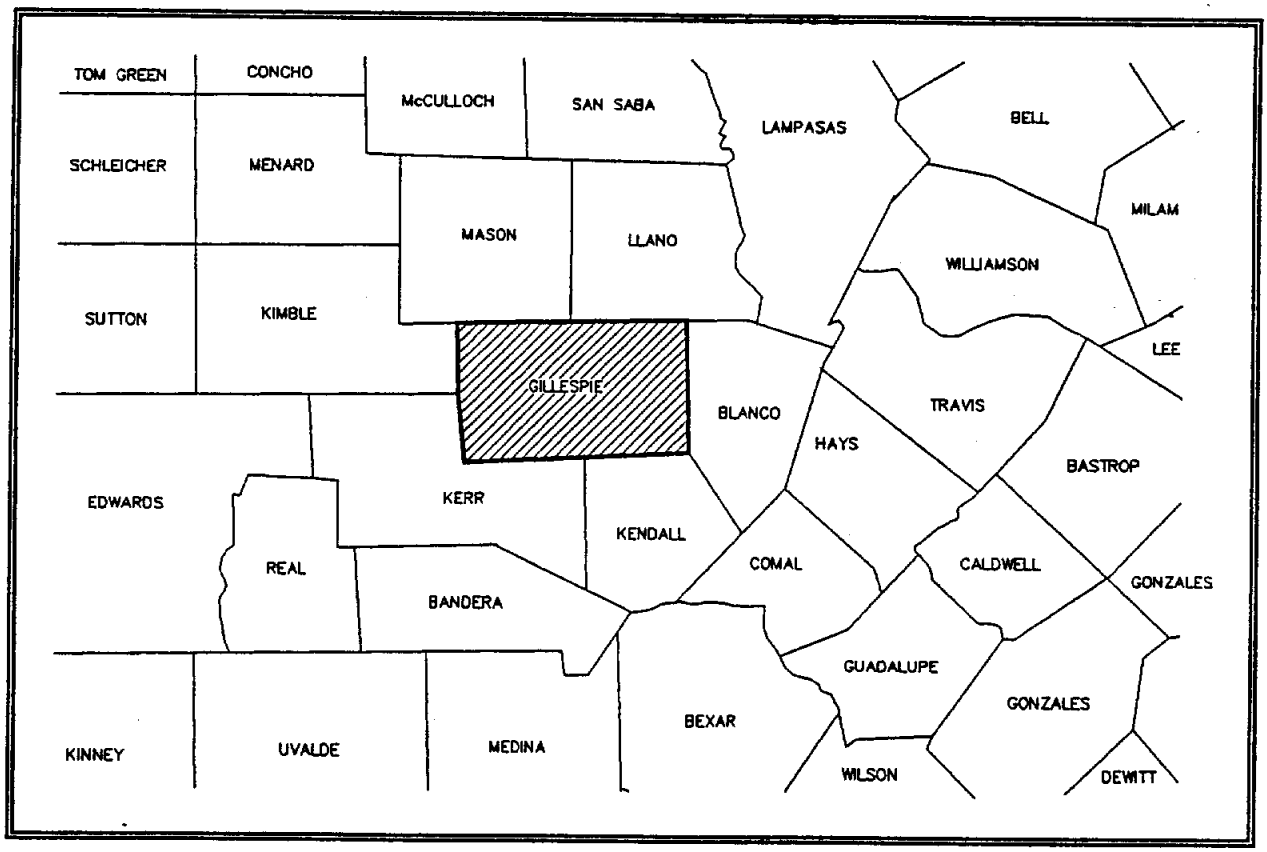
HILL COUNTRY UNDERGROUND WATER CONSERVATION DISTRICT

REGIONAL WATER PLAN



Prepared by

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in association with
Blackwell Environmental Inc.
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SECTION 1

INTRODUCTION

The Gillespie County Regional Water Management Plan is a planning effort led by the Hill Country Underground Water Conservation District (HCUWCD) in conjunction with Gillespie County and the City of Fredericksburg.

The overall objective of this effort is to develop a long-range plan to meet the water supply needs of Gillespie County and the City of Fredericksburg (See Figure 1) for the duration of the term of the Plan (50 years).

Funding for the development of this plan has been provided by each participant and the Texas Water Development Board. Each participant has also appointed a representative to the technical advisory committee to provide local input and periodic review of the planning effort. This report provides the results of this study and satisfies the requirement of the TWDB contract requirements of this plan.

The specific Objectives of the Plan include:

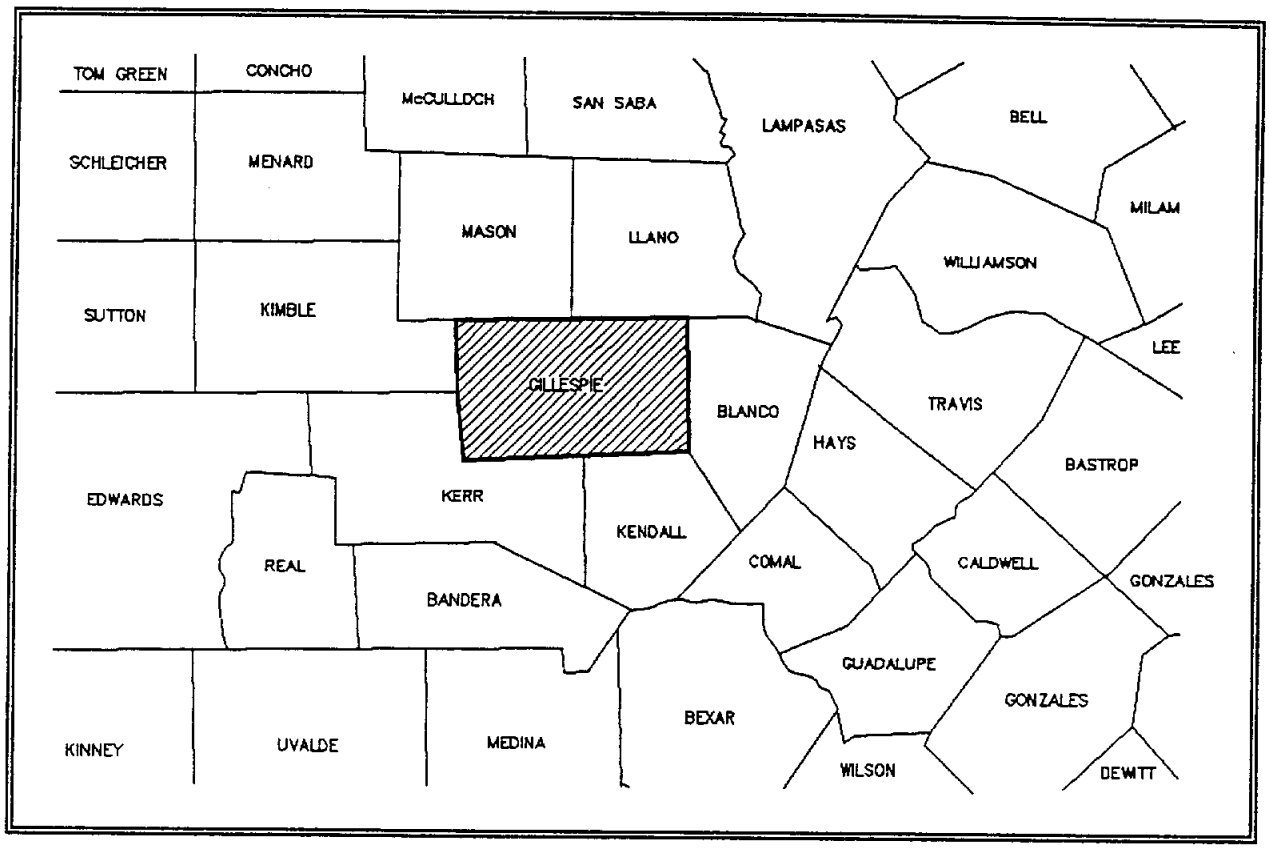
- Establish county-wide population and water demand projections for the City of Fredericksburg and Gillespie County;
- Describe the quantity and quality of water resources that are available to meet future demands within the study area, and to quantify any limits to development of these resources;
- Evaluate **conjunctive management** and use of ground water and surface water resources within Gillespie County and the City of Fredericksburg, and provide a basis for management strategies that may be used to fulfill the regional water demands; and
- Formulate the basic elements of alternative plans that may be used to reconcile water demands with the resources available.

