, Data Table 2 of the updated water plan.

Inventory of Projected Supplies

To determine whether sufficient water supplies are available to serve the revised water demand projections, an inventory of projected water supplies is made for each WUG considered in the regional water plan. The inventory of the projected water supplies for each WUG is specific to the source and type of water (i.e. surface water or groundwater). The amount of water that can be developed over the planning period from each water source listed in the inventory of projected water supplies is included in the projection. The amount of water that can be developed from each source is related to the infrastructure capacity of the WUG associated with a specific source of water. For example, this may be the capacity of a water treatment plant for surface water supplies or the pumping capacity of a well field for groundwater supplies. The amount of the projected water supplies for a specific source in the inventory of a WUG may be held constant over the planning

period or reduced over time (i.e. to reflect depletion of a well field). The inventory of projected water supplies is presented in Exhibit B, Data Table 5 of the revised water plan.

Reconciling Projected Demand and Supplies

When the inventory of projected water supplies is completed, a comparison is made between the projected water demand of each WUG and the projected water supplies of the WUG. If the amount of projected water supplies of a WUG is greater than the projected demand, the WUG has adequate water to meet its needs over the planning period and no further action is needed. If the comparison between projected water demand and projected water supplies indicates that the amount of projected demand will exceed the amount of projected supplies at some point in the planning period, a water management strategy must be developed. To develop a water management strategy the inventory of available water supplies given in Exhibit B, Data Table 4 of the revised water plan is consulted.

The inventory of available water supplies in Exhibit B, Data Table 4 includes both surface water and groundwater. The value listed in the Table gives the amount of water stored in each source of water that may be used on an annual basis. For surface water, this amount may be the Safe Yield of a reservoir or the amount of un-permitted flow in a river after environmental needs have been met. For groundwater, the amount of water given in the Table is the amount of water that may be sustainably pumped from an aquifer. Where a groundwater conservation district exists, the district Board of Directors determines the preferred criteria to assess the amount of groundwater that may be sustainably used from an aquifer. Where a groundwater conservation district does not exist, the regional water planning group may determine the preferred criteria to determine sustainable yield.

After consulting the inventory of available water supplies, the sources of water that may offer a sufficient amount of water for the un-met projected demand of a WUG are identified. If several sources of water potentially offer sufficient water for the un-met demand, an analysis is made of the feasibility of developing additional water supplies from the source. The regional water planning group considers the feasibility analysis and determines which source is preferred for the water management strategy that will be recommended in the updated regional water plan for each WUG that had un-met water demand identified. The list of recommended water management strategies given in the regional water plan is Exhibit B, Data Table 12. When the projected water demand for each WUG can be met over the 50-year planning period of the regional water plan with ether the projected water supplies or with a recommended water management strategy, the planning process is complete.

District Planning Approach

Hays County is one of the few counties divided by two Regional Planning Groups: the Lower Colorado Region (Region K) in the north, and the South Central Texas Region (Region L) in the south. The County also includes three other groundwater Districts, the Edwards Aquifer Authority, Plum Creek Conservation District and the Barton Springs Edwards Aquifer Conservation District (Figure 3). The drainage divide between the Colorado and Guadalupe River basins defines the shared boundary of Region K and L within Hays County. Based on GIS analysis conducted by Turner, Collier and Braden during the preparation of this plan, the jurisdiction of the HTGCD covers approximately 76% of the Region K area and 38% of the Region L area within Hays County respectively (Figure 1). In contrast to the whole county, the area of the District itself (370 square miles) is divided between Region K and L in the following ratio: 61% (226 square miles) Region K and 39% (144 square miles) Region L (Figure 4). In addition, the District is located within the Hill Country Priority Groundwater Management Area, which is an area designated under Texas Water

Code Chapter 35 as an area experiencing or expected to experience critical groundwater shortages (Cross and Bluntzer, 1990).

Pursuant to TWDB rules, this management plan must not conflict with the regional plans in addressing water supply needs. The District must also use the best available data in developing the plan and may use site-specific data available to the District. Accordingly, in the adoption of this plan the District has used:

- TWDB, "Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulations through 2050" (T-HC GAM) (Mace et. al, 2000);
- TWDB, "Groundwater Availability Model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium Aquifer System, Texas" (E-T GAM) (Anaya et. al, 2004);
- Planning information from Regions K and L Water Planning Groups;
- Adjoining Groundwater Conservation Districts' adopted plans;
- Data from regional surface water providers such as the Lower Colorado River Authority and the Guadalupe Blanco River Authority, and;
- Site-specific data developed by the District.

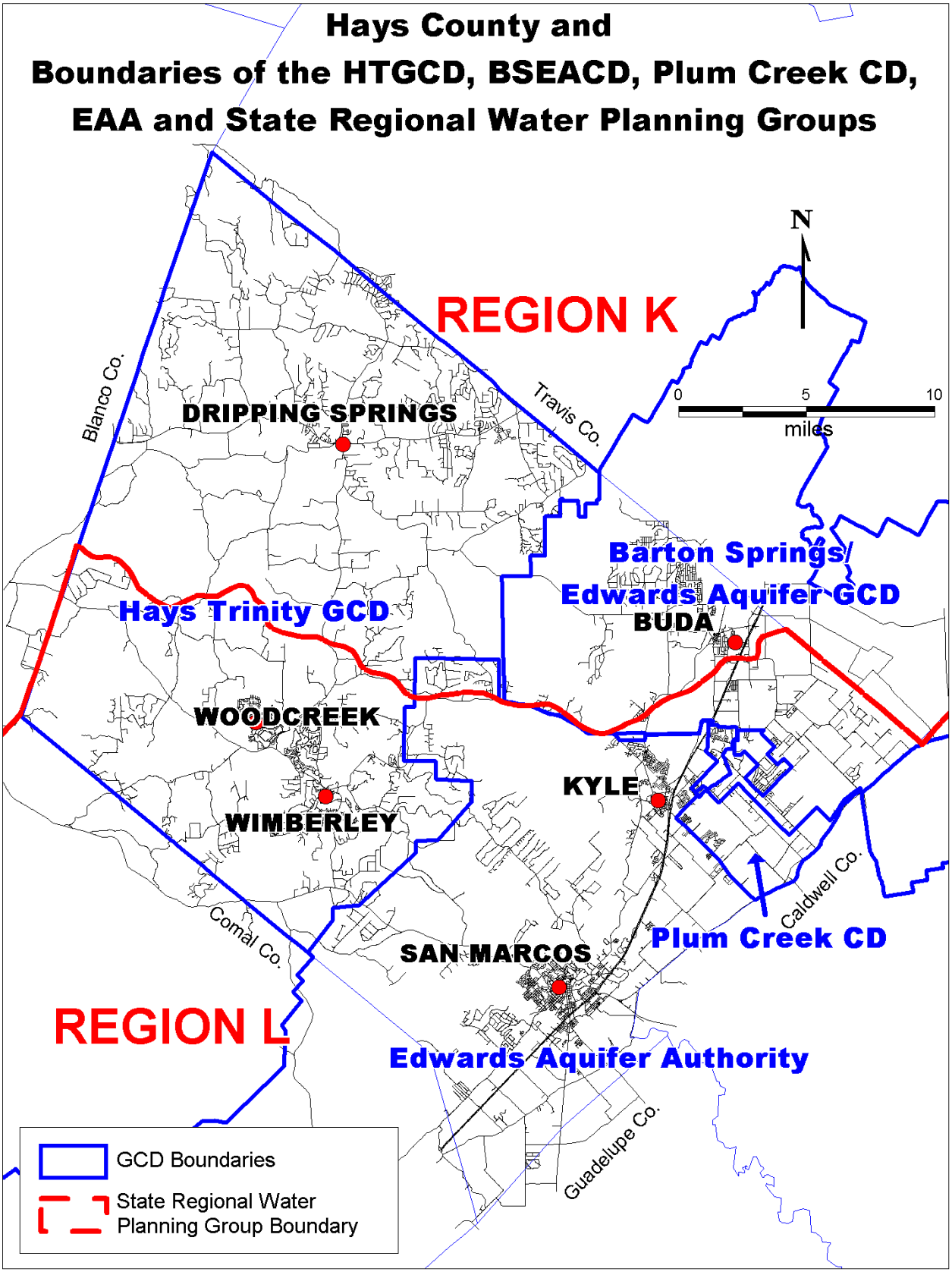

Figure 3: Hays County and Boundaries of HTGCD, BSEACD, EAA, Plum Creek CD and State Regional Planning Groups

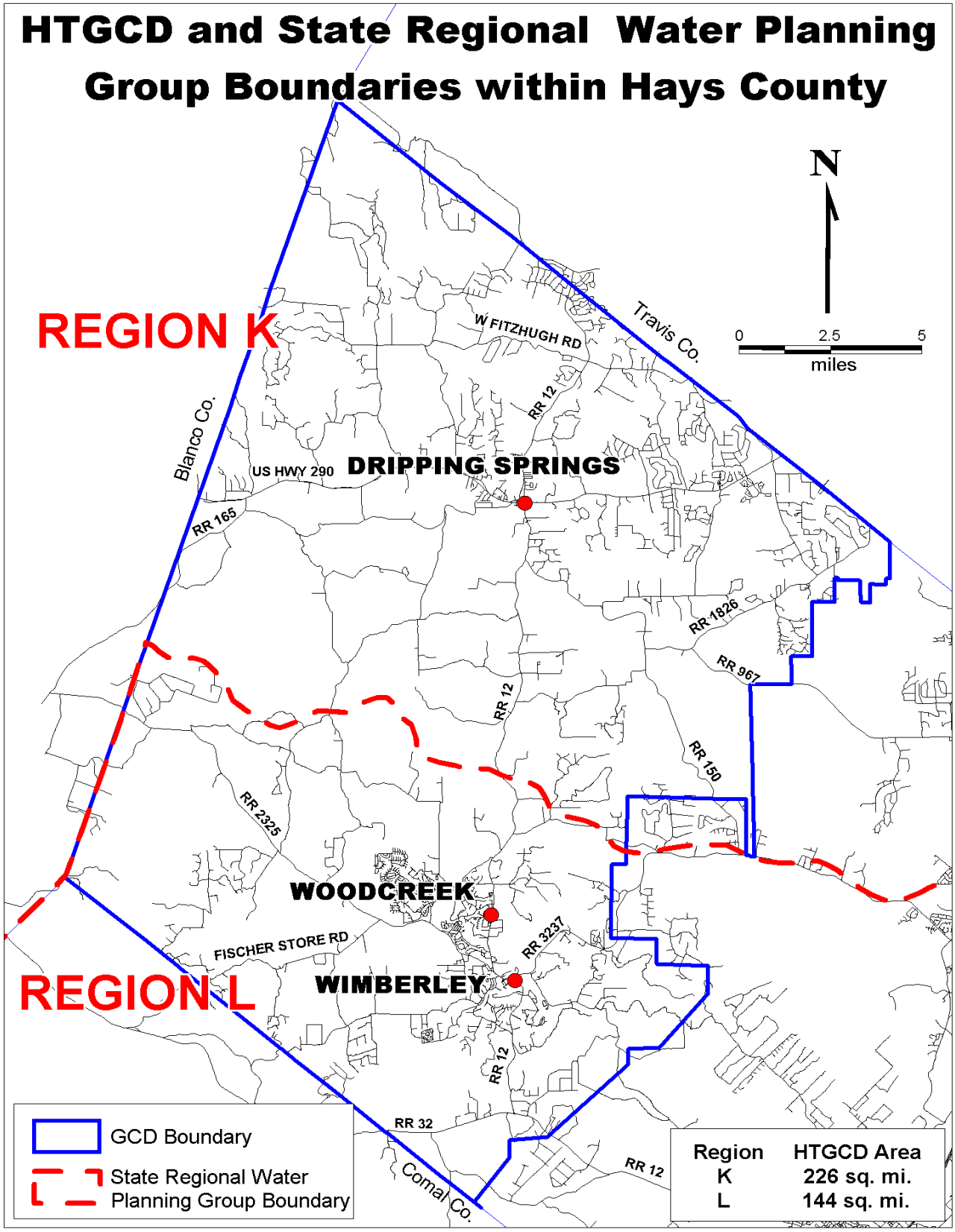

Figure 4: HTGCD and State Water Planning Group Boundaries Within Hays County

This plan serves as a basis for the development and revision of existing rules and adoption of new District rules. The Board adopted District rules on August 8, 2001, which were amended on March 29, 2004, March 9, 2005 and on May 5, 2005.

HAYS COUNTY GEOGRAPHY

Population

Since the 1970s, growth in the northern and eastern parts of the county has been influenced by the increased employment opportunities in the Austin metropolitan area, growth related to the Austin-San Antonio Interstate Highway 35 corridor, and a general migration of people to the southern part of the U.S. The IH-35 corridor is generally a few miles east of the District boundaries and intense growth along this transportation corridor affects the District. In 1973, Hays County became part of the Austin Metropolitan Statistical Area (TSHA, 2004).

Hays County had a projected/estimated total population of 114,193 in 2003 and actual 2000 population of 97,589 and occupies an area of 679.8 square miles in south central Texas (U.S. Census Bureau, 2003). According to 2003 Census Bureau projections, Hays County was the 31st fastest growing county in the nation, and among the top 5 in Texas based on percentage increase, with a 17 percent population increase between April 2000 and July 2003 (Austin Business Journal, 2004). With a 49% 10-year increase in population (1990-2000), Hays County ranked number 13 out of 254 counties in Texas (DeskMap Systems, 2003).

The District has a population of approximately 28,000 to 29,000 residents. Wimberley is the largest city in the Hays Trinity Groundwater Conservation District with a year 2000 population of 3,797 people. Dripping Springs is the second largest city in the District with a total population of 1,548 in the year 2000. Woodcreek is the third largest city in the District with a 2000 population of 1,274. The majority of the people in the District live in unincorporated areas outside of town/city limits and either live in the ETJ of Dripping Springs or in the unincorporated area surrounding Wimberley and Woodcreek.

The major public water supply companies in the District are Dripping Springs Water Supply Corporation, Wimberley Water Supply Corporation and Woodcreek/AquaTexas. There are approximately 25 smaller public water supply companies in the District. Table 1 summarizes the smaller public water systems in the District.

Table 1: Small Public Water Supply Systems Located Within the HTGCD By Regional Water Planning Group, Population and Estimated Daily Water Usage

Region K	Population Served	Daily Usage (gpd)*
Brown Karahan Health Care Inc.	71	7,810
Camp Ben McCullough WS	25	1,250
Cardinal Valley Water Co. Inc	141	15,510
Dripping Springs Dental Clinic	30	1,500
Gateway Estates II	108	11,880
Gateway Estates III	36	3,960
LaVentana Water Supply System	78	8,580
Radiance WSC	93	10,230
River Oaks Ranch	300	33,000
Salt Lick BBQ	1,200	60,000
Signal Hill Water System 24	35	3,850
Total Region K	**2,117**	**157,570 gpd, or 177 acre-feet/year**
Region L	**Population Served**	**Daily Usage (gpd)***
Camp Young Judea Inc	200	10,000
Cedar Oaks Mesa WSC	654	71,940
Cielo Azul Ranch	104	11,440
El Rancho CIMA	26	2,860
Goldenwood West Inc.	426	46,860
LSR WSC	36	3,960
Mountain View Motel	34	1,700
Sac & Pac 109	250	12,500
Skyline Ranch Estates	168	18,480
Wimberley Oaks WSC	78	8,580
Wimberley VFW Post 6441	250	12,500
Total Region L	**2,226**	**200,820 gpd, or 225 acre-feet/year**

*gpd = gallons per day. Daily Usage is assumed to be: 110 gpd/person for residential or 50 gpd/person for commercial, camps and other.

