VILLAGE OF BEE CAVE, TEXAS

LOWER COLORADO RIVER AUTHORITY

REGIONAL WATER SUPPLY PLANNING STUDY

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1.0 INTRODUCTION

1.1 Background

The Village of Bee Cave has been an active residential and commercial area of western Travis County for over 150 years. A general description of the location of Bee Cave includes the land mass surrounding the intersections of SH 71 West and RM 2244 (Bee Cave Road), SH 71 West and RR 620 South, and SH 71 West and Hamilton Pool Road. Bee Cave is located approximately three (3) miles south of Lakeway and Lake Travis. Bee Cave and Lake Travis are attractive areas for residential and commerical development due to the natural aesthetic beauty, scenic views and proximity to Austin and the Highland Lakes area. Most historic development was oriented toward commercial and retail establishments fronting the primary roadways and large lot single-family subdivisions.

Prior to the 1950's, residents and businesses obtained potable water solely from individual, privately owned wells ranging in depth from 300 feet to 600 feet. During the late 1950's several property owners in Bee Cave organized themselves and created Travis County Water Control and Improvement District No. 14 (WCID No. 14) in conjunction with other land owners along SH 71 West and in Oak Hill, located approximately eight (8) miles to the east of Bee Cave at the junction of SH 71 West and US 290 West. This arrangement provided water to virtually all of the commercial establishments along SH 71 and several of the area residences. WCID No. 14 purchases treated, potable water on a wholesale basis from the City of Austin for distribution and retail sale to WCID No. 14 customers. This system worked reasonably well until the growth boom of the early to mid 1980's absorbed virtually all of WCID No. 14's service capacity west of the Oak Hill area.

At the same time, more single-family subdivisions were being platted and developed in the Bee Cave area. These subdivisions relied solely on groundwater and individual wells for potable water supply because most of the properties were not within WCID No. 14's boundaries and, even if they were, the water district did not have the capacity to provide service. In 1988, many of

the wells in Bee Cave began going dry. The potential health hazards associated with this situation, coupled with the realization that no water suppliers in the area were prepared to provide water to the citizens in need, created the impetus for the Village of Bee Cave, the Lower Colorado River Authority (LCRA) and Texas Water Development Board (TWDB) to prepare this regional water supply planning study.

The need for an adequate and dependable supply of potable water for Bee Cave and surrounding areas has been recognized for several years by community leaders, property owners and water suppliers. In recent years, several proposals have been brought forward to establish regional water service for this area. For several years the City of Austin has been interested in providing water and wastewater service in the southwest Lake Austin and Lake Travis areas, primarily as a means to manage development intensity in some areas. For many reasons, high capital costs and small customer base being primary among them, however, the City of Austin has been unable to successfully extend water service to the Bee Cave area. WCID No. 14, as discussed above, has provided water to a portion of Bee Cave since 1959. WCID No. 14 has proposed to assist in improving existing service to the area but is not in a position to substantially serve the remainder of Bee Cave and other properties in Bee Cave's extra territorial jurisdiction (ETJ) without massive, high capital cost expansions of its pumping, transmission and storage facilities. WCID No. 17 has expressed a level of interest and willingness to serve the area as has the Uplands Water Supply Corporation (UWSC), a private water supply company.

In 1984, the LCRA conducted the Lake Travis West Regional Water and Wastewater System Feasibility Study. This effort evaluated the potential for LCRA providing regional water and wastewater service for a very large area in Travis and Hays Counties including all of Bee Cave and its surrounding area.

Several alternatives and concepts for a regional water system were presented and evaluated. However, a lack of municipalities or other governmental entities in the area made it extremely difficult to identify specific methodologies for implementation of the plan. In the intervening years, Bee

Cave was incorporated and several MUDs and WCIDs were created in the region. The advent of these governmental agencies with which LCRA can develop contractual and financial relationships, combined with the need to resolve an immediate problem, makes it possible for the Bee Cave - LCRA regional water system to become a reality.

Bee Cave, because of the acute water needs of many of its citizens, has taken a joint leadership position with LCRA in addressing the water needs of the area. In this report, solutions to the water needs of the study area are discussed within three (3) planning horizons: 1) a short term or immediate time frame that deals with solving the water supply problems of the Bee Cave West subdivision and other properties on the western end of Bee Cave where non-producing wells may pose public health problems; 2) an intermeditae horizon thta includes, and is consistent with providing Bee Cave citizens with a single, reliable source of potable water and; 3) a long term outlook that includes Bee Cave and its ETJ and the participation of this area in a regional potable water supply system.