Study Area

The geographical area for the planning study is Gillespie County (Figure 1), which is located in the Hill Country of south-central Texas approximately 80 miles west of Austin on U.S. Highway 290.

Gillespie County covers approximately 1,061 square miles. The principle physiographic feature is the Pedernales River.

Figure 1
Gillespie County



Climate

According to the Climactic Atlas of Texas, the climate of the region is characterized as subtropical, subhumid with temperatures averaging between 32 and 96 degrees. Mean annual temperature is 64-66 degrees. Year round temperatures are conducive for composting and sufficient moisture is available for microbial breakdown of organic waste. The average gross lake surface evaporation rate for the area is 67 inches which is more than twice the average annual precipitation rate of 28 inches. Prevailing winds are out of the south south east. The most damaging storms are flash floods which often occur in the low lying areas and cause extensive erosion. Because of the rugged terrain and shallow soils in the area, the destructive power of surface runoff tends to be great.

Wildlife and Natural Areas

Because of generally smaller populations and lack of extensive agricultural capacity Subregion III-A contains some relatively undisturbed and important areas of native woodlands. In addition, the numerous incised canyons serve as important natural habitats. Many endangered species make their home in this region. Among them are the Bald Eagle, the Arctic Peregrine Falcon, and the Texas Horned Lizard.

Surface and Groundwater

The Edwards-Trinity Aquifer lies in partly in Gillespie county. It's principal use is for irrigation. Saturated thickness reaches a maximum of 800 feet, providing water of increasing salinity as the water enters discharge points to major rivers and streams. A minor aquifer, the Ellenberger-San Saba Aquifer also supplies water to the area.

The Colorado River Basin drains most of Gillespie county. In the region, the major streams rise in the hilly regions and generally move in a SE direction towards the Gulf of Mexico. The rapid movement of water through the region means a higher risk of erosion.

Ground-water in the area is generally available from four strata:

- Hickory Sandstone
- Ellenburger Limestone
- Hensell Sand
- Edwards Limestone

Of these strata, the wells draw water from the Hensell Sand at depths ranging from 60 to 171 feet. The low yield wells are currently being utilized for domestic and agricultural purposes. Hensell Sand is composed of a mixture of sand, silt and clay with occasional beds of sandstone and limestone. The higher producing zones are typically deeper in the formation. Precipitation on the sandy outcroppings recharges the strata and flows in a southwesterly direction.

Topography

The Hill Country, which covers most of the area, has rough terrain with elevations ranging from slightly less than 1,000 to 2,500 feet mean sea level (MSL). Soils are shallow and underlain by limestone. The rough terrain of the Hill Country contains numerous, deeply incised canyons and ravines formed by rapidly flowing surface runoff. However, most of the hilltops are fairly flat to gently rounded with similar elevations, being remnants of the Edward's Plateau.

The top portion of Gillespie County lies in the Llano Basin which, like the Hill Country is characterized by rugged terrain and considerable relief. Some areas of this erosional basin may be as much as 1,000 feet below the high limestone rims, and elevations may reach 2,000 feet MSL.

GEOLOGY AND SOILS DESCRIPTION

Most of Gillespie County lies in the Hill Country. The northern part of the county is in the area of the Llano Basin. Soils in this area consisted of interlayered clay, clayey sand, and silty sand which is typical of the Hensell Sand strata. Below the Hensell are Precambrian granite and gneiss. The San Marcos Arch, a submarine topographic high, runs southeastward from the Llano Basin. The San Marcos River flows almost down the crest of the San Marcos Arch.

Alfisols, common in the prairie and plains areas, are also found in northern Gillespie County. The alfisol profile typically exhibits a light-colored upper horizon not darkened by humus and ranging from shallow to moderate depth, and a lower horizon of deep relatively impermeable clay. Alfisols are generally desirable for sludge application and landfill siting.

DEMOGRAPHIC DESCRIPTION

Table 1-1 depicts general demographic data for Gillespie County. Gillespie county has a population of 17,204 that is spread out over the county. Fredericksburg, the only large city has a population of 6,934. The average per capita income in the County is $17,757.

Population

Table 1-1 illustrates demographic data in Gillespie County:

TABLE 1-1

GENERAL DEMOGRAPHIC DATA

County	1990 Population	Area (sq mi)	Pop Density (cap/sq mi)	Per Capita Income
GILLESPIE COUNTY	17,204	1,061	16	17,757

Gillespie County has shown a population increase in the ten years between 1980 and 1990. Gillespie County's population has increased 27% since 1980.

In Table 1-2 a breakdown of population for the year 1990 was taken from the 1990 census. Projections were based on this census as well.

TABLE 1-2

POPULATION GROWTH IN THE ALAMO AREA SUBREGION III-A

County	1990	1993	1994	1995	1996	1997	2000	2010	2015
Gillespie County	17,204	17,660	17,682	17,708	17,746	17,803	17,946	18,094	18,167