Wimberley / Woodcreek Population and Growth Trends
Wimberley and Woodcreek are located near the intersection of Ranch Road 12 and Farm to Market Road 2325 in the southern portion of the District. The 2000 census for Wimberley indicated a total population of 3,797 people living in 1,576 housing units (U.S. Census, 2000). There were 352 vacant housing units. 1,077 of the housing units had families living in them with an average size of 2.79 people. 499 housing units contained non-family households with an average of 2.34 people in them. 2004 data from TCEQ's Public Water Systems Data Sheet for Wimberley WSC (1050018) indicates that as of 2004, about 4,839 people were served through 1,521 meters (TCEQ, 2004). The system is supplied by 4 Middle Trinity Aquifer wells. It is not precisely known how many customers are within the City versus the ETJ.

The 2000 census for Woodcreek indicated a total population of 1,274 people living in 588 housing units (U.S. Census, 2000). There were 50 vacant housing units. 416 of the housing units had families living in them with an average size of 2.58 people. 172 housing units contained non-family households with an average of 2.17 people in them. 2004 Data from TCEQ's Public Water Systems Data Sheet for Woodcreek indicates they have two distinct Public Water Systems, #1 and #2, that are owned and operated by Aqua Texas Utility (formerly Aquasource Utility). These public water systems are not currently interconnected. The 2004 TCEQ data indicates that WSC #1(TCEQ #1050037) served 2,334 people through 779 meters and is supplied by a Glen Rose and Cow Creek well (TCEQ, 2004). The 2004 TCEQ data indicates that WSC #2 (TCEQ #1050039) served 1,410 people through 501 meters and is supplied by 2 Glen Rose wells. Some of the people served by Woodcreek WSCs probably live outside of Woodcreek which would account for the large discrepancy between the 2000 Census data and the 2004 TCEQ data.

Dripping Springs Population and Growth Trends
Dripping Springs is located at the intersection of Highway 290 and Ranch Road 12 in the northern third of the District. The 2000 census for Dripping Springs indicated a total population of 1,548 people living in 554 housing units (U.S. Census, 2000). There were 30 vacant housing units. 419 of the housing units had families living in them with an average size of 3.24 people. 135 housing units contained non-family households with an average of 2.79 people in them. 2004 data from TCEQ's Public Water Systems Data Sheet for Dripping Springs WSC (1050013) indicates that 3,315 people were served through 1,074 meters. The system blends surface water supplied by LCRA and groundwater from four Trinity Aquifer wells. It is not precisely known how many customers are within the City versus the ETJ. The ETJ of Dripping Springs has been estimated to have 10 times the population of the City itself. The population is expected to increase at a compounding rate of 2.5 to 6.5% per year based on student enrollment projections (DeskMap Systems, 2004).

Much of the growth in the District in the last ten years has been along the Highway 290 corridor and along Ranch Road 1826. Both corridors are located in the City of Dripping Springs ETJ. This trend will continue due, in part, to Lower Colorado River Authority (LCRA) surface water pipelines built and planned in the area and the proximity to Austin. Table 15 lists the approximately 6,000 recently platted LUEs in 14 subdivisions utilizing LCRA Highway 290 surface water. Refer to the discussion of 'Surface Water Resources and Usage in the HTGCD' for more information regarding surface water and projected growth.

Golf Courses
There are two golf courses in Woodcreek. The course in Woodcreek Phase 1 (Quicksand Course) is open the public and currently irrigated with groundwater. The second course in Woodcreek has been constructed but is presently not open. It is the Districts' understanding this course is currently irrigated with wastewater effluent.

The Polo Club on Highway 290 has several groundwater wells permitted for golf course irrigation, but the golf course has yet to be built. The proposed Coyote Crew golf course, located south of Highway 290 along RR12 in Dripping Springs, has yet to be built. The owner's intention is to irrigate the course with a combination of groundwater and wastewater effluent.

Physiography

The county is located on the border between the eroded margin of the Edwards Plateau and the southern Black Prairie region. The Balcones Escarpment marks the division between the physiographic regions and divides the county into hilly, tree-covered ranch country in the northwest three-quarters and grassy, agricultural plains in the southeast quarter. The principal natural grasses are big bluestem and Indian grass; trees commonly associated with Central Texas-including live oak, cedar, pecan, and mesquite are indigenous to Hays County (TSHA, 2004).

Climate

The climate in the region is characterized as humid subtropical with hot summers and relatively mild winters. Daytime temperatures in summer are hot; with daily high temperatures over 90 degrees Fahrenheit (°F) approximately eighty percent (80%) of the time with highs for many days approaching the 100s. Overnight lows are generally in the 70s. On some occasions, lows can be in the 50s. During the summers, winds are generally from the south or southeast, with occasional periods experiencing west and southwest winds. Most of the time, the moderating affects of the Gulf of Mexico limit daytime highs; however, they also add to the discomfort with higher humidity. In summer, the average temperature is in the mid 80s, and the average daily maximum temperature is approximately 96°F. Average rainfall in Hays County is approximately 34" per year. December through March are typically the driest months with May and June being the wettest. Due to the abundance of Gulf Coast moisture, Hays County is subject to large rainfall events. Flash flooding of streams and rivers is common.

Table 2: Average Temperature and Precipitation

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total.
Avg.Hi°F	59	63	72	79	85	91	95	96	91	82	72	62	-
Avg.Lo°F	38	42	51	60	66	71	73	73	69	60	49	41	-
Avg. Rain (")	1.89	1.99	2.14	2.51	5.03	3.81	1.97	2.31	2.91	3.97	2.68	2.44	33.65

1971-2000 Average Rainfall – City of Austin (NOAA, 2005)

Topography and Drainage

The District is drained by two major river basins, the Colorado River basin in the north and the Guadalupe River basin in the south. Several smaller watersheds including the Pedernales River, which drains the northern tip of the county, and Barton Creek and Onion Creek, which both drain the north-central part of the county, are tributaries to the Colorado River Basin. The tributary

watershed of the Guadalupe River basin in the District is the Blanco River. The Blanco River joins the San Marcos River approximately three miles east of San Marcos before joining the Guadalupe River near Gonzales, Texas. The District's major geomorphic feature is the eroded margin of the Edwards Plateau. The Edwards Plateau is an elevated structure primarily made up of Cretaceous age limestone, marl, and dolomite. The eroded margin of the plateau is the Hill Country that is bounded by the Balcones Escarpment to the southeast and the undisturbed portions of the plateau to the west. The District's major geologic feature is the San Marcos Arch, a plunging SE-NW nose off the Llano Uplift. This positive Paleozoic feature influenced the deposition of Lower Cretaceous sediments. Elevation in the District ranges from a low of about 700 feet above sea level where the Blanco River leaves the District to approximately 1,600 feet above sea level, along ridge summits of the Guadalupe River-Colorado River drainage divide.

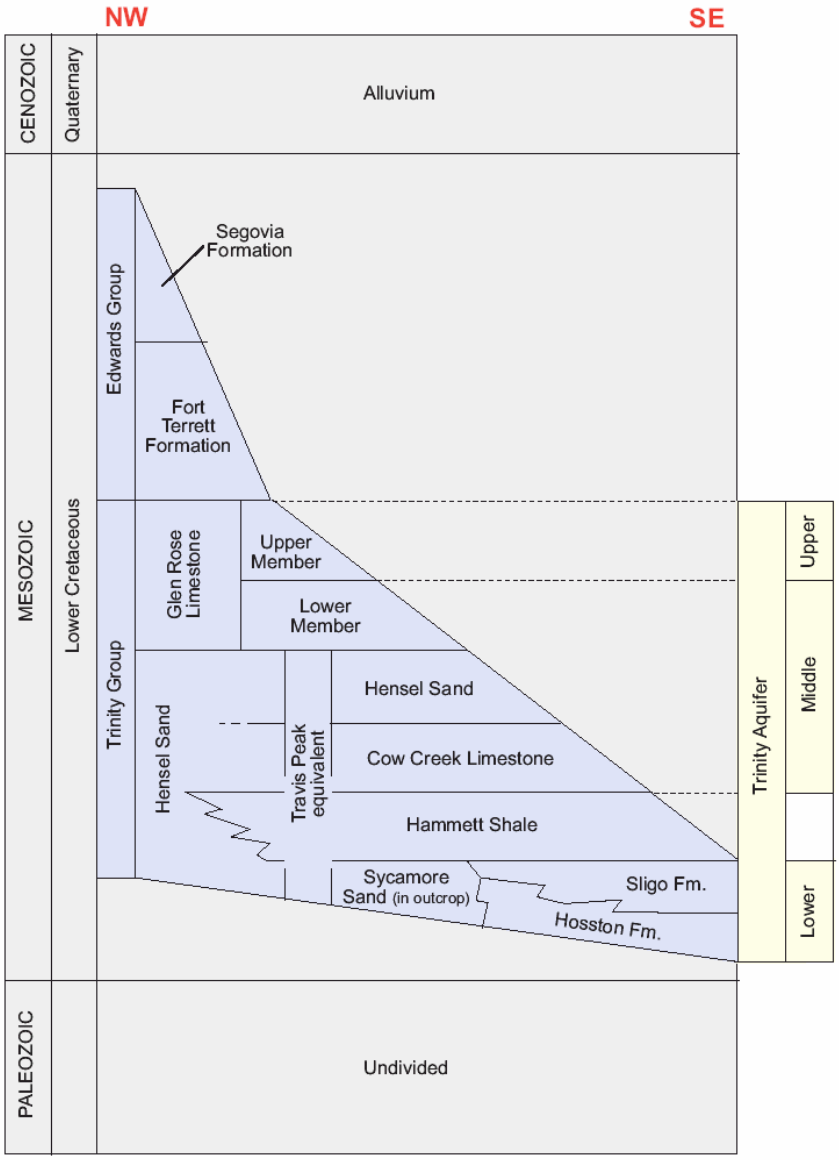

Figure 5: Stratigraphic and Hydrostratigraphic Section of the Hill Country (Mace et. al, 2000)

GROUNDWATER RESOURCES OF THE HAYS TRINITY GROUNDWATER CONSERVATION DISTRICT

Trinity Aquifer

Within the District, the Trinity Aquifer is the principal aquifer that provides groundwater to the District's residents. This aquifer is typically divided into three hydrostratigraphic units, the Upper, Middle, and Lower Trinity (Figure 5). The Trinity Aquifers behave as a more or less semi-confined or leaky aquifer system (Muller and McCoy, 1987). Each of these aquifers has a characteristic hydrostatic pressure head (water level). The Lower Trinity Aquifer has the lowest hydrostatic head while the Middle and Upper Trinity aquifers have respectively higher heads. This arrangement of water levels can be interpreted to mean that groundwater moves downward at a very slow rate through the low-permeability strata (aquitards) to the aquifers below while typically moving laterally at higher rates (Muller and McCoy, 1987).

Several wells in the northern tip of the county produce a minor amount of water from one or more of the Paleozoic aquifers.

Upper and Middle Trinity Aquifers

Aquifer thickness for the combined Upper and Middle Trinity Aquifer range from 400 to 600 feet, but are variable and depend entirely on site-specific topography and geology. The Trinity Aquifer is recognized by TWDB as a 'major aquifer'. A major aquifer may either produce large quantities of water or produce smaller amount of water over a large area. The latter is true of the Trinity Aquifer; where well yields can be comparatively lower than other aquifers. Yields in the aquifer can vary considerably over a short distance because many of the formations that make up the Trinity Aquifer are primarily limestone and yields may be controlled by the location of fractures and dissolution features as well as lithology (Mace et. al, 2000). Groundwater production from Trinity Aquifer wells in the District is used primarily for municipal, rural domestic, and livestock demands.

The Upper Trinity Aquifer is composed of the Upper member of the Glen Rose Limestone. The Upper member of the Glen Rose Limestone contains two distinct evaporate zones composed of gypsum and anhydrite (Bluntzer, 1992; Stricklin et al, 1971). The Middle Trinity Aquifer in Hays County is composed of (from youngest to oldest) the Lower member of the Glen Rose Limestone, the Hensel Sand, and the Cow Creek Limestone (Figure 5). The division between the Upper and Lower Glen Rose Limestone and, the Upper and Middle Trinity Aquifer, is defined by a consistent Corbula bed (Bluntzer, 1992; Stricklin et al, 1971). In some hill top areas the Upper Trinity Aquifer (Upper Glen Rose Limestone) is capped by an erosional remnant of the Edwards Group. The primary sources of recharge to the Trinity Aquifer are from rainfall on the outcrop and seepage losses through headwater creeks (Mace et. al, 2000). The outcrops that receive most of the direct recharge are composed of the Upper and Lower Member of the Glen Rose Limestone, the Hensel Sand, and Edwards Group. Beds of relatively low permeability marl sediments within the Upper Member of the Glen Rose Limestone impede downward percolation of interstream recharge and provide for baseflow and springflow to the mostly gaining perennial streams that drain the Hill Country (Mace et al, 2000). The Upper Trinity generally behaves as an unconfined aquifer. The Middle Trinity Aquifer may locally behave as a confined aquifer but more typically behaves as an unconfined to semi-confined aquifer.

Ashworth (1983) reports that in some areas "caverns formed by the solution of limestone and evaporites by ground water are common in the Trinity formations, particularly in the Glen Rose Limestone. These caverns are characteristically influenced by the jointing structure of the limestone and may extend both vertically and laterally for great distances and provide major conduits for the flow of ground water. When caverns grow to such a size as to no longer support their overburden, they collapse thus forming sinkholes that are visible from the surface as circular depressions that may transmit large quantities of surface water to a passage below ground. Sinkholes are a common occurrence in streambeds flowing over the Glen Rose Limestone and provide a passageway for a substantial amount of recharge to the aquifer".

Lower Trinity Aquifer

The Lower Trinity Aquifer in Hays County is an artesian aquifer separated from the Middle Trinity Aquifer by the Hammett Shale that acts as a confining bed (aquitard to aquiclude) and typically ranges in thickness from 30 to 60 feet. Below the Hammett shale are the Lower Trinity Aquifer members: the Sligo member, a sandy, dolomitic limestone of about 50 feet in thickness; and the Hosston member, a sandstone, shale, limestone and conglomerate formation of about 180 feet in thickness (Figure 5). According to Bluntzer (1992), the Lower Trinity yields small to very large quantities of fresh to slightly saline water.

Regional Groundwater Flow

"Water entering the Trinity Aquifers generally moves slowly down dip to the south and southeast. Regional water-level measurements indicate an average water-table gradient of 20 to 25 feet per mile. In areas of continuous pumpage, however, the groundwater will flow towards these points of discharge. Locally, groundwater movement is also toward the points of natural discharge through springs (Ashworth, 1983)".

Approximately along the District's eastern boundary, the Upper and Middle Trinity Aquifers contribute groundwater to the Edwards aquifer along the Balcones Fault Zone (BFZ). The specific amount is not well understood. Mace et al (2000) note that some studies suggest that up to 50% of the Edwards BFZ Aquifer recharge is contributed from the Upper and Middle Trinity Aquifers but many experts believe this estimate is too high. A number of studies have shown, either through hydraulic or chemical analyses, that groundwater likely flows from the Trinity aquifer into the Edwards BFZ Aquifer (Mace et al, 2000). Most of the studies have focused on the movement of groundwater from the Glen Rose Limestone into the Edwards aquifer. The T-HC GAM calibrated with 12% and 14% of the precipitation recharge to the Upper and Middle Trinity Aquifers', respectively, discharging to the Edwards BFZ Aquifer (Mace, 2003). A schematic representation of this flow regime is shown in Figures 6 and 8 depicting the Trinity Aquifers' water budget for the District.