1.2 Citations of Authority

Implementation of a water supply plan and system for the study area will require the involvement and leadership of the entities with authority to provide utility services. The Village of Bee Cave was incorporated in August, 1987 under the provisions of Title 2 - Chapter 9 of Vernon's Local Government Code. LCRA is a political subdivision created by the LCRA Act of the Texas Legislature in 1934. Both LCRA and Bee Cave possess the legal authority to plan, develop and operate water and wastewater facilities within the study area and thus implement the recommendations put forth in this planning study. The Village of Bee Cave is empowered with the authority to plan, develop and operate a water system under Vernon's Local Government Code Title 13 - WATER AND UTILITIES CHAPTER 402. MUNICIPAL UTILITIES SUBCHAPTER A. PUBLIC UTILITY SYSTEMS IN GENERAL.

402.001 Municipal Utility Systems; General Powers

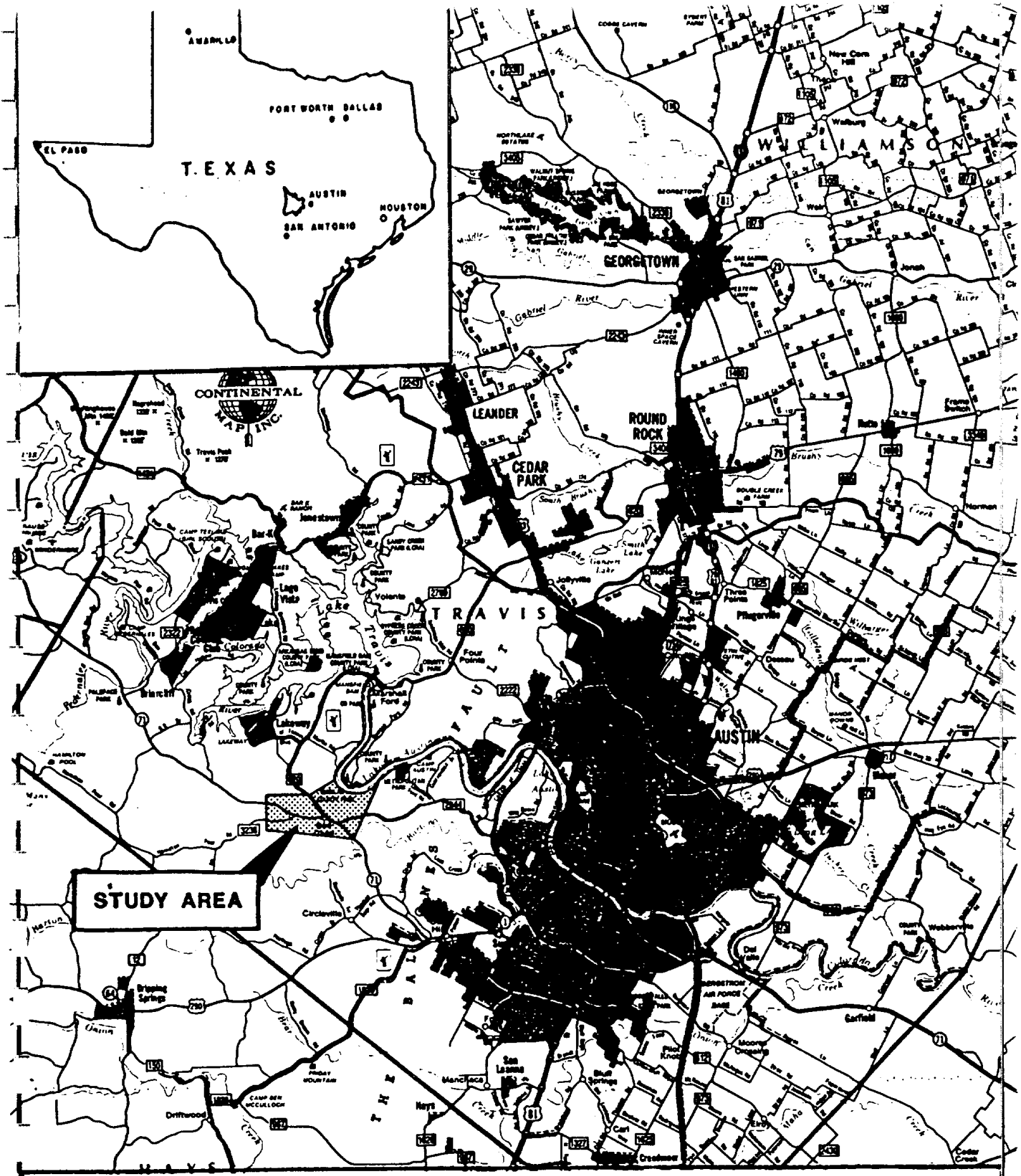
(a) In this section, "utility system" means a water, sewer, gas or electricity system.