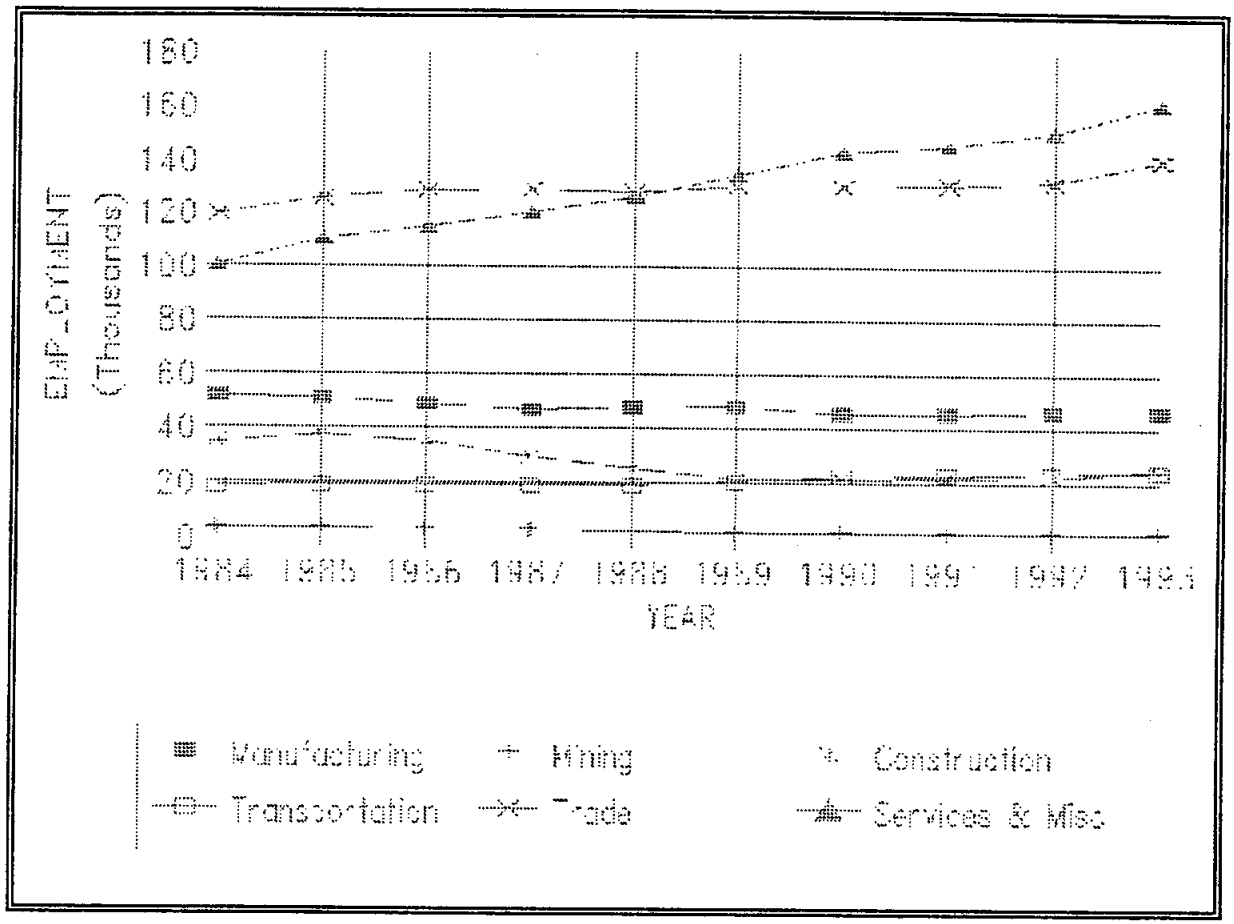
ECONOMIC DESCRIPTION

The area's total income totals approximately $514 million annually. Average per capita personal income in 1990 was 17,757. Gillespie County has an employment growth rate of 23 percent.

Employment

The employment for the region is as shown in Figure 1-1.

FIGURE 1-1
ECONOMIC TRENDS IN AACOG REGION



Manufacturing

There is relatively no manufacturing in Gillespie County.

Airports

One commercial airport services the area - County Airport. Also within the county are 4 private airports.

Agriculture

A large percentage of the area's income comes from agricultural business. In Gillespie county most of the population's income is from cattle and other livestock. Hay, Grain sorghum, oats and wheat are also profitable. Gillespie boasts being the largest peach growing county in Texas.

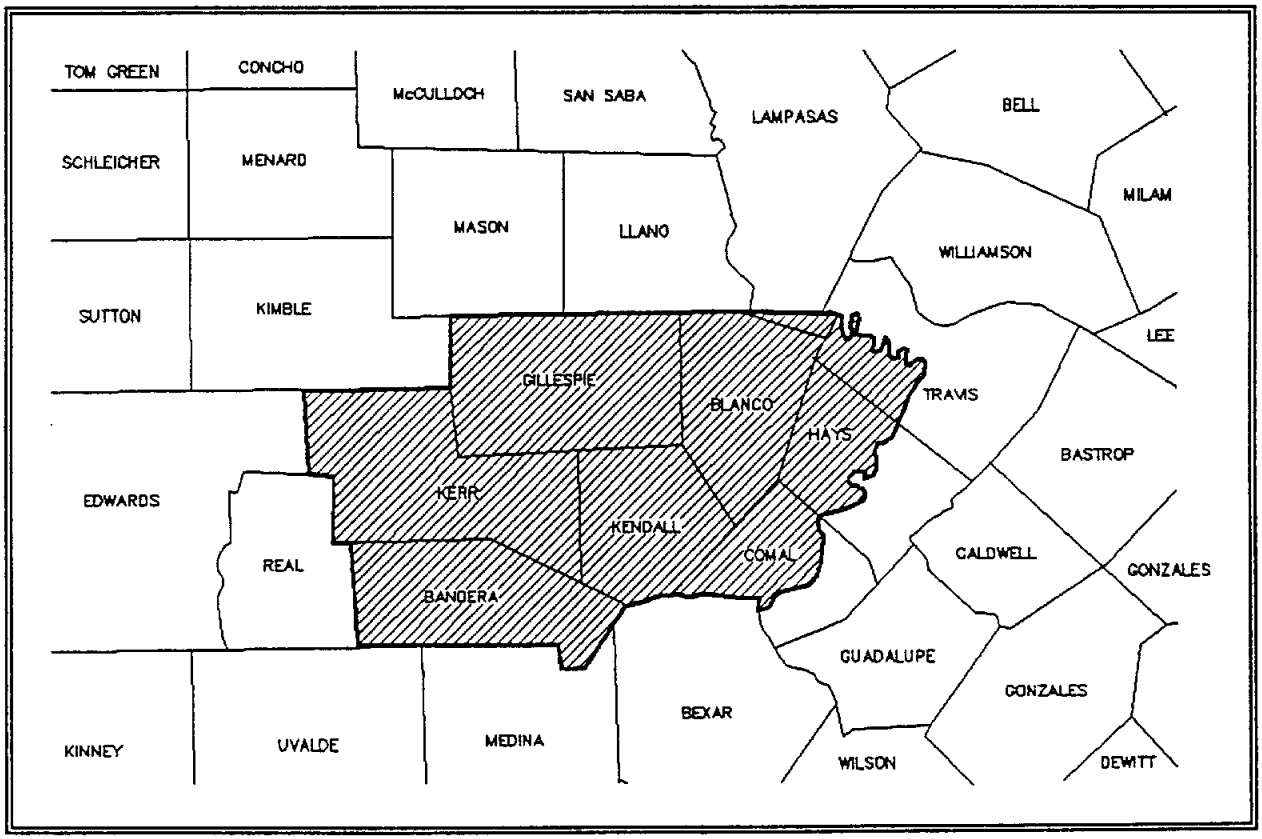
Tourism

Tourism is another major component of the region's economy. The county depends on profits from hunting and fishing licenses as well as profits from visitors to the many camps and parks located throughout the area. Fredericksburg has many local events such as Oktoberfest, night in old Fredericksburg, and the county fair which draw many people from outside of the county.

Current Status

In 1990 the Texas Water Commission and the Texas Water Development Board released a report (Cross and Bluntzer, 1990) that proposed critical area designation for all or portions of eight hill country counties (Figure 2). Included in this 5,500 square mile area is all of Gillespie County. Critical areas are areas that are experiencing or will experience in the next 20 years ground water shortages, land subsidence, or ground water contamination. Based on potential ground water shortages due to lowering water tables and low recovery potential from the aquifers, the Hill Country Counties have been designated as a critical area (§ 31 TAC Sect.294.24).

Figure 3
Hill Country Critical Area



The critical area designation gives the Texas Water Commission the authority to hold a hearing to determine if an underground water conservation district (UWCD) should be formed in the critical area. If an UWCD is formed it has full regulatory authority over ground water use and development in the critical area. Some of the regulatory powers of an UWCD include, but are not limited to:

- Eminent Domain Power
- Water Well Permitting
- Restricting Well Spacing
- Restricting Ground Water Use
- Enforcing Well Abandonment Procedures

The Hill Country Underground Water Conservation District has been organized in Gillespie County. This district has worked closely with the City of Fredericksburg and Gillespie County in the preparation of the Regional Water Management Plan.