Mace et al (2000) believe that 'part of this groundwater moves into the Edwards through faults, and part continues to flow in the Trinity Aquifer beneath the Edwards. It is likely that the groundwater that continues to flow in the Trinity Aquifer eventually discharges upward to the Edwards BFZ Aquifer (Mace et al, 2000)'.

Trinity Aquifer Water Quality

Water quality and quantity also vary greatly throughout the District. Water quality within the aquifer can often be defined or characterized in a general sense, but can still be affected by local geology, hydrology and possibly the integrity of well construction. According to the Region K

Water Management Plan, the water quality from the Trinity Aquifer is generally acceptable for most municipal and industrial purposes. High total dissolved solids, sulfates, iron and fluorides are common in the Trinity Aquifer, rendering the water locally unsuitable for potable use (Ashworth, 1983; Muller and McCoy, 1987). In 1990, Muller (Texas Water Development Board Report 322) investigated nitrate pollution of Upper Trinity groundwater within and near the City of Dripping Springs and determined it was the result of inadequate well casing / sealing procedures, a perched water table less than 10-feet below ground surface, thin soils and a lack of enforcement of State and County septic system rules and management practices.

Numerous authors note the negative impact on water quality caused by inadequate well casing and/or casing annular space sealing practices within the District (Ashworth, 1983; Bluntzer, 1992; Muller, 1990; Muller and McCoy, 1987; and others). In some areas, wells that have not been properly cased have degraded water quality by allowing commingling of aquifer zones of different water quality. Poor casing practices is thought to have contributed to increased sulfate content in the Middle Trinity Aquifer where wells penetrate through the anhydrite and gypsum beds of the Upper Glen Rose (Ashworth, 1983; Bluntzer, 1992).

Paleozoic Aquifers

Much older Paleozoic rocks lie unconformably beneath the lower Trinity Aquifer. There are reportedly a small number of ranch/residential wells in the northern tip of Hays County that penetrate the Paleozoic Age Aquifer. Otherwise, there are no other known Paleozoic wells. However, if future use of brackish water becomes feasible, there are three other possible aquifers present at lower stratigraphic intervals under artesian conditions within the District:

- Marble Falls, Pennsylvanian age limestone
- Ellenburger-San Saba, Cambrian age limestone-dolomite
- Hickory, Cambrian age sandstone

These aquifers are probably brackish (1,000 to 10,000 mg/L total dissolved solids), and will be substantially more expensive to develop than the shallower Trinity Aquifers. The potential of these aquifers is summarized in “Brackish Groundwater Manual for Texas Regional Water Planning Groups” and the “Major and Minor Aquifers of Texas” published by the TWDB, February, 2003 and November, 1995 respectively (LBG-Guyton Associates, 2003 and; Ashworth and Hopkins, 1995). The District will retain any data that is obtained on these aquifers from within its jurisdiction as it is generated and continue to evaluate these aquifers as potential resources for the future.

PLANNING ESTIMATES AND PROJECTIONS

Definitions of Planning Estimates and Projections

TWDB rules require that GCD management plans address specifically defined estimates and projections relating to present and projected water use. Definitions of these categories of estimates and projections taken from 31 TAC §356.1 – 356.10 are included below.

Amount of groundwater being used - The quantity of groundwater withdrawn or flowing from an aquifer naturally or artificially on an annual basis.

Projected water demand - The quantity of water needed per annum for beneficial use during the period covered by the management plan. The demands shall be projected for the types of use that are included in the State Water Plan. Each type of use may be subdivided into sub-types by the District.

Projected water supply - The useable amount of groundwater of acceptable quality that is available per annum as determined by the district using the best available data and the quantity of surface water available per annum during the period covered by the management plan based on full implementation of any applicable, approved regional water plan.

Recharge - The addition of water from precipitation or runoff by seepage or infiltration to an aquifer from the land surface, streams, or lakes directly into a formation or indirectly by way of leakage from another formation.

Artificial recharge - Increased recharge accomplished by the modification of the land surface, streams, or lakes to increase seepage or infiltration rates or by the direct injection of water into the subsurface through wells.

Useable amount of groundwater – the amount of groundwater that can be pumped on an annual basis without depleting the aquifer to a predetermined amount (also referred to as available groundwater and/or sustainable groundwater yield).

Methods Employed to Develop Planning Values Specific to the District

The District covers the western 54.5% of Hays County (Figure 1). As mentioned above, Hays County is divided into two RWPGs, K and L. The District occupies approximately 76 % of the area of Hays County in Region K and approximately 38 % of the area of Hays County in Region L. Other GCDs have jurisdiction over most of the remaining area within the Hays County portion of Regions K and L. The TWDB values from Regions K and L presented in this plan for projected water demand and projected water supplies, do not include the data points known to be from outside of the District boundaries (e.g. cities of Hays County that are not located within the District such as Buda, Kyle and San Marcos) (Figure 1). Other values, that are not location specific within the District portion of Hays County, are corrected by an amount proportional to the percentage of the District area within the RWPG in Hays County that is the source of the data (TWDB, 2004). For example, if the projected water demand for 'livestock watering' in the Region L portion of the County is 50 acre-feet per year, then for the District's planning purposes only 38% of 50 acre-feet, or 19 acre-feet, would be used for planning purposes in this document. This is because the location of the 'livestock watering' within Hays County is not specific and the HTGCD only occupies 38% of the Region L area within Hays County.

The estimate of the amount of useable groundwater presented in this plan is based on predictive groundwater use simulations of the TWDB's Groundwater Availability Models (GAMs). Region K and L each use different TWDB published GAMs for the 2006 Regional Water Plan that include the Upper and Middle Trinity Aquifers within the jurisdiction of the HTGCD:

- "Groundwater Availability Model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium Aquifer System, Texas, TWDB GAM Report" (Anaya and Jones, 2004). This GAM is used by Region K and is referenced to as the E-T GAM in this plan.

- "Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulations through 2050, TWDB Report 353" (Mace et al, 2000). This GAM is used by Region L and is referenced to as the T-HC GAM in this plan.

The District was invited to participate in the Region K assessment process and provided critical input to the decisions affecting the Trinity Aquifer of Hays County. 31 TAC 356 requires the District's groundwater management plan must 'not be in conflict' with TWDB approved Region L Regional Water Plan. 'Not in conflict' means the same values used in the approved TWDB regional plan must be used in this plan. To avoid conflict with the existing TWDB approved Region L Regional Water Plan, the total pumpage applied to the Trinity Aquifer in Hays County during the Region K availability assessment had to be adjusted upwards by approximately 300 ac-ft per year.

Currently, neither the E-T GAM nor the T-HC GAM includes the Lower Trinity Aquifer. As a result, an estimate of the amount of useable groundwater in the Lower Trinity is outside of the scope of this management plan. The TWDB is expected to have the Lower Trinity Aquifer incorporated into a revised version of the T-HC GAM during the first half of 2006 (Jones and Anaya, 2005). The District will consider the availability of the Lower Trinity Aquifer as the updated T-HC GAM or other new data as it become available and will amend this plan as appropriate.

In determining the annual amount of recharge to the Trinity Aquifer occurring within the District, both the E-T GAM and the T-HC GAM were considered (Jones, 2004). The T-HC GAM was used to show recharge in an average rainfall year (simulating 1974). The E-T GAM was used to show recharge in a Drought of Record year (simulating 1956).

This plan considers estimates of annual groundwater use in the Trinity Aquifer from two sources: One, the TWDB annual 'water use survey' data for the Trinity Aquifer in Hays County is presented for the period of available record and; Two, data generated by the District that is more current or focused than TWDB data. Planning data from the State Water Plan available through TWDB are presented for each water user group (WUG) for all of Hays County subdivided by river basin in Table 6. The TWDB water use survey data probably under reports usage due to the fact the data is obtained from a 'voluntary' annual survey. Due to the voluntary nature of this survey, the data is not consistent. Although these data are therefore of questionable value, 31 TAC 356 requires this survey data be presented for planning purposes.

Recognizing the need for accuracy of the estimate of annual groundwater use from the Trinity Aquifer, the District developed its own estimate based on a local survey of water suppliers and other site specific data. The site specific data developed by the District involves estimating the number of wells serving individual household and calculating the collective amount of annual use. The District has also estimated the number of wells in the District producing from the Lower Trinity Aquifer and estimated their use collective annual use. The estimate of annual use of the Lower Trinity Aquifer was used to reduce to the estimate of District wide use of the Trinity Aquifer and, provide a more accurate estimate of actual use of the Upper and Middle Trinity Aquifers.

Estimate of the Total Amount of Useable Groundwater

The amount of groundwater that is available for use from an aquifer, or groundwater availability, must be determined by science and policy. The District has a goal of sustainable management to

maintain 90% of the Trinity Aquifer contribution to stream leakage and stream/spring base-flow during a repeat of the drought of record and, in critical depletion areas, a rate of stream flow that maintains a sound ecological environment. The District will depend on TWDB GAMs, published reports and data generated within the District to make up the 'science' portion of groundwater availability equation. The District shall determine availability based on an adaptive management strategy that considers the District's mission statement, guiding principles, management plan, new data, and improved analysis. It is important to note that none of the GAMs currently include the Lower Trinity Aquifer. The District will address groundwater availability from the Lower Trinity Aquifer through independent analysis and collaborative efforts with TWDB, and possibly other interested organizations.

The current estimate of the total amount of useable groundwater from the Upper and Middle Trinity Aquifers is 3,713 ac-ft per year. To develop an estimate of usable groundwater the District utilized data from Regions K & L. The District participated in the Region K modeling committee assessment of groundwater availability for the 2006 Regional Water Plan and used the Region L estimate of Trinity Aquifer availability from Table 4 of the Region L 2001 Regional Water Plan and which is unchanged for the 2006 plan in development.

With District input, Region K has recently performed predictive simulations of the Upper and Middle Trinity Aquifers using the E-T GAM. The District and Region K both identified the maintenance of the Trinity Aquifer system leakage (spring flows, seeps, and gain flows in streams and rivers) as the defining criteria for groundwater availability. This criterion is especially important to the District because the stream leakage value in the model represents the Trinity Aquifer contribution to surface water flows. There is an undeniable relationship between aquifer use and potential reductions in flows of landmark streams and springs in the District. The District is determined to manage groundwater use for maximum benefit while maintaining the creek and spring flows which sustain the environment and economy of the District.

The benchmark stream leakage value was developed by running a 50-year E-T GAM simulation with no pumping that ended in a repeat of the drought of record. The drought of record as simulated in the GAMs replicates the historic conditions of the 1950's drought. Region K and the District adopted a criterion to limit pumping to the amount of groundwater that could be used while maintaining 90 percent of the no-pumping, drought of record, stream leakage was adopted. Region K also adopted a second criterion, that pumpage of groundwater in one County should not reduce the stream leakage in adjoining counties below the established 90 percent stream leakage criteria.

Multiple iterative simulations of the E-T GAM using increasing groundwater pumping rates were performed to determine at what rate of pumping that the leakage to streams and springs was reduced below 90% of stream leakage that occurred during the drought of record. The iterative increases in Hays County pumping (in conjunction with pumping increases in Travis and Burnet Counties) did not reduce the Hays County drought of record stream leakage enough to reach the 90 percent criterion. The iterative simulations were terminated when the combined amount of pumping in Hays, Travis and Burnet counties reduced the Burnet County drought of record stream leakage to slightly less than 90 percent (approximately 89.9 percent). The amount of annual Hays County pumping in the final simulation was 3,411 ac-ft per year. The Region K portion of the District contributed 2,500 ac-ft per year and the Region L portion of the District contributed 911 ac-ft per year to the Hays County total pumping amount.

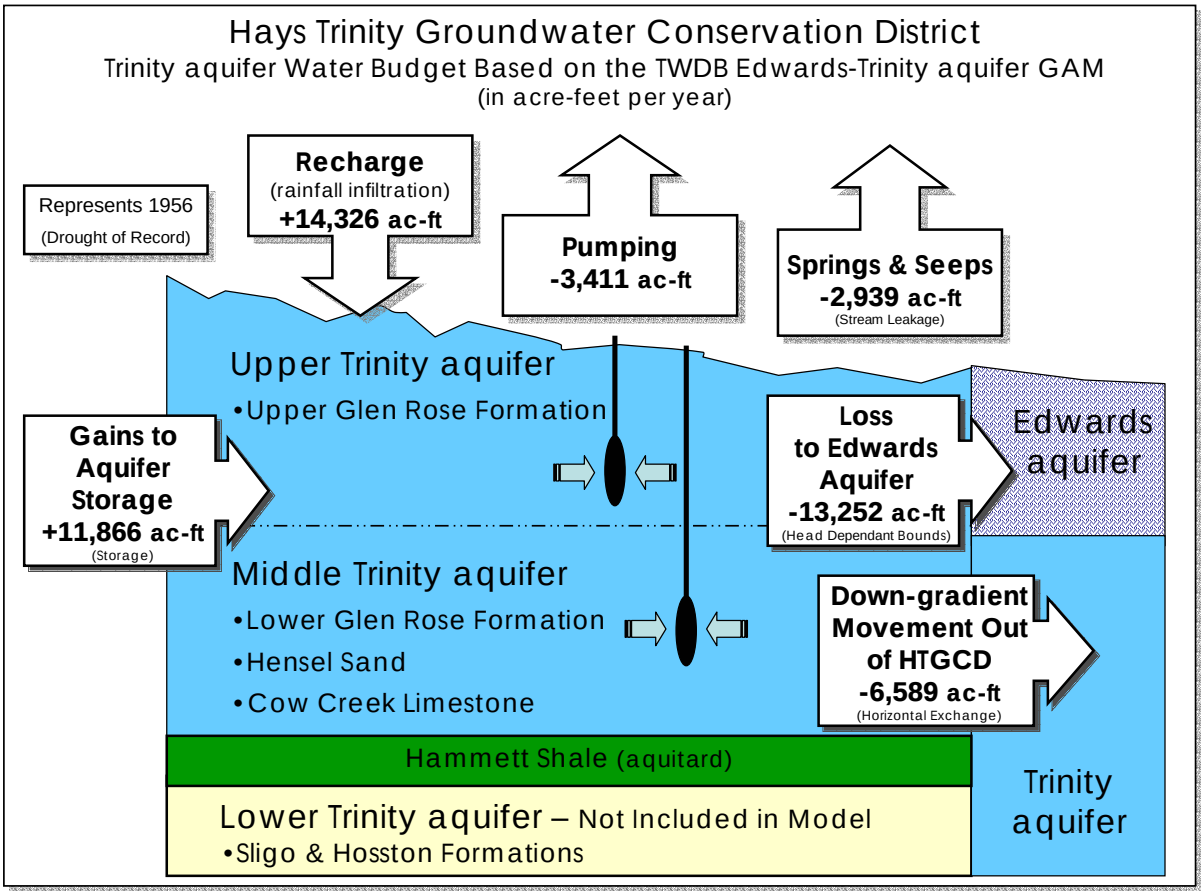

Figure 6: Illustration of the E-T GAM Simulation Used as the Basis of the Estimate of Useable Groundwater

In developing an estimate of the total amount of useable groundwater, the District used the E-T GAM simulations as the basis of the estimate. However, after completion of the simulations, certain modifications to the E-T GAM results were made to better characterize conditions of the aquifers within the District. In the E-T GAM simulations, the amount of pumping applied to the Trinity Aquifer in the Region L portion of Hays County was 911 ac-ft per year.