(b) A municipality may purchase, construct or operate a utility system inside or outside the municipal boundaries and may regulate the system in a manner that protects the interest of the municipality.

LCRA is empowered to plan, develop and operate water systems under its enabling legislation and various policies as adopted by the LCRA Board of Directors.

At present, Bee Cave has 1,280 acres within its corporate limits. House Bill No. 2884 enacted by the 71st Legislature, Regular Session, granted Bee Cave a one-mile ETJ constituting an area of approximately 10,200 acres. This created a regional water supply planning area of approximately 11,500 acres or 18 square miles. The initial planning grant application envisioned a service area of approximately 6,500 acres. The latter area will still hold true for water demand planning and projections because much of the additional 4,000 acres is subject to having potential water service from other suppliers such as the Uplands Water Supply Corporation. Also included within the ETJ and this study area are West Travis County MUDs 3, 4 and 5 (Bohl's Ranch) and the Homestead subdivision as well as the area between Bee Cave and the boundaries of WCID No. 17.

Figure 1 indicates the location of the regional water supply planning area in relation to Bee Cave, Lake Austin and area highways. Boundaries of other governmental entities and developments relative to Bee Cave's corporate limits, one mile ETJ and proposed ETJ to be negotiated with the City of Austin are depicted in Figure 2.



VILLAGE OF BEE CAVE - LCRA

REGIONAL WATER SUPPLY STUDY AREA

FIGURE 1

2.0 CONCLUSIONS AND RECOMMENDATIONS

The Village of Bee Cave and surrounding areas are located in a suburban setting which is conducive and attractive to continued residential and commercial development and economic growth. Currently, water shortages affect many area residents who rely on groundwater and private wells for potable water. Residents and commercial establishments who receive water service from WCID 14 often experience severe pressure drops and lack of delivery during peak hours and peak days of the summer months. This planning study has identified potential short-term and mid-term solutions to these immediate problems and long-term future programs which will be necessary to provide adequate water service for the health, safety and welfare of the consuming public.

Bee Cave is situated in the Lake Travis, Lake Austin, Barton Creek watersheds which are noted for their environmental uniqueness. Several rare and endangered species have been identified in the overall general area and these, coupled with the sensitivity to preserve and enhance water quality in the aforementioned water bodies will require that great care be taken in the planning and implementation of future water system improvements. The provision of centralized water service can serve as a great inducement to eliminate continued depletion of groundwater in the area as well as be used as a tool to guide development in an appropriate and acceptable manner. Bee Cave, in coordination with the LCRA and its environmental and water service policies will need to recognize and work within these environmental constraints while providing a high quality of domestic and commercial service for potable water, and fire protection.

Environmental conditions of the area are briefly described in this report in Section 11.0 as they relate to the future planning parameters and development guidelines. Future design, construction and operating efforts should be coordinated with other area environmental authorities early in each project life to identify potential areas of concern and mitigation measures in order to avoid possible delays in design approvals and construction of the improvements.

Bee Cave and the LCRA currently impose certain development controls within the planning area. City of Austin development restrictions are in place in those areas outside of Bee Cave and its ETJ. A watershed/water quality ordinance

has been enacted by Bee Cave to comply with the requirements of HB2884. This ordinance is patterned after LCRA water quality policies, rules and regulations and is oriented toward maintaining and/or improving the quality of storm water runoff (non-point source pollution abatement) in post-development conditions. The ordinance has been reviewed and approved by the Texas Water Commission and LCRA. This ordinance, when combined with the proposed zoning ordinance and existing subdivision ordinance, and the availability or lack of centralized wastewater collection, treatment and disposal will have tremendous impact on future development and its potential densities. Of all these concerns and constraints, wastewater service availability will have the greatest effect on area development.

Projections of future development in the regional planning study area have taken into account the above parameters, including the possibilities of centralized wastewater service as well as the dictates of on-site disposal. A secondary consideration of this planning study, although not specifically in the scope of effort, is the provision of centralized wastewater service by a regional provider. Bee Cave and LCRA can and should continue to work together to plan, develop and implement efficient and effective wastewater treatment and disposal options to ultimately enhance the surface water and groundwater quality of the area and surrounding watersheds.