SECTION 2

WATER DEMANDS

One of the main purposes of any Regional Water Plan is to determine the demand for water over the length of the Planning Study. In doing so, population and water use projections should be developed for two alternative growth scenarios representing the high and low series water demand forecasts. These growth-related alternative water demand forecasts should then be assessed for without- and with-conservation scenarios.

In general, the methods developed by the Texas Water Development Board for projecting population and water demands should be used in this study, and modified based on additional water use data and local input. At this time demand forecasting may be prepared and analyzed for the following categories of water use:

- **Municipal Water Demand**, which includes quantities of fresh water used in homes, offices, public buildings, restaurants, and stores for drinking, food preparation, bathing, toilet flushing, clothes laundering, lawn watering, car washing, air conditioning, swimming pools, fire protection, street washing, and other sanitation and aesthetic uses.

- **Irrigation Water Demand** is the water required to meet consumptive use requirements of agricultural crops cultivated in the study area.

- **Mining Water Demand** is the water used in sand and gravel washing operations and in the recovery of oil and gas.

- **Livestock Water Demand** is the water required for drinking and sanitation associated with various livestock operations including: beef cattle, dairies, swine, sheep, goats, and poultry.

- **Manufacturing Water Demand** is the water used in the normal operation of an industry for cooling water, process/product makeup water, sanitation, and landscaping.

- **Steam Electric Demand** is the water needed to replace steam or induced evaporation generated through the operation of boilers, cooling the generation equipment and for general plant uses.

Per Capita Demands

Per capita demands, or the average volume of water used in gallons per person per day is multiplied by the population to arrive at **water demand**. For the purpose of the Regional Water Management Plan, evaluation of historical demands in relation to:

- Accepted Norms
- Water Conservation Goals
- Economic Impacts

should be made.

Municipal Demands

Municipal water use requirements are based on projected population and per capita water use. Data reported by suppliers of municipal and commercial water can provide the necessary information to compute historical per capita water use for the planning area. Per capita water use for the high series forecast should consider the highest recorded per capita water use for each supplier and should reflect demands during periods of below average rainfall conditions, while the low series forecast would reflect per capita water use representative of average rainfall conditions.

Irrigation Demands

Irrigated agricultural water requirements depend on the acreage that is currently in irrigated production, the current water usage per acre, water costs, and the availability of water supplies. Projections of irrigation water needs should reflect quantities of water associated with typical Texas irrigated farming operations, including regional water supplies and cropping patterns.

Mining Demands

Mining water requirements are based on water use coefficients. These coefficients are representative of each type of mining operation in the region, historical national and state trends in mineral production, and reflects substitutions of mineral fuels for energy production.

Livestock Demands

Livestock water use rates for the different classes of livestock are developed using animal nutrition data to determine daily water requirements and livestock census information. Water use rates and forecast of livestock production should provide the basis for estimating future livestock watering needs.

Manufacturing Demands

Manufacturing water use is estimated using national and state wide growth outlooks developed for each industrial category in the state, historical water use, known facility expansions or construction, the industry base of the county, and potential savings through recirculation and approved water use technology. Based on the different sets of potential growth patterns, high and low series of future manufacturing water use should be developed for each industry in the County.

Steam-Electric Demands

Steam-Electric power generation future water needs are based upon forecasts of power demands, fuel sources used for generation, cooling technology, and plans for expanding power generating capacity identified by the industry. The high and low series should be based upon high and low series projected population and industrial growth reflected in future residential, industrial, and other power demands.

Supply Forecasting

The allocation of future water demands to available supplies should first be analyzed at the City and County levels. Water supplies used should include existing or under-construction reservoirs, locally available groundwater, and projected municipal and industrial return flows.

Surface Water Resources

The purpose of surface water resources is to review existing surface water supplies available to serve the water supply needs of Gillespie County, review any additional surface water supplies that may be available from the Pedernales River, and any limitations that may be imposed on the supply, with consideration of instream flow requirements and water quality.

The natural flows of the surface water streams of the State of Texas are subject to the use under an appropriation system managed by the Texas Water Commission. A permit must be obtained from the Texas Water Commission in order to divert or store surface water. A priority of use (Municipal, Agricultural, Industrial) and a priority in time (first in time-First in right) has developed. The surface water rights in each river basin have been adjudicated and are reviewed periodically by the Texas Water Commission. This process **confirms existing water rights or in instances where water rights have not been utilized to the fullest extent, cancels them to make water to new users available** which utilizes the resource to the greatest benefit without impeding the existing right of other users.

Water availability from all major existing or under-construction reservoirs should be calculated based on either the defined firm annual yield (which is the maximum quantity of water that can be withdrawn from a reservoir each year, on a dependable basis, during a repetition of the most critical drought of record) or the supplies that could be developed under the operating mode of the supply source during drought conditions.

The volume of surface water supplies projected to be available for beneficial use would include the firm annual yield of reservoirs, direct runoff of rainfall, and springflow during the worst year of the critical drought. The available supply from a reservoir to be used in this analysis should be the smaller of the calculated yield, or the water rights issued for the reservoir. Return flows, defined

as discharges into rivers and streams from municipal and industrial wastewater treatment plants and industrial recirculation facilities, should also be used as surface water supply sources, whenever appropriate.

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GROUNDWATER RESOURCES

This section summarizes and evaluates the ground water resources available in Gillespie County. This information should be used to evaluate the total water resources available in Gillespie County, and provide a basis for ground water modeling efforts which will be used to further define ground water limitations.

Another element of this section would be to evaluate and quantify ground water resources to determine if any limitations to the development of a **conjunctive management** system might exist.

Determination of ground water resources will rely heavily on the following:

- ❑ Texas Water Development Board Reports
- ❑ Texas Water Commission Well Records
- ❑ Bureau of Economic Geology Reports
- ❑ Hill Country Underground Water Conservation District Water Levels and Analytical Data
- ❑ City of Fredericksburg Public Utility Records
- ❑ Private Consultant Reports
- ❑ Data derived from this study

The estimate of the groundwater supply capability within the region should be based on the determination that some form of groundwater management program should be instituted within the region where it is prudent to do so. The Texas Water Development Board recommends that in areas where natural recharge of the aquifer is significant, and in some areas where it is currently believed that ground water can be mined from storage without causing harm to the aquifer or users, ground water supplies should be allocated on a "Safe-Yield" basis. However, in parts of West Texas and in the High Plains where natural recharge aquifers is negligible and ground water "mining" or withdrawals in excess of natural recharge is necessary and practical, ground water should be presumed to be mined at a decreasing annual rate, according to the hydrologic capabilities of the aquifers.

Both existing and projected ground-water supplies should be utilized, in many cases, in **conjunction with surface water supplies and facilities**, particularly where such coordinated operation of water supply facilities would be expected to lower the cost of providing adequate water supplies.

The Texas Water Development Board, in conjunction with ground-water districts and other local ground water interests, is initiating efforts to update it's information relating to groundwater, storage, natural rates of recharge, and appropriate best management techniques for use in the Board's on-

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WATER RE-USE

The City of Fredericksburg operates a wastewater treatment plant which serves the City of Fredericksburg immediate area. The plant effluent is currently discharged into Barons Creek, which enters the Pedernales River immediately downstream.

The City of Fredericksburg also uses the plant effluent to irrigate the City Golf Course. The Golf Course has existing holding ponds which hold the effluent until ready for irrigation, however, the golf course is not capable of consuming all of the city's effluent. Therefore, a considerable amount of water re-use may be obtained from the effluent of the City of Fredericksburg wastewater treatment plant.