The District reviewed the TWDB approved 2001 Region L Region Water Plan (RWP) to determine the amount of Trinity Aquifer groundwater needed to meet the water supply needs of the RWP. The District found that Exhibit B, Table 5 of the 2001 Region L RWP has Trinity Aquifer water supplies totaling 1,213 ac-ft per year and that Exhibit B, Table 4 Trinity Aquifer availability was 1,213 ac-ft per year within the time period of this plan. The 2001 Region L RWP Exhibit B, Table 12 had no water management strategies requiring Trinity Aquifer groundwater from Hays County. After reviewing the 2001 Region L RWP, the District increased the Trinity Aquifer availability for the Region L portion of the District calculated using the E-T GAM by 302 ac-ft per year to a total of 1,213 ac-ft per year for the time period of this plan to avoid conflict with the Region L RWP. The District will continue to work with future versions of the TWDB GAMs and possible other groundwater models to further refine these availability estimates.

Addressing Water Supply Needs in a Manner Not in Conflict with Regional Water Plans

This plan addresses water supply needs in a manner not in conflict with a TWDB approved RWP by

using an estimate of useable groundwater in the Trinity Aquifer equal or greater than the Trinity Aquifer availability values given in Exhibit B, Table 4 of the approved RWPs of Regions K and L. The difference in RWPG K data between 2001 and 2006 is due to the use of manual calculations for the 2001 Region K RWP and the use of the E-T GAM for the 2006 Region K RWP availability and usage determinations.

Table 3: Exhibit B, Table 4 Trinity Aquifer Availability Values from the 2001 TWDB Approved RWPs (The 2001 Region K RWP used a manual calculation for the 'availability' determination. Region L used the T-HC GAM.)

RWPG	Aquifer	River Basin	2000	2010	2020	2030	2040	2050
L	Trinity	Guadalupe	1,213	1,213	1,213	1,213	1,213	994
K	Trinity	Colorado	597	597	597	597	597	490
Total (ac-ft per year) =			**1,810**	**1,810**	**1,810**	**1,810**	**1,810**	**1,484**

Table 4: Anticipated Exhibit B, Table 4 Availability Values to be Used in 2006 RWPs in Development by RWPGs (The 2006 Region K RWP is using the E-T GAM for the 'availability' determination for the first time. Region L used the T-HC GAM.)

RWPG	Aquifer	River Basin	2000	2010	2020	2030	2040	2050
L	Trinity	Guadalupe	1,213	1,213	1,213	1,213	1,213	994
K	Trinity	Colorado	2,500	2,500	2,500	2,500	2,500	2,500
Total (ac-ft per year) =			**3,713**	**3,713**	**3,713**	**3,713**	**3,713**	**3,494**

Table 5: District Estimate of the Amount of Useable Trinity Aquifer Groundwater by RWP Within The District

Region K	Region L	District Total
2,500	**1,213**	**3,713**

Groundwater Use

TWDB Water Use Survey Data For The Trinity Aquifer in Hays County collects data on water use across the State each year. Data is categorized by source (aquifer, river, reservoir etc.) and type of use. TWDB recognizes 6 categories of water use groups (WUGs): Municipal (cities with populations greater than 500); Manufacturing (Mfg); Steam Electric Power Generation (Power); Mining; Irrigation; and Livestock. TWDB began collecting water use data in 1980. The most recent year for which TWDB Water Use Survey Data is available is the year 2000. The results of this survey data for Hays County are presented in Table 6. The 'Mining' usage occurs east of the District's jurisdiction. The amount of groundwater being used in the County on an annual basis, according to the most recent TWDB water use data, is 2,285 ac-ft per year (Table 6). This data is presented in the plan to satisfy TWDB requirements and is for all of Hays County, not just the District. The District has developed a site specific estimate of groundwater usage based on data collected by the District that is discussed in the following section.

Table 6: TWDB Water Use Survey Data by WUG for Trinity Aquifer Use in Hays County Over the TWDB Period of Record

Basin	Year	Municipal	Mfg	Power	Mining	Irrigation	Livestock	Basin Total	Annual Total
Colorado	1980	651	0	0	0	0	189	840	
Guadalupe	1980	630	0	0	0	102	133	865	**1,705**
Colorado	1984	225	0	0	0	0	112	337	
Guadalupe	1984	624	0	0	0	50	142	816	**1,153**
Colorado	1985	604	0	0	0	0	20	624	
Guadalupe	1985	870	0	0	0	64	21	955	**1,579**
Colorado	1986	646	0	0	0	0	22	668	
Guadalupe	1986	857	0	0	0	44	16	917	**1,585**
Colorado	1987	770	0	0	0	0	19	789	
Guadalupe	1987	542	0	0	0	35	21	598	**1,387**
Colorado	1988	724	0	0	0	0	20	744	
Guadalupe	1988	587	0	0	0	29	23	639	**1,383**
Colorado	1989	825	0	0	0	0	20	845	
Guadalupe	1989	842	0	0	0	0	23	865	**1,710**
Colorado	1990	943	0	0	0	0	20	963	
Guadalupe	1990	818	0	0	0	0	22	840	**1,803**
Colorado	1991	917	0	0	6	0	21	944	
Guadalupe	1991	930	0	0	47	0	23	1000	**1,944**
Colorado	1992	900	0	0	6	0	15	921	
Guadalupe	1992	886	0	0	68	0	16	970	**1,891**
Colorado	1993	1001	0	0	6	0	18	1025	
Guadalupe	1993	953	0	0	68	0	19	1040	**2,065**
Colorado	1994	1061	0	0	6	0	20	1087	
Guadalupe	1994	1138	0	0	153	0	21	1312	**2,399**
Colorado	1995	1224	0	0	6	0	20	1250	
Guadalupe	1995	1071	0	0	153	0	21	1245	**2,495**
Colorado	1996	1347	0	0	6	0	16	1369	
Guadalupe	1996	1257	0	0	153	0	16	1426	**2,795**
Colorado	1997	1339	0	0	6	0	14	1359	
Guadalupe	1997	1513	0	0	150	0	14	1677	**3,036**
Colorado	1998	1497	0	0	6	0	17	1520	
Guadalupe	1998	1692	0	0	141	0	17	1850	**3,370**
Colorado	1999	1375	0	0	4	0	18	1397	
Guadalupe	1999	1824	0	0	143	0	18	1985	**3,382**
Colorado	2000	905	0	0	4	0	16	925	
Guadalupe	2000	1201	0	0	143	0	16	1360	**2,285**

Site Specific District Groundwater Use Estimate

The District has attempted to validate the 2000 water use data TWDB presented in Table 6 above. This was done by developing District specific data for agricultural use and use of groundwater by the approximately 5,000 exempt residential wells that exist in the District. To validate the agricultural water use, the District met with the Hays County Agricultural Extension Agent (Mr. Davis) to discuss the 2004 Agricultural Increment Report for the County. The County Increment report details the agricultural production within the County by crop and animal. Mr. Davis provided estimates of how much of the total county production occurred in the District. The District used published water requirement rates for the animals and crops inventoried to arrive and revised the irrigation and livestock water usage for 2004 (Table 7).

Irrigation: Most crops grown in the District are “dry land” farmed, meaning they are not irrigated but are solely dependent on precipitation. However, based on 2004 data, the District estimates that wine grapes grown in the District require about 7.2 acre-feet per year (Table 7). More acres of grapes have been recently planted.

Livestock: If the water demand of horses is combined with the water requirements of beef and other meat animals the total “livestock” requirements in 2004 are 145 acre-feet (Table 7) versus the 32 acre-feet reported in Table 6.

Mining (Quarrying): All significant mining or quarrying operation in Hays County are east of the District boundaries, therefore the 147 acre-feet of water usage reported for year 2000 in Table 6 should be reduced to “0”. The District polled geologists that are familiar with the area and spoke to TCEQ Region 11 Industrial Storm Water Permitting Staff, to determine if regulators or knowledgeable professionals were aware of active Mining or Quarrying operations within the District area. Those polled were unaware of any mining or quarrying operations using significant amount of water within the District.

Based on the above discrepancies in Table 6, the total water usage should be decreased by (values are in acre-feet):

Net Estimated Decrease Water Usage		Revised Livestock		Revised Irrigation		Revised Mining
-26.8 acre-feet	=	{145-32}	+	{7.2-0}	+	{0-147}

Table 7: District Estimate of Agricultural Water Use in District Based on 2004 Agricultural Increment Report Data for Hays County

Notes:	1	2	3	4	5	6	7
			Median	**Variab.**	**Percent**	**Irrig.**	**Irrig.**
	Acres	**Acres**	**Irrig.**	**Water**	**Production**	**Water**	**Water**
	Harvested	**Harvested**	**Water**	**Use**	**In HTGCD**	**Use**	**Use**
	Hays Co.	**HTGCD**	**Use**	**(+ or -)**		**per day**	**Per year**
			gpd/unit	**gpd/unit**		**(gal)**	**(gal)**
Crops							
Wheat	4,794	1198.5	DL		25%		
Corn	2,482	0	DL				
Hay	1,167	291.75	DL		25%		
Oats	1,639	245.85	DL		15%		
Sorghum	2,283	0	DL	Grapes: Estimated annual drip irrig. Reqs.			
Cotton	1,186	0	DL	per acre of mature Muscadine grapes.			
Peaches	500	100	DL		20%		
Pecans	100	30	DL		30%		
Grapes	100	75	151,200	25,000	75%	31,068	2,330,137
Horses (hd)	1,100	550	10	2	50%	5,500	2,007,500
					Irrigation Subtotal		4,337,637
Livestock							
Breeder Cattle-Beef (hd)	11,000		11.5	4.5	30%	37,950	13,851,750
Calves-Beef (hd)	8,800		9.5	5.5	30%	25,080	9,154,200
Stocker Cattle-value added	10,000		11.5	4.5	30%	34,500	12,592,500
Other Meat Animals							
Goats (hd)	12,300		2.5	1.5	75%	23,063	8,417,813
Hogs (hd)	100		4		0		
Feeder Pigs (hd)	250		3		0		
Sheep & Lamb (hd)	1,500		2.5	1.5	80%	3,000	1,095,000
					Livestock Subtotal		45,111,263
	Total Agricultural Water Use In HTGCD In 2004 (gal / year)						49,448,899
	Total Agricultural Water Use In HTGCD In 2004 (ac-ft / year)						151.75

Notes:

1, 2, 5) Davis, Bryan, Y., Hays County Agricultural Extension Agent, Personal communication concerning the '2004 Agricultural Increment Report for Hays County' and what portion of the data is derived from the jurisdiction of the HTGCD and what are the irrigation water demands of the various crops and livestock. San Marcos, April 11, 2005.

3, 4) Median & variability value was determined from a range of water Demand values.

DL = Dry Land Farmed, typically not irrigated, rain dependent.

Demand data for all but grapes from: McGinty, 1996; Landefeld and Bettinger, 2005.

Grape Demand Data: Combs, 2005; Elliot, 2005; McEachern and Baker, 1997; Slack and Martin, 2005.

6, 7) Based on median daily water use and percent of production in HTGCD.

1 acre-foot = ~325,851 gallons

The District is currently compiling a database of exempt wells in the Trinity Aquifer, to the extent that well records exist. The HTGCD has approximately 5,000 State of Texas Water Well Reports for exempt wells within the TWDB grid system that encompasses the District as of March 2005. Approximately 1,750 of these well reports have sufficient location information to enter into a database and plot on a map. Approximately 3,250 of the older well reports contain only enough location information to know that they are contained within the grids that overlay the District boundaries. Well depths vary from less than 100 feet in the Upper Trinity to over 1,000 feet in the Lower Trinity. Most Middle Trinity wells range from 300-700 feet in depth. Assuming each of these exempt wells serves a residence that uses an estimated 110 gallons per day per person and each residence has 3 people, groundwater usage from these residential wells is approximately 1,850 acre-feet per year.

In addition to residential well usage, the other major groundwater users in the District are listed below in Table 8 based on 2003 and 2004 data obtained from the entities listed or based on the assumptions discussed above for the 'exempt residential well' usage.

Table 8: District Estimate of Groundwater Use (acre-feet) in District for 2003 and 2004

Major District Users (acre-feet/year)	**Year**	
	2003	**2004**
Rainfall (City of San Marcos)	25.45"	52.68"
Dripping Springs Water Supply Corporation	253	51
Wimberley Water Supply Corporation	664	564
AquaTexas/Woodcreek	591	558
Woodcreek Golf Course	192	72
HTGCD Agricultural Usage (Table 7)	152	152
Small PWS Corps (Table 1)	402	402
Residential, Exempt Wells (~5,000)	1,850	1,850
District Total Estimated Trinity Groundwater Use (acre-feet/year)	**4,104**	**3,649**

Based on the available site-specific data developed by the District, the total Trinity Aquifer groundwater use was approximately 4,104 acre-feet in 2003 and 3,659 acre-feet in 2004. These site-specific estimates of Trinity Aquifer groundwater use in the District are inclusive of the Upper, Middle and Lower Trinity Aquifers. For management of the Upper and Middle Trinity Aquifers, the District qualified the estimate to differentiate between the use of these aquifers and Lower Trinity Aquifer use.

To estimate Lower Trinity Aquifer 'exempt use' (wells used for domestic use by a single private residential household) as a portion of the overall Trinity Aquifer 'exempt use', the inventory of 1,750 locatable wells' State Well Reports were screened for total depth data by the District to estimate the number of wells penetrating the Lower Trinity Aquifer. 1,350 of the 1,750 locatable

wells had ‘total depth’ data. The basis of the screening to determine if a well penetrated the Lower Trinity Aquifer was an elevation map of the top of the Hammett Shale developed by the District using TWDB geologic structure data from the T-HC GAM and new data from boreholes within the District. An assumed thickness of 35 feet was used for the Hammett Shale. Control data point elevations were reduced by this amount to simulate the base of Hammett Shale. The simulated base of Hammett Shale elevation data were contoured and imported to GIS for screening (Figure 7). The GIS screening operation compared the elevation of the total depth of each located well to the corresponding elevation of the base of Hammett Shale to determine if the well may produce water from the Lower Trinity Aquifer.

The screening operation identified 608 wells from the located well inventory with total depth information that penetrated the top of the Lower Trinity. To avoid over estimating the percentage of wells producing water from the Lower Trinity, the identified wells were screened a second time to include only wells with total depths greater than 10 feet below the simulated surface of the top of the Lower Trinity Aquifer. The second screening identified 196 wells from the located well inventory with total depth information that apparently produce water from the Lower Trinity Aquifer. This represents approximately 15.3 percent of the inventory of located wells with total depth data available.

To estimate the Lower Trinity Aquifer exempt well use, this percentage was extrapolated to the entire inventory of 5,000 exempt wells resulting in an estimated total number of Lower Trinity wells of 765 wells 15.3 percent of the total estimate of exempt well use of 1,850 ac-ft per year is 283 ac-ft per year subtracting the estimate of Lower Trinity Aquifer exempt well use of 283 ac-ft per year from the 2004 total estimate of Trinity Aquifer use of 4,104 ac-ft per year, the qualified site-specific estimate of Upper and Middle Trinity Aquifer use is 3,821 ac-ft. Using the site specific groundwater use of 3,649 ac-ft for 2004 indicates the usage from the Upper and Middle Trinity Aquifers to be 3,366 ac-ft.

The site-specific estimate of the amount of groundwater being used from the Upper and Middle Trinity Aquifers of 3,821 ac-ft in 2003 and 3,366 ac-ft in 2004 range between a deficit of 108 ac-ft per year to a surplus of 347 ac-ft per year in comparison the estimate of the total amount of useable groundwater for the same aquifers of 3,713 ac-ft per year. The below average amount of rainfall in 2003 significantly increased the deficit. The above average rainfall in 2004 generated the surplus. This indicates that the current amount of annual use of the Upper and Middle Trinity Aquifers is slightly above or slightly below the amount of groundwater use that is predicted to maintain the desired future condition of the aquifers in a repeat of the 1950’s drought identified by the District.

On a District-wide basis, the current annual use is exceeding the estimate of useable groundwater by a small amount. The northern part of the District in Region K appears to have an adequate surplus. The southern part of the District (Wimberley and Woodcreek areas - Region L) has a significant deficit even in a year of significant above average rainfall. Table 9 shows the surplus/deficit for the two regional planning areas contained in the District. The District will work to refine the estimate of the total useable amount of groundwater, but the data indicates that the District may not be able to grant requests for the permitted use of groundwater from the Upper or Middle Trinity Aquifers in the southern part of the District.

Table 9: District Calculation of Groundwater Surplus/Deficit (acre-feet) By Regional Planning Group in District for 2003 and 2004

Major District Users (acre-feet/year)	Region L 2003	Region K 2003	Region L 2004	Region K 2004
Rainfall (San Marcos)	25.45"	25.45"	52.68"	52.68"
Dripping Springs Water Supply Corporation	-	253	-	51
Wimberley Water Supply Corporation	664	-	564	-
AquaTexas/Woodcreek	591	-	558	-
Woodcreek Golf Course	192	-	72	-
Agricultural Usage*	59	93	59	93
Other Water Supply Corporations**	225	177	225	177
Residential, Exempt Wells ***	721	1,129	721	1,129
Total Usage (acre-feet)	2,452	1,652	2,199	1,450
Lower Trinity Usage	110	173	110	173
Total Usage less Lower Trinity Usage	2,342	1,479	2,089	1,277
Available Water	1,213	2,500	1,213	2,500
Surplus/Deficit	(1,129)	1,021	(876)	1,223

*From Table 7 (Region K-76%, Region L-38%)
** From Table 1
*** From Table 8 (Region K-76%, Region L-38%)

Until the District has confirmed or clarified the estimate of the amount of useable groundwater from the Upper and Middle Trinity Aquifers, the District will consider applications for the permitted use of groundwater from the Lower Trinity Aquifer. The TWDB is still 6 to 12 months away from publishing a GAM that includes the Lower Trinity Aquifer (Jones and Anaya, 2005). Therefore, there is no GAM available for the District to use in determining the amount of useable groundwater from the aquifer that would maintain a desired future 90% of stream and spring leakage during a repeat of the drought of record. However, the Lower Trinity Aquifer use in much of the District is estimated to be sufficiently low to allow the District to grant requests for the permitted use of groundwater from the Lower Trinity Aquifer until TWDB completes work to incorporate the lower Trinity Aquifer into the existing T-HC GAM. Each Lower Trinity Aquifer permit will be evaluated based on District Rules and this plan. When the revised T-HC GAM is released, the District will identify the criteria necessary to maintain the sustainability of the aquifer during a repeat of the 1950's drought. When the sustainability criteria are identified the District will apply increasing amounts of pumping to the GAM to assess the amount of useable groundwater for the Lower Trinity Aquifer.

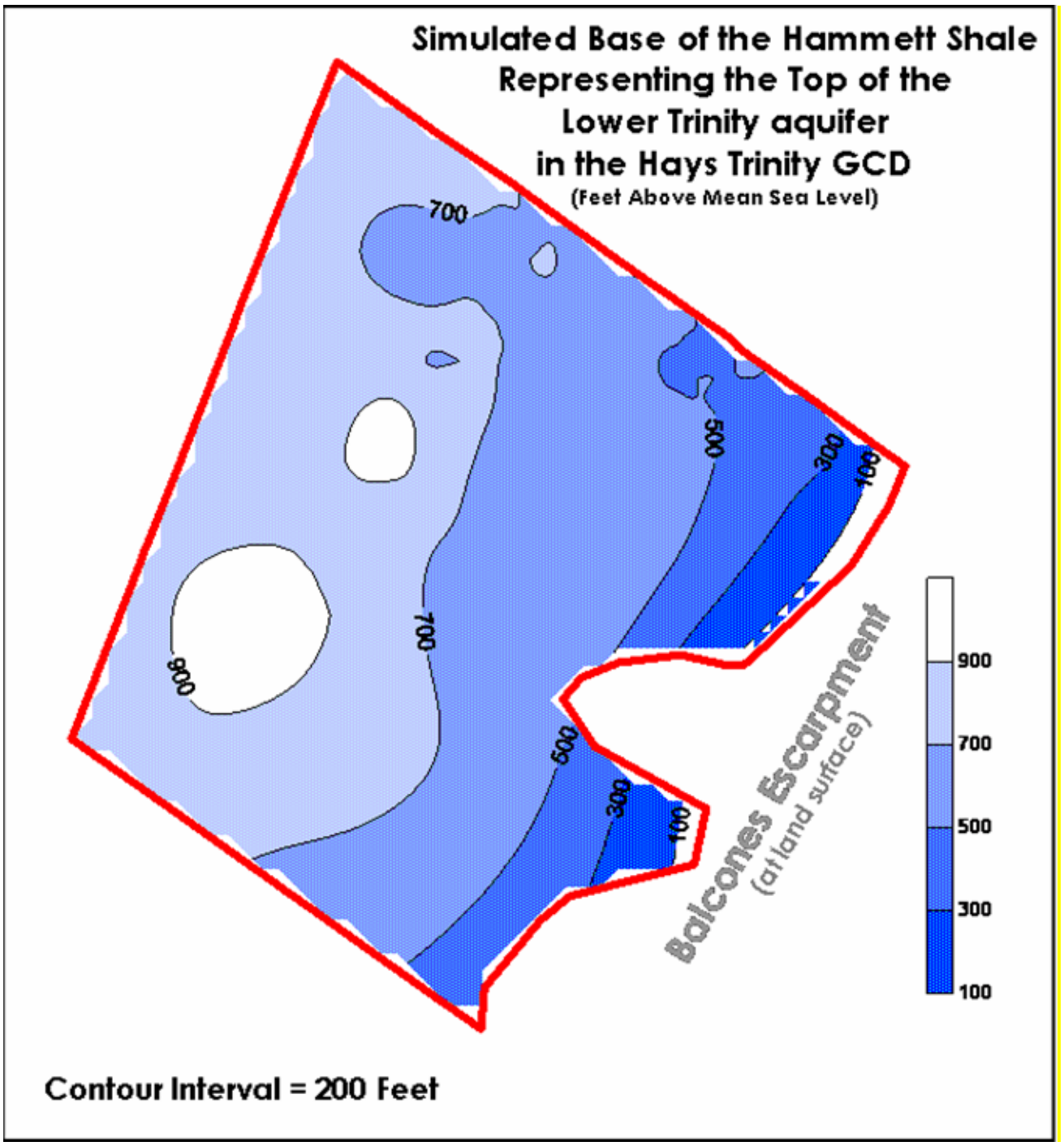

Figure 7: Map of the Simulated Base of the Hammett Shale Used to Estimate the Percentage of Exempt Wells in the District Producing Water from the Lower Trinity Aquifer

Recharge of Groundwater in the HTGCD

Precipitation Recharge to the Upper and Middle Trinity Aquifer

The amount of annual natural precipitation recharge to the groundwater resources of the District is 33,000 ac-ft per year during an average rainfall year. This estimate is based on the T-HC GAM,

GAM run 04-18 on October 7, 2004 (Figure 8 and Table 10). The natural recharge of groundwater occurring in the District is thought to be primarily through percolation of rainfall on the outcrop of the geologic units composing the Trinity Aquifer. These outcrops occur over the majority of the area of the District. The TWDB calculated annual recharge coefficient of approximately 4.7% of annual rainfall (Jones, 2004).

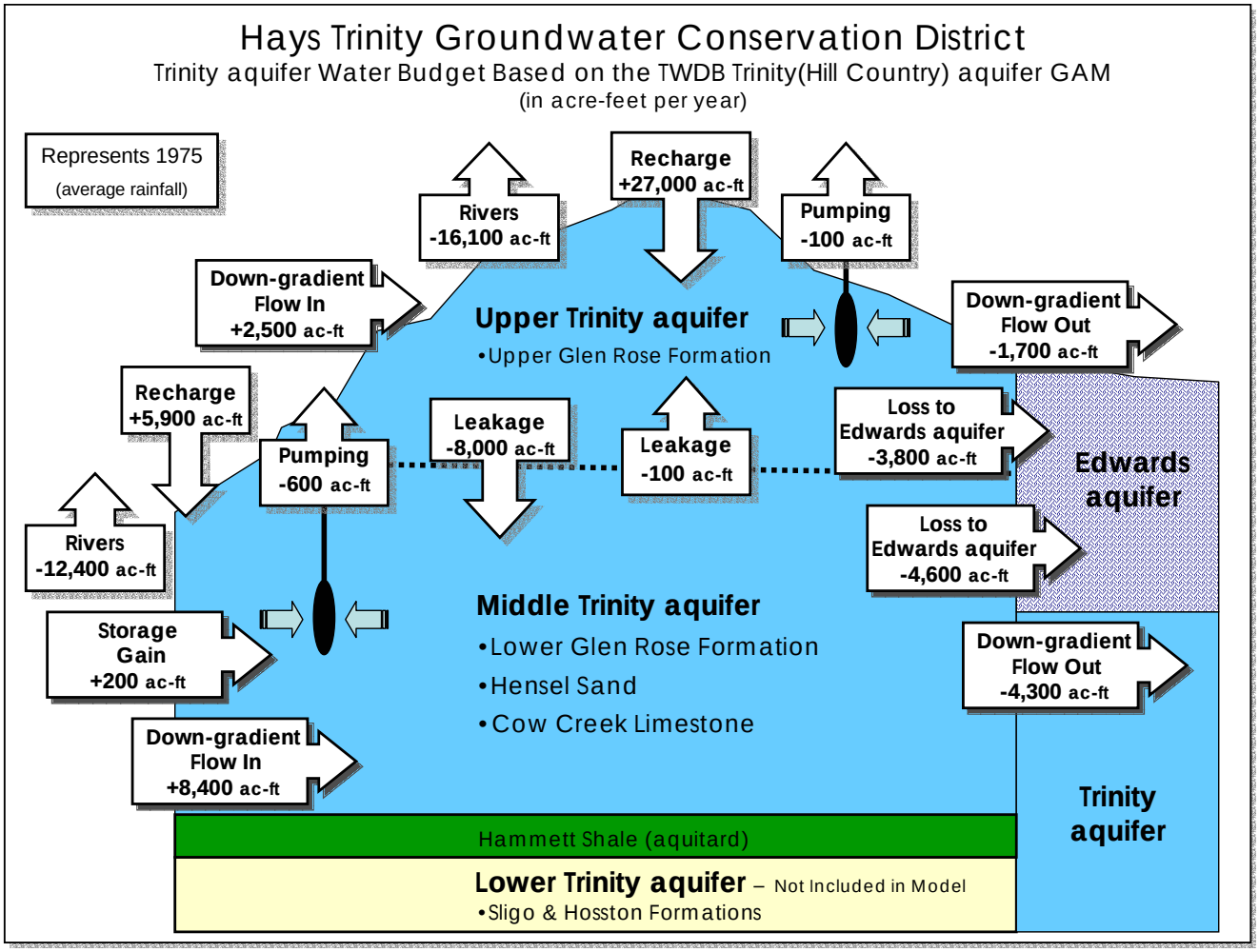

Figure 8: Hays County Water Budget from the Trinity (Hill Country) Aquifer GAM Used for Estimating Annual Natural Recharge Occurring in the District (Mace et. al., 2003)

Table 10: Hays County Water Budget for Trinity (Hill Country) Aquifer Combining Upper and Middle Trinity Aquifers in Ac-Ft per Year (Mace et. al., 2003)

	Re-charge	Rivers	GHB	Stor-age	Wells	X-flow in	X-flow Out	Upper Z-flow in	Upper Z-flow out	Lower Z-flow in	Lower Z-flow out	Total in	Total out	% dif
Hays	**33,000**	**-28,500**	**-8,400**	**-200**	**-700**	**10,900**	**-6,100**	**8,000**	**-100**	**100**	**-8,000**	**52,000**	**-52,000**	**0.00**

Notes: All values are relative to the aquifer within Hays County. A negative value means water is leaving the aquifer within the County and going into the column category, and a positive number means water is contributed to the aquifer from the column category.

1. **Rivers** includes rivers, streams and springs (negative value indicates aquifer discharging to Rivers).
2. **GHB** refers to flow out of the Hill Country area to the south and east into the Balcones Fault Zone Edwards Aquifer (negative value indicates aquifer discharging to Edwards BFZ Aquifer).
3. **Storage water contributed from the aquifer to storage (negative value indicates water is being added to storage from the aquifer, which means rising water-levels in the aquifer. This is a counterintuitive construct but a negative storage value in this table indicates rising water-levels in the aquifer.)**
4. Wells water pumped or injected during 1975 to the aquifer by wells (negative value for wells indicates that the net effect of wells is that water was removed from the aquifer)
5. **X-flow in** refers to lateral flow into the county (positive value means water is being added to the aquifer).
6. **X-flow out** refers to lateral flow out of the county (negative value means water is flowing from the aquifer).
7. **Z-flow** Upper refers to the vertical flux through the upper boundary of the aquifer being considered either in (positive) or out (negative) of the aquifer (cross-formational flow).
8. **Z-flow** Lower refers to the vertical flux through the lower boundary of the aquifer being considered either in (positive) or out (negative) of the aquifer (cross-formational flow).
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. Figures shown are combined values for both Upper Trinity and Middle Trinity Aquifers in Hays County
11. 1975 was an average recharge year with minimal pumpage of 700 AF/yr

The water budgets in Figure 6 and Table 10 above are described in Figure 50, Mace et al 2000 with updated information in GAM run 02-01 (Mace, 2003). The recharge value of 33,000 ac-ft per year represents direct recharge. Down gradient flow in the aquifer into Hays County from Blanco County is 10,900 ac-ft per year. The total input of water into the aquifer in Hays County is approximately 43,900 ac-ft per year. However, most of this water is not available for use in Hays County. Water leaves the County flowing down gradient in the Trinity Aquifer, and is contributed to the Edwards Aquifer. Also, leakage from the Trinity Aquifer makes up the base flow of rivers, creeks and springs in the County. Note that only 700 ac-ft per year was withdrawn by wells in 1975. Based on further study, more or less water might be available for pumpage by wells. It is essential that a long-term water-level monitoring program be maintained and GAM models be refined with new and additional data to assess trends in water availability within the District.

Recharge to the Lower Trinity Aquifer

As previously described, the Lower Trinity Aquifer is a confined aquifer under artesian conditions. On a regional basis, there is very little recharge from precipitation on a surface outcrop because very little of this aquifer crops out anywhere (Ashworth et al, 2001). The primary means of recharge to the Lower Trinity is by leakage from overlying and underlying aquifers (Ashworth et al, 2001). Ashworth (1983) notes that the primary source of Lower Trinity recharge is from up dip areas north and west of the District where the Hammett Shale is thin or absent. Where the Hammett is present and faulted some recharge/leakage across the Hammett shale probably occurs (Ashworth, 1983). Tritium studies of well water from the Lower Trinity across the Hill Country indicate that there is

not ‘recent water’ (‘recent water’ has not been exposed to the atmosphere since 1952) in the Lower Trinity (Ashworth et al, 2001; USGS, 1997). Surficial ‘recharge to’ or ‘discharge from’ the aquifer may occur in the northern tip of Hays County where the Pedernales River has incised to a point where it runs across the Lower Trinity. Other than this stretch of the Pedernales River, the Lower Trinity is not exposed at the surface within the District. As more wells are drilled to the Lower Trinity, and not carefully completed to isolate the Lower from the Middle Trinity, there is the increased possibility of leakage from the Middle to the Lower Trinity.

Recharge volumes to the Lower Trinity Aquifer have not been calculated or estimated. Through additional data collection, studies, and review of published reports the District will attempt to quantify the volume and types of recharge to the Lower Trinity Aquifer within the HTGCD.