Increased supplies of reclaimed water will be available from the Fredericksburg wastewater treatment plant as the City of Fredericksburg grows. Reclaimed water might be used to replace ground water for irrigation and to bring new irrigated acres into production. The City of Fredericksburg owns and operates several city parks and one golf course. These facilities have varying degrees of need for irrigation water, which might be supplied by reclaimed water in the same manner that the golf course is.

The larger parks within the City of Fredericksburg may also be considered for installation of conveyance piping to deliver water to each facility. The smaller parks would be economical to serve with reclaimed water, only if they were adjacent to the conveyance line to the larger parks.

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WATER CONSERVATION
AND
DROUGHT MANAGEMENT PLAN

CITY OF FREDERICKSBURG

Prepared for the

CITY OF FREDERICKSBURG

By the

HILL COUNTRY UNDERGROUND WATER CONSERVATION DISTRICT

March 1992

WATER CONSERVATION AND DROUGHT MANAGEMENT PLAN

CITY OF FREDERICKSBURG

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WATER CONSERVATION AND DROUGHT MANAGEMENT PLAN

FREDERICKSBURG, TEXAS

CHAPTER 1

1.1 INTRODUCTION

The City of Fredericksburg is a Home Rule City operated with a Mayor/Council form of government in which a Mayor and four Council members are elected from the general public. All matters relating to City activities are approved by the Council. The City Manager ensures all work approved by Council is carried out.

The City of Fredericksburg provides water to approximately 2918 customers inside the city limits and to 235 customers outside the city limits. All water is obtained from nine water wells. Six wells produce water from the Ellenburger Limestone which comprises approximately 85% of the City's total production. Three Hickory Sandstone wells make up the difference and are used during peak demand months.

From the summer of 1989 to the summer of 1991, the city imposed water rationing. This was in response to water demand surpassing the City's capibility to deliver water through the distribution system and the subsequent decline in water levels in the City Ellenburger Water Field, located along the Old San Antonio Road. In that aquifer, water is derived from cavities located within an interval thirty to fifty feet from the top of the formation. Since 1989, pumping levels have fallen within this cavity zone during the summer months. This along with the population growth and water demand projections for the City of Fredericksburg (Appendix 1), has necessitated the development of a water conservation/drought management plan.

The Water Conservation Plan involves the implementing of permanent water use efficiency or reuse practices, while the Drought Management Plan established temporary programs designed to be used only as long as a water emergency exists.

1.2 GOALS

The goals of this plan will be the following:

- To limit annual water production to the point that water levels will not drop into the cavity zone of the Ellenburger aquifer. At present, it appears that if annual production from the six Ellenburger wells is limited to less than 600 million gallons, then water levels should, under average rainfall conditions, remain above the cavity zone.

- Achieving a significant reduction of water usage through a water conservation/drought management plan will provide a cushion before any additions to water service facilities are in place.

1.3 UTILITY EVALUATION

The following utility evaluation is provided as an aid in evaluating the potential effectiveness of the proposed conservation measures:

WATER SUPPLY AND DISTRIBUTION SYSTEM INFORMATION

A. Population of Service Area 7,500

B. Size of Service Area 4.54 (Sq.mi.)

C. Water Production and Sales Information

(1) Water Supplied (water produced from your own wells, diverted and treated from a lake or stream, purchased from another utility, etc.) during the Last Year 701,267,000 (gal/yr)

(2) Average Water Supplied for Last 3 years 745,419,667 (gal/yr)

(3) Estimated Monthly Water Sales by User Category for the Last Year in 1,000's of gallons (based on customer meters)

Month	Residential	Institutional	Industrial	Total
January	22,789.700	13,225.600	2,775.300	38,790.600
February	16,645.000	9,674.300	4,039.600	30,358.900
March	24,949.200	11,951.300	6,059.100	42,959.600
April	31,731.600	16,724.300	5,852.400	54,308.300
May	30,348.400	16,900.600	5,823.700	53,072.700
June	37,449.700	20,850.400	5,354.700	63,654.800
July	40,710.500	20,807.100	6,644.800	68,162.400
August	53,244.900	27,967.200	6,045.600	87,257.700
September	24,456.700	14,879.300	6,326.700	45,662.700
October	35,719.200	19,368.800	6,643.100	61,731.100
November	20,075.900	12,449.800	5,551.100	38,076.800
December	21,166.500	13,538.000	5,829.400	40,533.900
Total	359,287.300	198,336.700	66,945.500	624,569.500

(4) Highest Daily Water Use (production) on Record for System
4,077,000 (gal/day)
August, 1985

(5) Peak Daily Use (production) for the Last Year
3,019,000 (gal/day)
(August)

(6) Unaccounted for Water
(Production - Sales) ÷ production x 100 = 10.94%
Unaccounted for water

D. Number and Type (Residential, Commercial, or Industrial) of Meter Connections in Service Area
3228 (Res.) 605 (Comm.) 1 (Ind.) 0 (Wholesale)

E. Net Gain/loss of New Connections per year
(New Connections less disconnects)
36 (Res.) 20 (Comm.) 0 (Ind.) 0 (Wholesale)

F. Source of Water (List the sources and relative volumes of water used from each source on an annual basis)

Source 1. Wells Volume of Water 701,267,000 (Gal/yr)

G. Safe Annual Yield of Water Supply ? (Gal/yr)

H. Design Capacity of Water System 4,000,000 (Gal/day)

I. Major High-Volume Customers

	NAME	USE (in 1,000 gallons per year)
1.	Sunday House Foods	66,945.5
2.	Lady Bird Johnson Park	22,928.1
3.	Fredericksburg Public School	13,605.7
4.	Hill Country Mem. Hospital	8,001.6
5.	City of Fredericksburg (multiple meters)	7,169.3
6.	Knopp Nursing Home # 1	6,830.6
7.	City of Fredericksburg Sewer	6,667.6
8.	Gillespie Co. Fair Assoc.	5,653.0
9.	Browns Rest Home	4,245.6
10.	Fredericksburg Nursing Home	3,966.0

CHAPTER 2

WATER CONSERVATION PLAN

Chapter 2 comprises the various facets which make up the water conservation plan. A water conservation plan is a report that describes the methods and means by which water conservation is to be achieved. The various methods are employed throughout the year regardless of water demand.

The plan employs the following nine methods to ensure a successful year round water conservation program:

2.1 Public education and information program
2.2 Water conservation plumbing and plumbing retrofit program
2.3 Water Conservation Rate Structure
2.4 Universal metering and meter repair/replacement program
2.5 Water Audits and Leak Detection
2.6 Water Conserving Landscaping and Watering
2.7 Summer Lawn Watering Conservation Program
2.8 Recycling and Reuse
2.9 Plan Implementation and Enforcement

2.1 PUBLIC EDUCATION AND INFORMATION PROGRAM

The City of Fredericksburg is in a portion of Texas which receives on the average 28" of rainfall per year (Appendix 2). The years in which water rationing was imposed were years that received average to slightly below than average rainfall. Consequently, public education as to the need to practice water conservation is a very important component to this plan, especially since this area in the past has experienced very severe droughts (i.e. 1956 received only 11.3").

The City and the Water Conservation District will promote water conservation by informing the public of ways to conserve water. The following are examples of programs that will be utilized:

- A letter to all customers explaining the new water conservation/drought management plan will initially be sent
- An article in the local newspaper will appear explaining the plan
- Regular articles will appear in the local paper concerning water conservation
- Customers who are regularly high water users will be contacted and provided with water conservation information
- New customers will receive general conservation information when applying for service
- Approach the City's commercial customers about ways to reduce water usage. For example, restaurants could conserve water by providing water only to their customers who request it.
- Public speaking programs promoting water conservation will be given to civic groups. A significant portion of the groundwater hydrology course given annually by the Water Conservation District in

conjunction with the community Education Program will highlight the need for water conservation.

- Programs such as Water Conservation Week will be utilized as a water conservation promotion. This would include newspaper articles and public service announcements aired on the radio.

2.2 WATER CONSERVATION PLUMBING AND PLUMBING RETROFIT PROGRAM

As of January 1, 1992, Texas law (Senate Bill 587) requires that only water conserving plumbing fixtures be manufactured, imported or supplied for sale in Texas. By September 1, 1992, labels with estimated water use for the fixtures will be required.

The maximum water use standards for specific types of fixtures are as follows:

Toilets	1.6 Gallons per flush (GPF)
Wall-mounted toilets	2.0 GPF
Shower Heads	2.75 Gallons per Minute (GPM)
Faucet aerators	2.2 GPM
Urinals	1 GPF

The City will adopt these standards in their plumbing code. The City will also inform and encourage customers of using water efficient appliances. Water conservation dishwashers which use only 6 gallons per load are now available. Efficient clothes washing machines use only 35 gallons per load, where as the average machine uses 45 to 55 gallons per load. The public will be informed of these water efficient appliances and encouraged to use them.

The City has participated with the Lower Colorado River Authority in distributing water saving plumbing retrofit devices. This program should be continued on a permanent basis. This would ensure that all plumbing fixtures, whether they are new or old, would eventually be water conserving. The hotel/motel industry will be advised of the benefits of retrofitting existing plumbing fixtures.

2.3 WATER CONSERVATION RATE STRUCTURE

As of January 23, 1992, the City has implemented a new water rate pricing structure which will encourage water conservation. The old rate was based on a declining block structure and is as follows:

Inside City Limits:

First 2,000 Gallons	$3.00 min.
Next 18,000 Gallons	$0.75/1000 gal.
Over 20,000 Gallons	$0.65/1000 gal.

Outside City Limits:
Double the above rates

The new rates are based on an increasing block schedule and are as follows:

RESIDENTIAL MONTHLY RATE

0-2000 gallons	$ 3.65 min.
2,001-15,000	$ 0.75/1000 gal.
15,001-25,000	$ 1.00/1000 gal.

25,001-30,000	$ 1.25/1000 gal.
30,001-40,000	$ 1.50/1000 gal.
over 40,000	$ 2.00/1000 gal.

Outside City Limits is double the above rates

GENERAL SERVICE COMMERCIAL MONTHLY RATE

0-2000	$ 5.00 min.
over 2000	$ 0.70/1000 gal.

Outside City Limits is double the above rates

INDUSTRIAL MONTHLY RATE

Service exceeds 2 million gallons/month
Next 11 months exceed 2 million gallons/month

0-2000	$75.00/min.
over 2000 gal.	$ 0.70/1000 gal.

Outside City Limits is double the above rates

2.4 UNIVERSAL METERING AND METER REPAIRS/REPLACEMENT PROGRAM

The City is 100 percent metered; however, some water usages such as fire hydrants go unmetered. The City has a policy of testing all meters which appear to have abnormally high or low water usage.

The City has established the following meter testing and replacement schedule:

- Production meters - tested once a year
- Meters larger than 1" - replaced every ten years
- Meters 1" and smaller - replaced every seven years

2.5 WATER AUDITS AND LEAK DETECTION

The Water Conservation District conducted a water audit for the year 1991 (Appendix 3). This audit broke out the various commercial users along with the residential. This audit will be conducted on an annual basis and includes an unaccounted for water loss evaluation.

The City in the past has performed leak detection surveys in conjunction with LCRA, in which a sonic leak detection device was used. This leak detection survey will be run on a periodic basis and additionally, should the annual audit identifies an increase in unaccounted - for water loss.

2.6 WATER CONSERVING LANDSCAPING AND AUTOMATIC LAWN SPRINKLERS

Water Conserving Landscape literature is available from the City, the Water Conservation District and the County Agricultural Extension Office. The Gillespie County Agricultural Building has been landscaped using native shrubs and ground covers. This serves as a xeriscape demonstration project. In addition, the city will use low water tolerant landscaping plants as much as possible on public grounds to limit water usage but also to serve as an example for the general public. The City has a building ordinance that requires a certain amount of green space on commercial developments. The City will encourage that low water tolerant plants be utilized wherever possible to satisfy this green space requirement.

The Water Conservation District conducted a survey of households with automatic lawn sprinklers. The survey computed annual water usage prior to the installation of the system as well as water usage after installation. This survey is shown on Appendix 4. The results indicate that average annual water usage after sprinkler installation increased by 28%. Additional surveys of this nature will be done by the City and the Water Conservation District.

In the future, any customer who applies for a building permit for an automated water sprinkler will be advised that their water usage may increase and that the automatic cycling should be set so that no more than 1" of water is applied per week. Sprinkler gauges will be available to aid in determining how long the system should be allowed to run to provide 1" of water.

The automated water sprinkler installers will also be advised of the survey results and provided with sprinkler gages to aid in the setting of the water cycles.

2.7 SUMMER LAWN WATERING CONSERVATION PROGRAM

Each summer between the months of June through September, the City will promote a summer lawn watering conservation program. The program will be voluntary until the trigger conditions outlined in the following Drought Management Plan are reached, then it will become mandatory. The program is designed to create a mind set for conserving water throughout the summer months, whether drought conditions are present or not. This should help to flatten the peak demand curve which normally develops under mandatory rationing measures.

The program would be structured so that people could water their lawn on specified days of the week based on the last digit of their street address. The last digit of the address will correspond to the following days for which lawn watering may occur.

Last digit of the address	Lawn Watering Day
0 - 3	Tuesday & Saturday
4 - 7	Wednesday & Sunday
8 - 9	Thursday & Saturday

This will allow for watering at least twice a week. If this schedule is followed, the quality of lawns will improve since this will promote deeper root penetration. Those customers with automatic sprinklers should be encouraged to switch their system from automatic to manual, so that the twice weekly watering schedule can be followed. Watering should occur only between the hours of 7 p.m. and 10 a.m.

2.8 WATER RECYCLING AND REUSE

The city has recently changed from using ground water to recycled water for watering the City's golf course. This has had the immediate savings of over 20 million gallons used annually on the City's nine hole golf course. However, an additional future savings will be seen beginning in the summer of 1992 when the course is expanded to eighteen holes.

In addition, the City will study where recycled water could be appropriately used for other landscape irrigating applications, (i.e. racetrack, cemeteries).

2.9 PLAN IMPLEMENTATION AND ENFORCEMENT

The plan will be adopted by the City Council. The City Manager and his staff will oversee the

execution and implementation of all elements of the plan. He will also be responsible to oversee the keeping of records for program verification.

The plan will be implemented by the following documents:

- A resolution by the city stating its water conservation goal through the adoption of this plan

- An Ordinance by the City which will provide the necessary legal documents to enforce this water conservation plan

The Resolution and Ordinance adopted by the City Council may be found in Appendix 5 and 6.

Any contract with another political subdivision of the state of Texas will be approved only if that entity adopts the City of Fredericksburg's Water Conservation and Drought Management Plan.