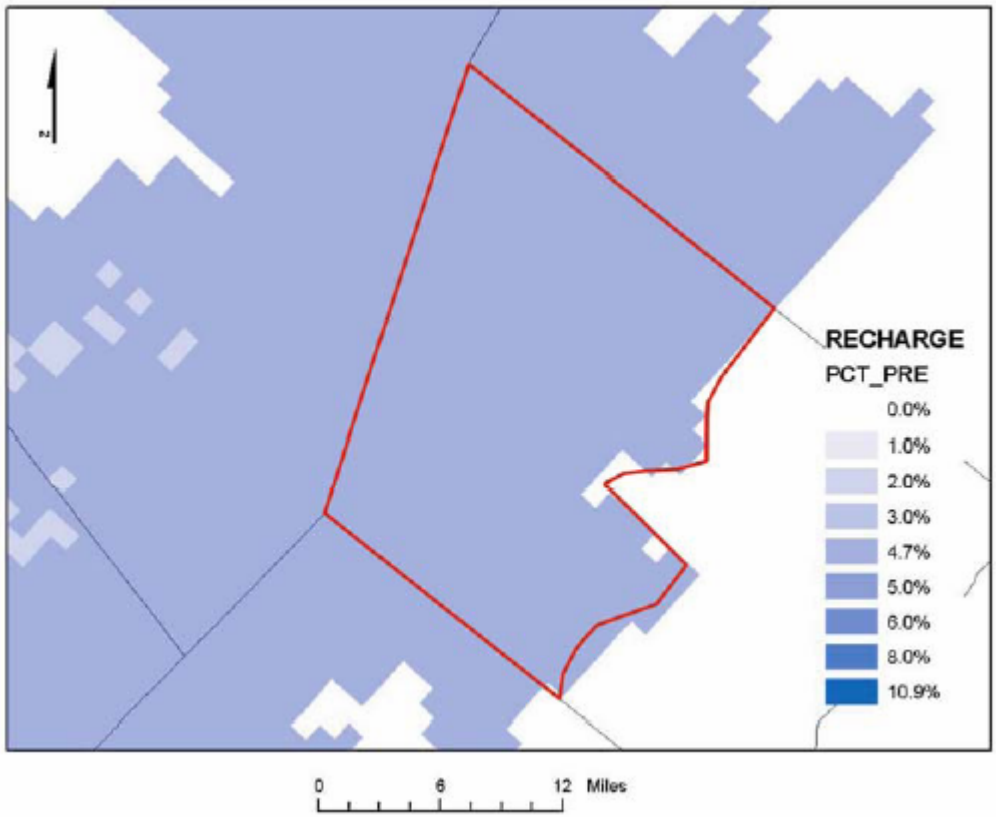

Figure 9: Upper and Middle Trinity Aquifer Precipitation Recharge for HTGCD as a Percentage of Annual Rainfall (Jones, 2004)

As the water budget calculations illustrate, ***recharge should not be confused with recoverable groundwater***. Not all groundwater is recoverable either locally or regionally. In contrast to the TWBD GAMs, Bluntzer notes in his 1992 report entitled “Evaluation of the Ground-Water Resources of the Paleozoic and Cretaceous Aquifers in the Hill Country of Central Texas” that “only a very small portion of …groundwater can be realistically recovered by wells on a sustained basis. This condition is due to the extremely low coefficients of transmissibility of the…Trinity Group aquifers” (pg 92). Furthermore, Bluntzer (1992) notes: “The estimated total annual ground-water sustained yield…amounts to about 10% of the area’s estimated annual natural recharge…” (This is the) “… approximate amount of ground water that can be recovered by wells without adversely effecting (sic) base flow (groundwater discharge) to area effluent streams, and without

causing adverse water-level declines and related encroachment of poor quality water; particularly in the Trinity Group aquifers" (pg. 95). Applying this line of reasoning to Jones (2004) analysis of GAM precipitation recharge would imply that only 0.47% of precipitation would be available for sustainable use as recharge to the Upper and Middle Trinity Aquifers.

According to the Blanco Pedernales Groundwater Conservation District's Management Plan of 2003:

"Some [groundwater] 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, much of the groundwater may be unrecoverable due to these hydrogeologic conditions.

"…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 quickly 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 approaches average annual net recharge or groundwater availability, then an aquifer mining condition may result and groundwater availability will decline."

Figure 10 illustrates local water levels for a well completed in the Middle Trinity Aquifer located in Region K between January 1999 and July 2005. The location of this well is shown on Figure 12. During dry periods, water depths can declined up to 60 feet during the period of measurement. In contrast, during seasonal rains groundwater levels increased up to 40 feet. Throughout the data collection period the water level has fluctuated within a 65' range.

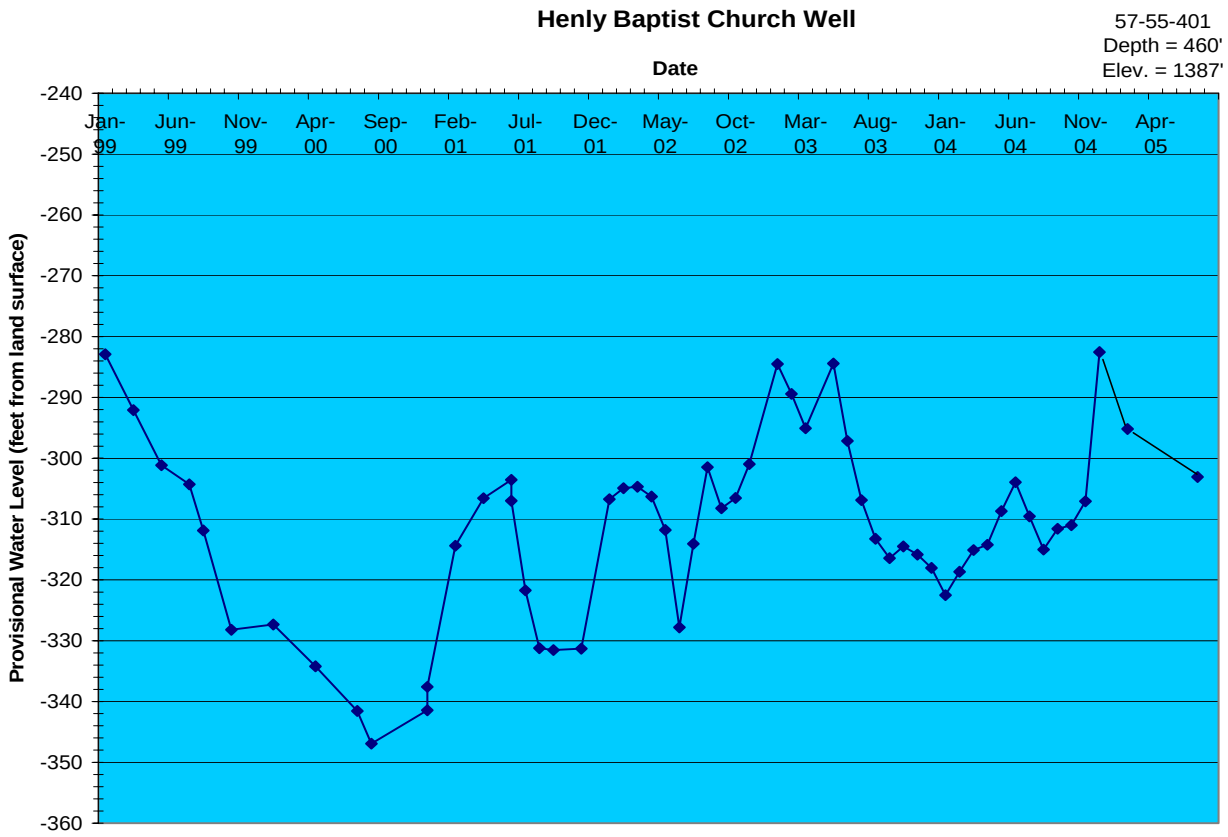

Figure 10: Henly Baptist Church Well Water Level in Feet Below Land Surface

Figure 11 illustrates local water levels for a well completed in the Middle Trinity Aquifer located in Region L between January 1999 and July 2005. The location of this well is shown on Figure 12. Heavy rainfall can result in significant recharge and a rapid rise in water levels in local wells, only to return to previous levels as groundwater was discharged, most likely through springs and seeps. This discharge, along with increased pumping, may act as a limiting factor to water-level rise.

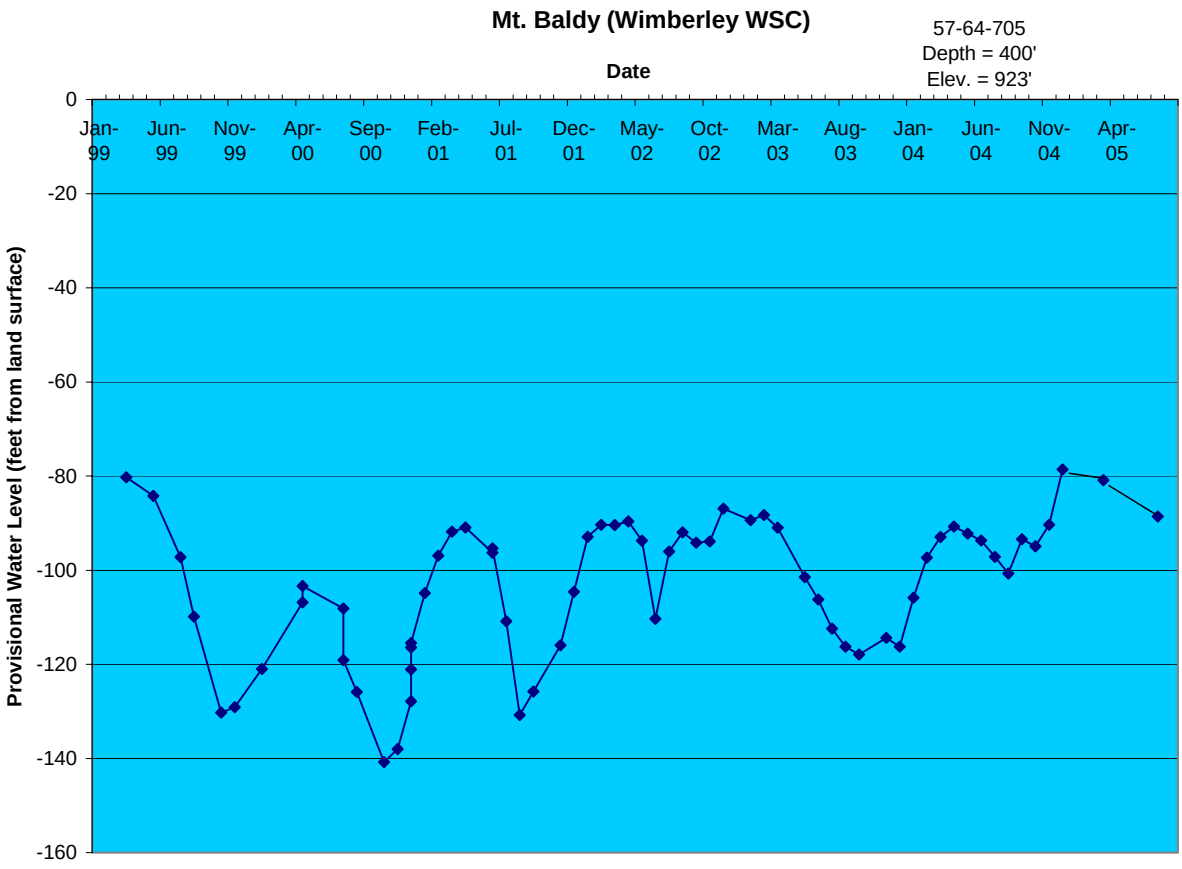

Figure 11: Mount Baldy Well Water Level in Feet Below Land Surface

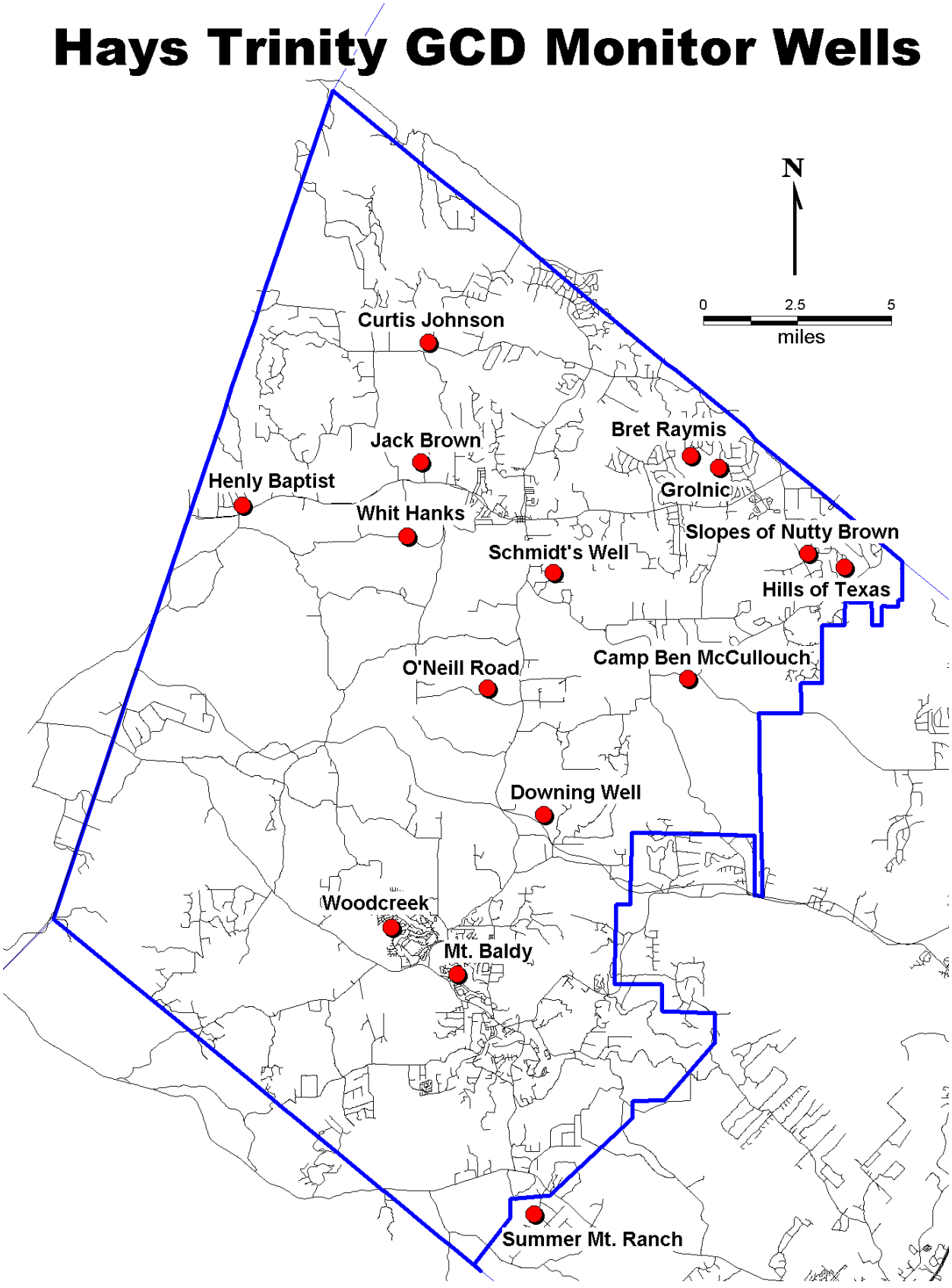

Figure 12: HTGCD Monitor Well Locations

How Recharge to the Groundwater Resources of the District May Be Increased

The District is just beginning operations and has yet to assess potential recharge projects in Hays County. The District will solicit ideas and information and investigate natural or artificial recharge enhancement opportunities, , that are 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 and re-establishment of native grasses and vegetation, 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.