CHAPTER 3

DROUGHT MANAGEMENT PLAN

A Drought Management Plan is an emergency water demand management plan which includes measures to be implemented to cause a significant, but temporary, reduction in water use due to drought conditions. Other uncontrollable circumstances that can disrupt the availability of a City's water supply are contamination or disaster. There is a significant difference between a drought management plan and a water conservation plan. Water conservation involves the implementing of permanent water use efficiency or reuse practices, while the Drought Management Plan establishes temporary programs designed to be used only as long as a water emergency exists.

This Drought Management Plan includes the following programs:

3.1 Trigger conditions which indicate when the necessary drought contingency measures will be put into effect

3.2 Drought contingency measures

3.3 Education and information concerning when initiation procedures for contingency measures are met

3.4 Termination notification

3.5 Means of Implementation

3.1 TRIGGER CONDITIONS

The City receives the bulk of its water from the Ellenburger Limestone aquifer. At the City's water field, the Ellenburger limestone is encountered at approximately 90' below land surface. The water is produced from cavities located within an interval 30' to 50' from the top of the formation. The trigger conditions will be based on the pumping level in relation to the cavity zone in the Boerner # 5 well, which is the largest water producing well in the field. The cavity zone in the Boerner # 5 well is encountered at -120' and extends to -140'. Trigger conditions will be set for moderate and severe conditions. During times of drought, the well will be monitored frequently.

MODERATE CONDITIONS - Pumping levels in the Boerner # 5 will fall within -115' and -125'

SEVERE CONDITIONS - Pumping level in the Boerner # 5 falls below -125'

3.2 DROUGHT CONTINGENCY MEASURES

Drought contingency measures will be used to flatten the peak demand curve as required by the drought conditions.

Moderate Conditions

When the trigger conditions indicate moderate drought conditions have been reached. The City Manager can restrict the use of water through the following:

- Notify the public through the news media that the trigger condition

for moderate drought conditions have been reached. Steps will be provided which will allow for the reduction of water use.

- Major commercial water users will be notified of the situation and request to voluntarily reduce water use.

- As moderate conditions intensify, mandatory lawn watering schedules will be implemented. The two day watering cycle outline in Section 2.7 of the Water Conservation Plan will become mandatory. Watering shall occur only between the hours of 7:00 p.m. to 10:00 a.m.

- Waste of water will be prohibited. Water waste will include water from landscape irrigation or other uses to escape into gutters, ditches, streets, sidewalks and other surface drains. Waste of water will also include the failure to promptly repair a leak due to detective plumbing after it is discovered, along with any other obviously wasteful uses as determined by the City.

- Penalties for noncompliance with any of the drought contingency measures will be set by the Council and enforced by the City.

Severe Conditions:

Under sever conditions, the City Manager may further restrict or ban the use of water totally for outdoor purposes. When the trigger condition indicates that severe drought conditions have been reached, the City Manager will implement the following:

- Notify the public through the news media that the trigger conditions for a severe drought have been reached. The public will be advised daily of the trigger condition.
- Outdoor water usage such as lawn and shrub watering will be further restricted or totally banned.
- Car washing prohibited except when a bucket is used.
- Private swimming pool filling may be banned.
- Public water uses not essential for public health or safety may be prohibited.

3.3 EDUCATION AND INFORMATION

Once Trigger Conditions and emergency measures have been reached. The public will be informed of the conditions and measures to be taken. The process for notifying the public includes:

- Posting the Notice of Drought conditions
- Notifying the local radio station & cable TV
- General circulation to the local newspaper

The public will be informed about the drought contingency plan periodically through the education and information activities of the long-term water conservation program.

3.4 TERMINATION NOTIFICATION

Termination of the drought measures will take place when the Trigger Condition which initiated the drought measures have subsidized, and an emergency situation no longer exists. The public will be informed of the termination of the drought measures in the same manner that they were informed of the initiation of the drought measures.

3.5 MEANS OF IMPLEMENTATION

The City Manager will be responsible for administering the drought contingency plan. The City will adopt a drought contingency resolution that (1) provides the city with the pre-assigned authority to implement any or all of the mandatory water use restrictions from the approved drought contingency plan whenever a specified trigger condition is reached and (2) provides enforcement procedures and penalties for noncompliance with the restrictions.

1992 WATER AUDIT
OF THE
CITY OF FREDERICKSBURG'S
WATER DEMAND

Prepared by the Hill Country Underground
Water Conservation District

INTRODUCTION

This report presents a water audit of the total water supplied by the City of Fredericksburg. The total amount supplied has been broken down by category and the water usage of these various categories is presented in the tables below. In addition to 1992 water usage, a comparison to 1991 water usage is also given. This comparison provides an increase or decrease in gallons that each category used in 1992 as compared to that of 1991. This increase or decrease in water usage is also presented as a + \- percentage.

Category	Table
Summary of All Water User Categories	I
Residential Water Use	II
Food Processing Water Use	III
City, County, Public Facility Water Use	IV-A, IV-B, IV-C
Non-Water Dependent Commercial Water Use	V
Hospital/Nursing Home, Clinic Water Use	VI
Motel Water Use	VII
Restaurant Water Use	VIII-A, VIII-B
School Water Use	IX
Water Dependent Water Use	X
Church Water Use	XI

DISCUSSION

In 1992, a total of 678,195,540 gallons of water were metered for sale across Fredericksburg. This represents a 3% increase over 1991, when 655,916,184 gallons were sold (Table I). This 3% increase amounts to 22,279,356 gallons of water. This increase occurred in a year when near record amounts of rainfall occurred (40.63").

The greatest increase in water use occurred in the residential category. A 6% increase in water use occurred in 1992 over that used in 1991 (Tables I & II). This increase amounted to 24,033,876 gallons.

The other categories which recorded increase water use over the previous year included:

Non-Water Dependent Ind.	+ 4,388,160 gal. (+ 11%)	Tables I, V
Motel	+ 3,520,812 gal. (+ 19%)	Tables I, VII
Restaurant/Industrial	+ 6,227,304 gal. (+ 34%)	Tables I, VIII A&B

The increase in these three categories are all probably related and due to an increase in the amount

of tourism in Fredericksburg.

The remaining eight categories (Table I) identified in this audit showed a decrease in water usage in 1992 as compared to 1991. The City, County and Public Facility had a 14% decrease in water (7,515,936 gal.) usage in 1992, which can be attributed in large part to the use of treated water to irrigate the golf course. A savings of 15,479,100 gallons was seen at Lady Bird Johnson Park in 1992, where treated water was used to irrigate the golf course (Table IV-B). However, the City of Frederickburg and the Pedernales Youth Soccer recorded substantial increases in their water usage in 1992. Fredericksburg used 5,311,212 gallons more in 1992 than in 1991, a 73% increase, and the Pedernales Youth Soccer Association used 1,488,948 gallons more in 1992, which represents a 237% increase over 1991. Both increases are apparently due to the irrigation of soccer fields. Table IV-C lists all the City's meters and the amount of water used for 1992 and 1991 along with a comparison.

RECOMMENDATIONS

The following provides some suggestions which may be used to reduce water usage in the areas where an increase in demand was recorded in 1992.

Residential

1) The high residential water users should be tagged and contacted either by letter or some other form of mail out and notified of their high water use. An evaluation of their water use should be attempted and the user advised of any water conservation methods available which will help in lowering their water requirements.

2) Implementation of the lawn watering conservation program outlined in the Water Conservation/Drought Management Plan provided for the City.

3) Review of water rate structure.

4) Promotion of plumbing retrofit programs and water conserving landscaping.

Tourism

1) Contact all motels and promote plumbing retrofiting for showers, faucets and toilets.

2) Contact all restaurants and promote plumbing retrofiting for all restrooms and kitchens.

3) Encourage restaurants to serve water only on request.

City, County and Public Facility

1) The increases in water usage in this category results mainly from irrigation. All irrigation by City, County or Public Facilities should be monitored very closely. Irrigation should be controlled manually and not on automated timers. Irrigate only when it is necessary and only in the cool hours of the day. Schools, hospitals and churches should also follow these guidelines.

2) Ensure all public facility plumbing is water conserving.

The Hill Country Underground Water Conservation District is available to assist the City in promoting any and all water conservation programs the City wishes to promote.

Paul Tybor
Manager

WATER DEPENDENT INDUSTRIAL WATER USE - 1991

COMPANY	MONTHLY AVG.	ANNUAL TOTAL
V & R Inc. Laundermat	212,191	2,546,292
E. Main Launderette	136,508	1,638,096
Wunderlich	70,899	850,788
George Ready Mix	61,274	735,288
Culligan	49,983	599,796
Kwik Car Wash	47,500	570,000
S & S Car Wash	20,016	240,192
	598,377	7,180,452

NON-WATER DEPENDENT COMMERCIAL WATER USE - 1991

COMBINED MONTHLY TOTAL	COMBINED ANNUALTOTAL
3,202,345	38,428,140

CHURCH WATER USAGE
1991

CHURCH	MONTHLY AVG.	ANNUAL TOTAL
Zion Lutheran	59,772	717,264
Holy Ghost	47,540	570,480
Fredericksburg Bible	47,025	564,300
Fred United Methodist	40,224	482,688
Church of Christ	37,591	451,092
Memorial Presbyterian	34,111	409,332
Bethany Lutheran	32,608	391,296
St. Mary's	27,591	331,092
United Penecostal	26,241	314,892
Emanuel Gospel	19,308	231,696
First Baptist	19,050	228,600
Assembly of God	16,250	195,000
St. Barnabas Episcopal	13,233	158,796
Fbg. Cong. Jehovah	12,233	146,796
Resurrection Lutheran	9,583	114,996
Baptist Spanish	9,450	113,400
New Hope Baptist	6,316	75,792
Our Lady of Guad.	3,500	42,000
Fredericksburg SDA	3,416	40,992
Hill Co. Evang.	2,558	30,696
Living Water	1,800	21,600
Fredericksburg Baptist	1,733	20,796
First Christian	633	7,596
	471,766	5,661,192

SCHOOL WATER USAGE
1991

SCHOOL	MONTHLY AVG.	ANNUAL TOTAL
Fredericksburg Public	1,133,807	13,605,684
St. Mary's	277,513	3,330,156
Fredericksburg Christian	2,941	35,292
	1,414,261	16,971,132

RESTAURANT WATER USAGE
1991

RESTAURANT	MONTHLY AVG.		ANNUAL TOTAL
Andy's	196,199		2,354,388
Friedhelm Baverian	151,725		1,820,700
Mamacita's	132,125		1,585,500
The Gallery	114,195		1,370,340
Golden Corral	108,700		1,304,400
Dairy Queen	98,833		1,185,996
Sunday House Inn	96,191		1,154,292
Plateau	85,625		1,027,500
Sonic Drive-Inn	72,991		875,892
Fenner & Beans	51,433		617,196
Altdorf	51,325		615,900
Austlander	43,150		517,800
Bircks	37,950		455,400
Fredericksburg Cafe	36,666		439,992
Mr. Gatti's	32,716		392,592
Georges German Bakery	29,816		357,792
Pizza Management Inc.	28,575		342,900
Engel's	26,000		312,000
Linden Baun	23,150		277,800
Fredericksburg Bakery	18,233		218,796
Danny's Fried Chicken	17,183		206,196
Deluxe Restaurant	16,750		201,000
Burger Inn	15,891		190,692
Delux Icebox	13,808		165,696
Bunzy's	13,574		162,888
The Cookie Jar		11,941	143,292
Alfredo's	9,916		118,992
Korner Koffee	4,966		59,592
	1,539,627		18,475,524

MOTEL WATER USAGE
1991

MOTEL	MONTHLY AVERAGE	ANNUAL TOTAL
Catering of C. Texas/ Sunday House	319,433	3,833,196
Comfort Inn	191,258	2,295,096
Save Inn	165,183	1,982,196
Econo Lodge	152,775	1,833,300
The Peach Tree	147,432	1,769,184
Sunset Inn	139,074	1,668,888
Tourist, Inc.	104,316	1,251,792
Deluxe Motel	100,083	1,200,996
Dietzel Motel	94,891	1,138,692
Miller Courts	78,316	939,792
Frontier Inn	34,050	408,600
Frederick Motel	24,800	297,600
Barons Creek Inn	16,750	201,000
	1,568,361	18,820,332

HOSPITAL/NURSING HOME/CLINIC WATER USAGE - 1991

ESTABLISHMENT	MONTHLY AVG.	ANNUAL TOTAL
Hill Country Mem. Hosp.	666,798	8,001,576
Knopp Nursing # 1	569,181	6,830,172
Browns Rest Home	353,799	4,245,588
Fbg. Nursing Home	330,500	3,966,000
Knopp Nursing # 2	264,094	3,169,128
Fredericksburg Clinic	111,016	1,332,192
Dr. Raleigh A. Smith	28,560	342,720
Dr. Michael Jones	26,425	317,100
Dr. Tim Barsch	13,866	166,392
Keidel Mem. Hosp.	12,250	147,000
Cornerstone Clinic	8,400	100,800
Dr. John S. Hoerster	8,041	96,492
Mid-Tex Health Care	5,241	62,892
Dr. Steve Kroger	4,866	58,392
Dr. Phillip Kothman	2,166	25,992
Kerrville State Hospital	600	7,200
	2,405,803	28,869,636

CITY, COUNTY & PUBLIC FACILITY WATER USAGE - 1991

ENTITY	MONTHLY AVG.		ANNUAL TOTAL
Lady Bird Johnson Park	1,910,675		22,928,100
City of Fredericksburg	597,445		7,169,340
City of Fbg. Sewer	555,633		6,667,596
Gillespie Co. Fair Assoc.	471,083		5,652,996
City of Fredericksburg Water	161,300		1,935,600
Nimitz Center	153,811		1,845,732
St. Mary's Cemetary	137,285		1,647,420
Greenwood Cemetary	112,033		1,344,396
Gillespie Co. Historical Soc.		65,629	787,548
Ped. Youth Soccer	52,458		629,496
Gillespie Co. Courthouse		42,000	504,000
Texas Highway Dept.	37,266		447,192
Gillespie Co. Law Enf.	34,708		416,496
U. S. Post Office	33,025		396,300
Central TX Elect. Coop	26,966		323,592
Gillespie Co. Farm Bureau	17,833		213,996
V.F.W.	17,800		213,600
American Legion	13,216		158,592
Gillespie Co.	12,216		146,592
Gillespie Co. Com. on Aging	9,175		110,100
Texas Dept. of Human Res.		7,866	94,392
Ft. Martin Scott	5,716		68,592
Fredericksburg Chamber	5,075		60,900
Fredericksburg Gene. Soc.	800		9,600
	4,481,014		53,772,168

FOOD PROCESSING WATER USAGE
1991

COMPANY	MONTHLY AVG.	ANNUAL TOTAL
Sunday House Foods	5,578,791	66,945,492
Fredericksburg Lockers	230,366	2,764,392
Dutchmans Market	52,066	624,792
	5,861,223	70,334,676