Projected Total Water Supply Hays Trinity GCD

The total water supply in the District is projected to be 5,529 ac-ft per year in 2010 (with 3,719 ac-ft per year of surface water and 1,810 ac-ft per year of groundwater). The projected groundwater supply year in the District in year 2000 was 1,810 ac-ft per. The information shown in Table 11 (Projected Total Water Supply for Hays County and the Hays Trinity Groundwater Conservation District) is based on information for Hays County as a whole from Table 5 of the 2001 Regional Water Plans for Region K and L. The data are also described in Exhibit B of the 2002 State Water Plan and aggregated with minor revisions in the TWDB's DB-02 (database 2002). This information can be accessed at the TWDB web site on the pages for the 2001 Region K and L water plans and their 'Data' page under 'Exhibit B' and 'WPIT' links. The 2001 Regional Water Plan Table 5 provides the most detailed presentation of the data. .

Table 11 includes TWDB projected supply for the entire county and a subtotal for the District. The District supply subtotal includes cities within the district, all of the Trinity Aquifer water supply, and the proportional amount from other sources of region K (76%) and L (38%) within the District (TWDB, 2004). The following procedure was used to derive District specific supply values from the TWDB Regional Water Planning Group's County data, since the District only occupies the western 54.4% of Hays County and is divided between RWPGs K and L: All locations cited in TWDB Table 5 from within the District were used directly in the calculation. Data for supply from sources known to be from outside the District was not used. Data generalized for county-wide sources from RWPGs K and L were used proportional to the amount of the area occupied by the District within the whole County of RWPG K or L. County-wide generalized source values from Region K and L were used in the following percentages: 76% and 38%, respectively (for further explanation, see section on "Methods Employed to Develop Planning Values Specific to the District").

Table 11: Projected Total Water Supply for Hays County and the Hays Trinity Groundwater Conservation District

RWPG	WUG	River Basin	Source Name	2000	2010	2020	2030	2040	2050
K	Dripping Springs	Colorado	Trinity Aquifer	553	553	553	553	553	454
L	Wimberley	Guadalupe	Trinity Aquifer	1,025	1,025	1,025	1,025	1,025	806
L	Woodcreek	Guadalupe	Trinity Aquifer	188	188	188	188	188	188
L	County-Other	Guadalupe	Guadalupe River Run-Of-River (ROR)	200	200	200	200	200	200
L	County-Other	Guadalupe	Guadalupe River ROR	2	2	2	2	2	2
L	County-Other	Guadalupe	Guadalupe River ROR	3	3	3	3	3	3
L	County-Other	Guadalupe	Guadalupe River ROR	38	38	38	38	38	38
L	County-Other	Guadalupe	Canyon Lake/Reservoir	47	47	47	47	47	47
L	County-Other	Guadalupe	Canyon Lake/Reservoir	335	335	335	335	335	335
K	Irrigation	Colorado	Trinity Aquifer	2	2	2	2	2	2
K	Irrigation	Colorado	Irrigation Local Supply	25	25	25	25	25	25
L	Irrigation	Guadalupe	Irrigation Local Supply	133	133	133	133	133	133
L	Livestock	Guadalupe	Livestock Local Supply	105	105	105	105	105	105
K	Livestock	Colorado	Trinity Aquifer	30	30	30	30	30	25
K	Livestock	Colorado	Livestock Local Supply	117	117	117	117	117	117
L	Manufacturing	Guadalupe	Other Local Supply	210	210	210	210	210	210
K	Mining	Colorado	Trinity Aquifer	12	12	12	12	12	10
L	Mining	Guadalupe	Trinity Aquifer	0	0	0	0	0	0
L	Steam, Electric Power	Guadalupe	Canyon Lake/Reservoir	973	973	973	973	973	973
L	Steam Electric Power	Guadalupe	Direct Reuse	0	1531	1531	1531	1531	1531
Total Projected Water Supply – Hays County (acre-feet/ year)				**3,998**	**5,529**	**5,529**	**5,529**	**5,529**	**5,204**
Total Projected Water Supply from Trinity Aquifer (acre-feet /year)				**1,810**	**1,810**	**1,810**	**1,810**	**1,810**	**1,485**

Projected Population Growth in Hays County

The year 2000 Region K & L water planning groups predicted that from 1990 to 2000 the Hays County population would grow approximately 56% from 51,478 to 80,474. In 2000, Hays County was projected to grow 32% between 2000 and 2010, and 24% between 2010 and 2020. In subsequent years, the U.S. Census projected that Hays County had a 2003 population of 114,193 (U.S. Census, 2005). In June 2004, the Texas State Data Center at the University of Texas San Antonio predicted that the County would grow between 9% and 25% between 2000-2010 and between 25% and 175% between 2000-2040 (Table 12). If population continues to grow above the Regional Water Planning group's projections, then water shortages are likely to ensue and people, the economy, and the environment will suffer. The County is currently exhibiting a growth rate that exceeds the Regional Water planning group's projected growth rate.

Table 12: Projected Population Growth – Region K Portion of Hays County

WUG	County	Basin	RWPG	1996	2000	2010	2020	2030	2040	2050
Dripping Springs	Hays	Colo.	K	1,155	1,330	1,648	1,989	2,400	2,883	3,463
County - Other	Hays	Colo.	K	14,483	17,346	24,740	31,834	40,247	49,435	54,526

Source: Lower Colorado Regional Planning Area (Region K)

Table 13: Projected Hays County Population Growth – Region L Portion of Hays County

County	Basin	RWPG	1990	1995	2000	2010	2020	2030	2040	2050
Hays	Guadalupe	L			80,474	106,378	132,110	163,586	199,215	226,516

Source: Table 2.1 and 2.2, 2001 South Central Texas Regional Planning Group (Region L)

Table 14: Actual Hays County Population Data Through 2000 Showing a Range of Growth Projections Through 2040 Using Texas State Data Center June 2004 Projections. Year 2003 is a U.S. Census Projection

County	RWPG	1990	1995	2000	2003	2010	2020	2030	2040	Scenario
Hays	K & L	51,478	63,901	97,589	114,193	114,651	123,247	128,087	131,114	0.0
						140,173	183,847	230,859	280,076	0.5
						171,672	273,790	409,986	575,797	1.0

Source: Texas State Data Center, June 2004 population projections for Hays; U.S. Census year 2003 projection

The demographic studies conducted in recent years for Wimberley and Dripping Springs Independent School Districts have compiled tables of the major platted subdivisions in and around these towns and show the total number of lots remaining to be built out. The tables are included in this report as Tables 15 and 16. These data provides an indication of the most rapidly available inventory of house lots in these areas, although there are tens of thousand of acres within the District that may be subdivided in the future.

Table 15: Major Developments in the Dripping Springs Area with a Significant Number of Lots Remaining to be Sold

Platted Development Dripping Springs	Total Lots	Approx. Lots Remaining	Water Source
Belterra	2,000	1,942	LCRA
Bush Ranch (Pulte)	350	350	LCRA
Hazy Hills Ranch	989	989	LCRA
Hidden Springs Ranch	55	55	
Howard Ranch	126	126	LCRA
Legacy Trails	71	27	
Polo Club	120	56	LCRA
Polo/Rooster Springs Golf	260	260	LCRA
Preserve at Dripping Springs	47	39	LCRA
Reunion Ranch/Krasovec	476	476	LCRA
Rimrock/Lloyd	682	682	LCRA
Highpoint/Pulte	705	705	LCRA
Vistas of Sawyer Ranch	197	60	LCRA~
Walking W Ranch	60	60	Trinity
Total Proposed New LUEs	**6,138**	**5,827**	**Approx. Total Units To Be Built (May '05)**

Source: DeskMap Systems, Inc., 2004

Table 16: Major Developments in the Wimberley / Woodcreek Area with a Significant Number of Lots Remaining to be Sold

New Development	Total Lots	Approx. Lots Remaining	Water Source
La Ventana (new section)	150	150	Trinity
River Mountain Ranch	200	130	Trinity
Sierra West	190	150	Trinity
Westridge	137	95	Trinity
Woodcreek North, (northern)	2,200	2,000	Trinity
Woodcreek North (Hills of Wimberley)	1,500	1,100	Trinity
Total Proposed New LUEs	**4,377**	**3,625**	**Approx. Total Units To Be Built (May '05)**

Source: DeskMap Systems, Inc., 2003

In the Dripping Springs area, an additional 166 lots were available in ten older subdivisions that were nearly sold out (DeskMap, 2004). No such inventory was provided for the Wimberley area (DeskMap, 2003). If the U.S. Census average of about 3 people per home is used (see section on Population at the front of the document), then the currently available house lots would support about 18,000 more people in the Dripping Springs area [3 x (5,827+166)] and about 12,000 more in the Wimberley/Woodcreek area [3 x 3,925]. The District has not aggregated this type of data for the unincorporated area of the District, but it can be assumed there are many acres that can be subdivided and platted for home construction.

The Woodcreek development is situated above Jacobs Well, in the watershed of Cypress Creek, a major contributor to the flow of the Blanco River. It was platted in the 1970s when platting requirements were more lax. The lots are substandard in size and location according to today's rules, ranging in size from 0.25 to 0.33 acres with some being platted on steep slopes and in floodplain. The high platted density may be mitigated slightly by the fact that some exiting home owners have built a single house on multiple lots. The District is concerned that if any subdivision is built to this level of density within the Jacob's Well watershed, there will be significant degradation to the Wimberley Valley watershed with specific negative impacts to Jacob's Well.

Projected Water Demand

The total water demand for the District is projected to be 9,126 ac-ft per year in 2010 (Table 17). This represents an increase from 5,531 ac-ft per year in the year 2000 projection. The projected water demands shown are based on information from Exhibit B, Table 4 of the 2002 State Water Plan for all of Hays County. It includes cities within the District and the proportional amount in other categories of region K (76%) and L (38%) within the District (TWDB, 2004). The following procedure was used to derive District specific water demand values from the TWDB Regional Water Planning Group's county data, because the District only occupies the western 54.4% of Hays County and is divided between RWPGs K and L: All locations cited in Table 17 from within the District are taken directly from TWDB data. Data for demand from users known to be from outside the District was not used. Data generalized for county-wide demand from RWPGs K and L were used proportional to the amount of the area occupied by the District within the whole county of RWPG K or L. County-wide generalized demand values from Region K and L were used in the following percentages: 76% and 38%, respectively (for further explanation, see section on "Methods Employed to Develop Planning Values Specific to the District").

Table 17: Total Projected Water Demands in the District per Regions K&L planning documents

RWPG	WUG	River Basin	Category	2000	2010	2020	2030	2040	2050
K	Dripping Springs	Colorado	Municipal	371	428	483	575	688	818
L	Wimberley	Guadalupe	Municipal	615	732	790	898	1,004	1,128
L	Woodcreek	Guadalupe	Municipal	171	160	149	150	153	157
L	County-Other	Guadalupe	Municipal	2,166	2,585	2,815	3,235	3,600	3,238
K	County-Other	Colorado	Municipal	1,591	2,083	2,549	3,140	3,823	4,180
K	Irrigation	Colorado	Irrigation	14	13	13	13	13	13
L	Irrigation	Guadalupe	Irrigation	114	114	112	112	110	109
L	Livestock	Guadalupe	Livestock	105	105	105	105	105	105
K	Livestock	Colorado	Livestock	130	130	130	130	130	130
L	Manufacturing	Guadalupe	Manufacturing	36	41	46	50	55	60
K	Manufacturing	Colorado	Manufacturing	176	208	238	266	292	320
L	Mining	Guadalupe	Mining	33	32	26	21	14	11
K	Mining	Colorado	Mining	7	5	2	1	0	0
L	Steam Electric Power	Guadalupe	Power	0	2,490	2,490	2,490	2,490	2,490
Total Projected Water Demand (acre-feet per year) =				**5,531**	**9,126**	**9,949**	**11,186**	**12,479**	**12,760**

Surface Water Resources and Usage in the HTGCD

Northern Hays County - LCRA

The relatively new LCRA Highway 290 Pipeline supplies surface water to large new developments in the area and to the City of Dripping Springs. The planned Hamilton Pool Pipeline may impact the RR 12 corridor. It is a 15-mile water transmission line and pump system that conveys treated water from LCRA's West Travis County Regional Water System at Bee Cave to western Travis County and northern Hays County. It's often referred to as the 290 water line because it was built in easements alongside U.S. Highway 290. With improvements to the water treatment plant, the water line has the current capacity to serve about 10,000 households. See Figure 13, obtained from the LCRA, for the location of existing/proposed pipelines and developments in eastern and northern parts of the District.

Water service from the 290 line began in 2002. A little less than half of the 290 line's capacity is available for developments that existed in May 2000. So far, about 180 households in the Sunset Canyon subdivision have connected to the line. LCRA also has a contract to provide the Dripping Springs Water Supply Corporation (DSWSC) with enough water for 1,100 households. At the request of private developers, DSWSC has extended the 290 pipeline further west to County Road 187 (McGregor Lane) and south to a development on Creek Road, adjacent to Onion Creek. The water line's remaining capacity is available for new developments. The LCRA Board has approved water service agreements for about 6,000 households in new developments.

The LCRA Board has approved wholesale water contracts for four developments: Cypress-Hays Rock Creek with about 1,250 households (north of 967 and east of RR-1826), John Lloyd's Rimrock (RR-1826 and Darden Hill Rd) and Greenhawe with about 675 households, Rutherford

West with about 300 households, Krasovec with about 480 households and Howard Ranch with about 170. These proposed developments are from a couple to several miles south of Highway 290, accessed by Ranch Road 1826 and 967 (Figure 13). To distribute water to the developments, the LCRA will front the construction cost of a line to the 290 pipeline that developers will have to repay as lots are sold. The LCRA Board also has approved a contract to allow Hays County Water Control and Improvement District No. 1 to provide enough water for about 1,600 households in the Belterra development along Highway 290, near the Hays-Travis county line. Belterra, Rimrock, and Highpoint are the developments authorized by the U.S. Fish and Wildlife Service that are under construction.

The LCRA has entered into an agreement in 2003 to serve 1,050 households in HighPoint Development (formerly Sawyer Ranch), just west of the Belterra development. The proposed Headwaters of Barton Creek development along Highway 290 is intending to use surface water from the 290 pipeline. The development includes over 900 households and large commercial area fronting Highway 290.

In 2004, the LCRA signed agreements with developers along Hamilton Pool Road to extend surface water supplies to several southwestern Travis County developments. As shown on Figure 13 published by the LCRA, it is the intent to extend the Hamilton Pool Road Pipeline to Highway 12. The pipeline will enter the District just south of the intersection of Highway 12 and Hamilton Pool Road. The pipeline will run south along Highway 12 to the City of Dripping Springs where it will tie into the Highway 290 pipeline. LCRA is also proposing to extend the Hamilton Pool Road pipeline south along Crumley Ranch Road that will ultimately tie into the 290 pipeline. Most of this pipeline is within the District.

Southern Hays County - GBRA

The Guadalupe Blanco River Authority is reportedly in discussions with Wimberley Water Supply Company to possibly pipe water to the Wimberley/Woodcreek area from Canyon Lake. After several attempts at communicating with the GBRA to obtain details on this possible project, all the District has been able to confirm is that GBRA is in discussions with Wimberley Water Supply Co.

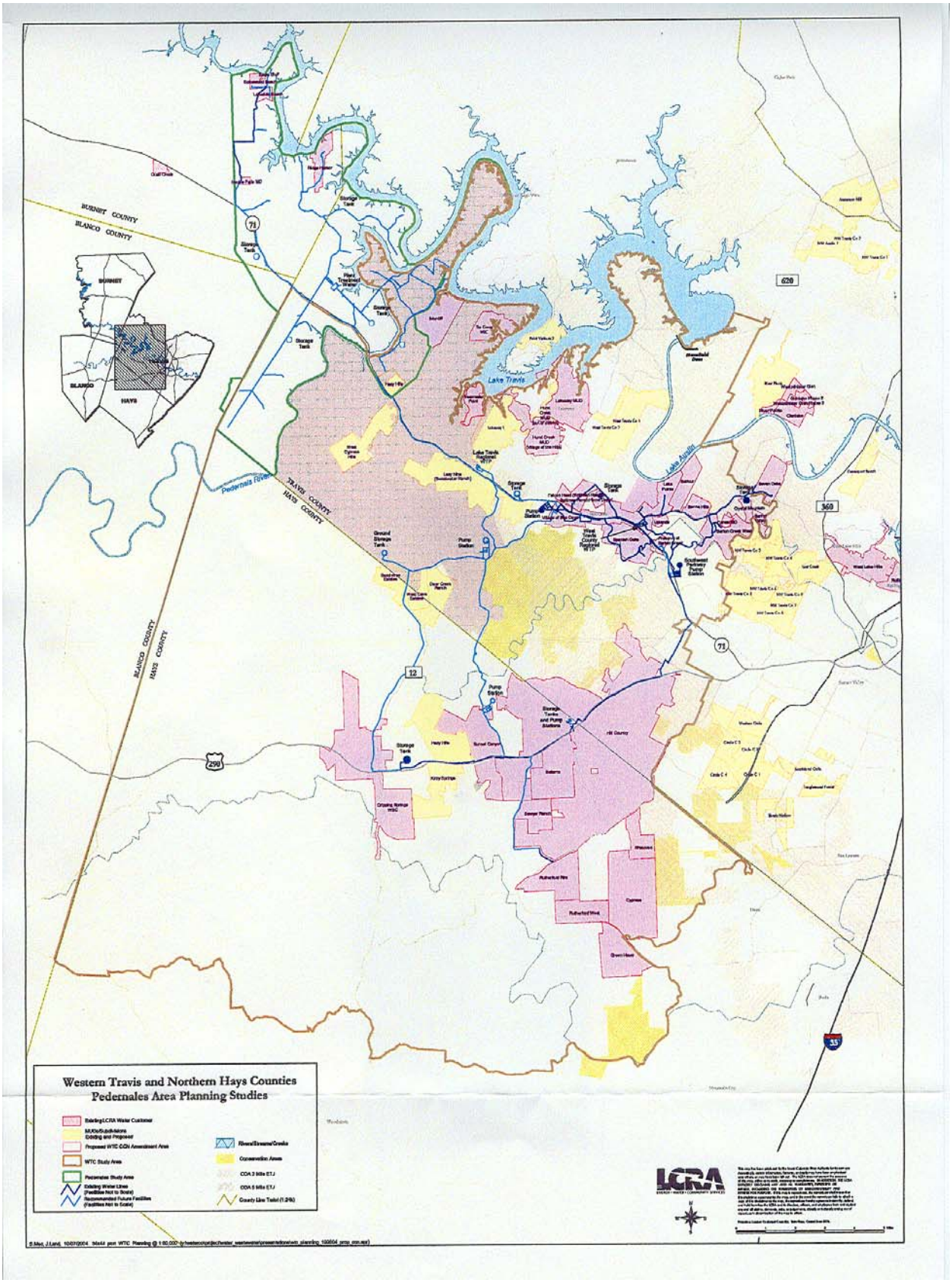

Figure 13: LCRA Surface Water Pipelines, Subdivision Outlines and WCIDs, Northern Hays County

DETAILS ON HOW THE DISTRICT WILL MANAGE GROUNDWATER

Implementing the Plan

- The District will work to implement the provisions of this plan and will use the plan as a guide for making policy and shaping District activities.

- Planning and operations of the District, agreements entered into by the District, and additional planning efforts by the District will be consistent with this plan.

- The District will cooperate with appropriate state, regional and local water management agencies, and other governmental entities in managing groundwater resources in accord with this plan.

- The planning period for this plan is 10 years. The District shall review and re-adopt this plan, with or without revisions, at least once every five years in accordance with Texas Water Code Chapter 36.1072(e). Any amendment to this plan shall be in accordance with Chapter 36.1073.

Enforcing Rules

- The District will encourage cooperative and voluntary Rule compliance, but if Rule enforcement becomes necessary, the enforcement will be legal, fair, and impartial.

- The District shall treat all citizens fairly.

- 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 spring and surface flow, adjacent landowners and potential future users of groundwater. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

Managing Groundwater

- The District will manage groundwater with the goal of maintaining 90% of stream and river base flow, even during a repeat of the Drought of Record. To accomplish this…
  - The District will use the best available scientific data to determine the most effective regulatory and conservation measures.
  - Groundwater within the District will be managed using the best available data on water availability and groundwater storage conditions.
  - During its decision making process, the District will use information from Groundwater Availability Models, including later versions developed by the TWDB for the Trinity Aquifer.
  - The District will monitor groundwater conditions (including available supply and groundwater storage) through its water level monitoring program and will continue to maintain and update the District's database.
  - The District will undertake and cooperate with investigations of the groundwater resources within the District as necessary and will make the results of investigations available to the public.

- The District will participate in regional water quality activities with other governmental agencies.

- The District will provide information and promote activities and studies with the goal of conserving and preventing waste of groundwater.

Groundwater Priorities

The District understands that to effectively manage the quantity of groundwater available for future use consistent with the District's guiding principles, groundwater use must be prioritized. The following list of priorities will be used to guide decision making when developing conservation measures, drought contingency planning, and future new groundwater use permitting. Highest priority uses are listed first, followed by lesser priority uses. It must be noted that the list is not absolute and site-specific factors may be considered in the decision making process.

1. Emergency Locations: Emergency locations include hospitals, critical care facilities, emergency clinics, nursing homes, police and fire departments, and Emergency Medical Services.
2. Domestic Use: The use of groundwater for personal needs or for household purposes such as drinking, bathing, heating, cooking, sanitation, household pets, or cleaning excluding pools/ponds and in-ground sprinkler systems.
3. Livestock: Domesticated horses, cattle, goats, sheep, swine, poultry, ostriches, emus, rheas, exotic deer and antelope, and other similar animals involved in farming or ranching operations.
4. Crop Irrigation: Crop irrigation utilizing drip irrigation systems or other water conserving irrigation practices that minimize evaporative losses (may include nurseries).
5. Commercial: The use of groundwater to supply water to properties or establishments that are in business to:
    a. build, supply, or sell products; provide goods, services, or repairs; and that use water in those processes; or
    b. supply water to the business establishment primarily for employee and customer conveniences (i.e. flushing of toilets, sanitary purposes, or limited landscape watering).
6. Industrial w/o Mining: Use of groundwater primarily in the building, production, manufacturing, or alteration of products or goods, or to wash, cleanse, cool, or heat such goods or products.
7. Crop Irrigation Crop irrigation utilizing spray irrigation systems.
8. Irrigation - Ornamental: Use of groundwater to supply water for application to plants or land in order to promote growth of ornamental plants, turf, or trees.
9. Irrigation – Recreation: Use of groundwater to supply water for golf courses and recreation/sports fields.
10. Car Washes: Use of groundwater for car washes or other high water use cleaning applications.
11. Vanity Ponds/Non-Commercial Fish Pond: Use of groundwater to supplement water levels in vanity ponds and non-commercial fish ponds.
12. Water quality treatment ponds where other sources of water are available.
13. Mining/Quarry: Dewatering and/or washing activities using groundwater at mining and/or quarry operations.

District Rules

- The District will adopt rules relating to the prevention of waste, permitting of wells and the production of groundwater for wells within the District.

- Any rules adopted by the District shall be pursuant to the District's enabling legislation, Texas Water Code Chapter 36, and the provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available.

- In regulating or limiting groundwater production, the District may consider preserving historic use prior to August 8, 2001 (the effective date of the District's formation) to the extent practical and consistent with this plan.

Critical Groundwater Depletion Areas (Management Zones)
In order to better manage groundwater resources the District may establish critical groundwater depletion zones, or management zones, for all sources of groundwater within the District. In each management zone the District may:

a) Establish groundwater availability and limit the production of groundwater
b) Determine and implement the proportional reductions of the use of groundwater for all classes of groundwater use that are established by the District

Section 36.116 of the Texas Water Code provides that the District may use the management zones to adopt different rules for each:

a) Aquifer
b) Aquifer subdivision
c) Geologic formation
d) Geographic area in which any part of a through c above may occur within the District

For the purpose of managing the use of groundwater within the District, the District will define sustainable use as the use of an amount of groundwater in the District as a whole or any management zone established by the District that does not exceed:

a) The District's goal of sustainable management of the Trinity Aquifer to maintain 90% of stream and river base-flow during a repeat of the drought of record.
b) Any other criteria established by the District as being a threshold of use beyond which further use of the aquifer or aquifer subdivision may result in a specified undesirable or injurious condition

The District will use the currently available estimates of groundwater recharge, movement and availability within the District in exercising the statutory responsibility of managing the groundwater in the District. As more information on groundwater conditions in the District becomes available, the District may use that information to refine the specific methodology by which the District will seek to sustainably manage the groundwater in the District.

Groundwater Mining

- The District is in agreement with the opposition to mining of groundwater expressed in the Region K Plan (ES.6.1).

Analysis of Existing and New Data

- Development or analysis of new or existing surface water, groundwater or aquifer data may result in changes to the groundwater availability volumes, with a corresponding change in production limits from the affected aquifers.

Drought Contingency

- A contingency plan to cope with the effects of water supply deficits due to climatic or other conditions will be developed by the District and will be adopted by the Board after notice and hearing.

- In developing the contingency plan, the District will consider the economic effect of conservation measures upon all water resource user groups, the local implications of the degree and effect of changes in water storage conditions, the unique hydrogeologic conditions of the aquifers within the District and the appropriate conditions under which to implement the contingency plan.

METHODOLOGY FOR TRACKING PROGRESS IN ACHIEVING MANAGEMENT GOALS

The District manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives. The presentation of the report will occur during the last monthly Board meeting of each year. The first and subsequent years will commence on the date of certification of this plan by TWDB. The report will include the number of instances in which each of the activities specified in the Districts management objectives was engaged in during the fiscal year. The Board will maintain the report on file, for public inspection at the Districts offices upon adoption. This methodology will apply to all management goals contained within this plan.

HTGCD GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

1.0 Providing the most efficient use of groundwater - The District will educate the general public on the most efficient uses of groundwater. A District education and information-sharing program, covering local groundwater issues, will be continued and strengthened. It will be designed to inform the public and public officials in Hays County and to add to the hydrogeologic skills of the local water well drilling industry. The program will cover all listed Management goals.

1.1 Management Objective

Each year the Distinct will hold at least one educational event

1.1 Performance Standard

Each year a summary of the District educational event will be included in the Annual Report.

2.0 The District has a goal to implement measures for managing and preventing waste of groundwater.

2.1 Management Objectives

Each year the District will evaluate the District rules to determine whether any amendments are required to decrease the amount of waste of groundwater in the District.

2.1 Performance Standard

In each Annual Report, the District will include a discussion of the annual evaluation of the District rules and determine if any amendments to the rules are recommended to prevent the waste of groundwater.

3.0 The control and prevention of 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 Addressing conjunctive surface water management issues – The District supports conjunctive use of ground- and surface-water throughout the District but not necessarily within a single service area of a water utility. The fact that groundwater is perceived as "free" and surface water delivered by public water supply system has a cost associated with it, does not allow 'the market' to efficiently allocate the resource. Under these conditions the 'free' resource tends to be hoarded and squandered. There are not sufficient groundwater resources to support the projected population growth projection in Hays County. Therefore, conservation measures and alternative supplies such as rainwater collection, surface water, de-salinization and water re-use must be studied and developed. The District will cooperate with surface water providers that wish to provide water to portions of the District that have insufficient groundwater resources. State water law, policy and management frameworks do not recognize the interconnectedness of ground and surface water resources. Texas regulations, laws, and institutions will have to evolve in order to recognize the interconnectedness of ground and surface water resources so that these resources can be conjunctively managed and sustain Texas and its economies. HTGCD rules and policies concerning conjunctive use will evolve as State water law, policies and management frameworks evolve.

4.1 Management Objective

To promote the use of surface water or other alternatives to groundwater in growing areas where groundwater demand is projected to reduce stream and spring flow to unacceptable levels.

4.1 Performance Standard

The District will strive to meet with the planning departments of major surface water providers within the District at least once per year. The District will summarize these meetings and their outcomes in the Annual Report.

5.0 Addressing natural resource issues that impact the use and availability of groundwater or are impacted by the use of groundwater – The District recognizes that the residents of the Hill Country take great pride in the rural character of the land and insist on the protection of the environment and related ecosystems. For this reason the District has a goal of sustainable management to maintain 90% of the Trinity Aquifer contribution to stream leakage and stream/spring base-flow during a repeat of the drought of record and, in critical depletion areas, a rate of stream/spring base-flow that maintains a sound ecological environment. The District will plan, develop, and participate in studies related to groundwater quality, availability, and the environment. This will include working jointly

with universities, government agencies, private groups, and the public to collect and interpret data from area springs and streams.

5.1 Management Objective

Each year the District will continue to participate in the Cypress Creek study being led by Texas State University.

5.1 Performance Standard

Each year a summary of the District participation in the Texas State University study of Cypress Creek will be included in the Annual Report.

5.2 Management Objective

Each year, the District will give data sharing support to the research of groundwater flow and quality at Jacob's Well.

5.2 Performance Standard

Each year a report of the District summary of data sharing activities will be included in the Annual Report.

6.0 The District has a goal to manage the use of groundwater such that sufficient groundwater resources are available for high priority uses during drought conditions – A review of the historical rainfall in Hays County, together with analyses provided by TWDB and regional agencies, demand effective planning and management of groundwater resources.

6.1 Management Objective

The District will develop a Drought Contingency plan to protect and conserve groundwater during critical climatic conditions.

6.1 Performance Standard

The District will prepare a draft drought contingency plan by May, 2006.

6.2 Management Objective

Each quarter the District will check the TWDB website for updates of the Palmer Drought and the District will download the updated Palmer Drought Severity Index (PDSI) map and check for the periodic updates to the Drought Preparedness Council Situation Report (Situation Report) posted on the Texas Water Information Network website www.txwin.net .

6.2 Performance Standard

Quarterly, the District will make an assessment of the status of drought in the District and prepare a quarterly briefing to the Board of Directors. The downloaded PDSI maps and Situation Reports will be included with copies of the quarterly briefing in the District Annual Report to the Board of Directors.

6.3 Management Objective

Each year the District will collect monthly water level data from a network of monitoring wells.

6.3 Performance Standard

Each year a report of the District water level collection activities including a table of the water levels measured in District monitoring wells will be included in the Annual Report.

6.4 Management Objective

Each year the District will monitor data collected from the U.S. Geological Survey springflow monitoring station at Jacob's Well, a major Trinity Aquifer spring.

6.4 Performance Standard

Each year, the District, at a public meeting, will review the prior years monitoring data with local, state or federal organizations and prepare a summary to be included in the Annual Report

7.0 The District has a goal to promote conservation of water resources throughout the District.

7.1 Management Objective

Each year the District will submit one article for publication regarding water conservation to at least one newspaper of general circulation in Hays County.

7.1 Performance Standard

Each year copy of the article submitted for publication will be included in the Annual Report.

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