The proposed remedies to the immediate water service problems as well as mid-term and long-term provision of retail water service to the planning area will, by necessity, cause the Village of Bee Cave and LCRA to jointly enter the public utility water business with LCRA potentially being a wholesale supplier of treated water and Bee Cave being the retail distributor. The resulting wholesale/retail water system will be on a par with other medium to large water utilities in the area. Depending on the interest shown and ability of LCRA to assemble other wholesale customers, the future system may serve up to 8,000 to 10,000 Living Unit Equivalents (LUE's) of water demand. At Bee Cave's and LCRA's urging, several existing and proposed, smaller water systems may be merged to expand the service region eastward to Loop 360 and southward toward Fitzhugh Road.

Bee Cave and the surrounding area have a growth potential which is probably greater than the overall Austin SMSA because of the aesthetic qualities of the Lake Travis, Lake Austin and Hill Country areas, proximity to Austin Lake Travis Independent School District, and the ability of landowners and developers to obtain straightforward and consistent application and enforcement of rules, regulations and ordinances. Future growth trends were evaluated in relation to other planning efforts by public and private sector entities to form the basis of predicted future growth and resulting water demand through the year 2020.

There are approximately 200 LUE's of water demand in the planning area today. This is expected to grow to 3,400 LUE's by the year 2020, with most of the growth occurring in the Bohl's Ranch and Homestead areas.

Water consumption trends vary considerably since water sources range from dry wells supplanted by trucked-in water, to normal municipal connections, to WCID 14 system connections. As such, they are not a reliable indication of future consumption patterns. Bee Cave does not have a raw water supply contract from LCRA. But, the Bohl's Ranch, Homestead, Uplands Water Supply Corporation, and WCID 17 do. Any one, or a combination of these could serve to provide short-term and long-term water to Bee Cave. Should LCRA take the steps necessary to be a wholesale provider of treated water, a raw water contract may be available. In any event, applicable state and local water demand planning and design criteria have been utilized to project water needs.

Hand-in-hand with regional water demand is the need to recognize that water is a limited and, therefore, extremely valuable resource. Water conservation will play a key role in the regional plan. LCRA, through its various Board policies regarding water conservation, will require that Bee Cave and its retail customers and any other wholesale customers, enact and enforce water conservation ordinances, rules and regulations. The primary issues of a water conservation plan and drought contingency plan are presented in Section 7.0 of this report. LCRA has already taken a pro-active role in the conservation of the water resources under its jurisdiction. Bee Cave can, and should, take an equally active role through ordinances, plumbing codes, landscape requirements and public education. A successful conservation program can produce benefits

in that more units of demand can be routinely served from major capital facilities such as treatment plants, pump stations, transmission lines and reservoirs which are sized, designed and constructed, assuming that no conservation controls are in place. A concern generated by this potential situation is that water rates per 1,000 gallons may need to be elevated to meet the operations and maintenance expense and debt service of the water system because less water is being sold on a retail basis.

Bee Cave and LCRA are in an excellent position to initiate the first steps of a regional water supply system. Location of a water source to provide service to the Bee Cave West subdivision is the very first and highest ranking priority. A viable, short-term (3 to 5 year) option exists from WCID No. 17 and pursuing this option is recommended. This alternative will involve the installation of an eight inch diameter transmission main from the WCID 17 standpipe located behind Lake Travis High School to the Bee Cave City Limits and on to the Bee Cave West subdivision. A distribution system consisting of six inch and four inch diameter lines that will provide sufficient capacity for domestic flow and fire protection, fire hydrants, valves and meter boxes would also be installed to service the area.

This alternative is extremely beneficial from two standpoints. Primarily, an acute problem is resolved in a manner that is satisfactory and consistent with long range water system planning and implementation. Secondly, it allows Bee Cave to make short-term decisions to cure the immediate problem without adversely impacting the development of the mid-term and long-term water system alternatives. A subset of those two issues are two distinct, separate areas of utility development. Each issue is independent yet interdependent on the other at the same time. The first, the planning and design of a water storage, pumping and distribution system for the overall Bee Cave area can be accomplished without prior identification of the ultimate source of treated and/or untreated water. Because of the terrain of the Bee Cave area, the storage and distribution systems will be essentially the same in any case.

The second; determination of the mid-term and long-term source of potable water, is not quite as simple. Several options are presented in the body of this study, each of which are technically feasible. Some suffer from economic

and financial burdens while others are subject to the uncertainties of land development and the real estate market. Yet others place Bee Cave in one or more water districts with essentially little or no control over its own water destiny. Suffice it to say that the procurement of untreated water and treatment facilities may be a task better suited to LCRA on a regional basis. This is not to say that Bee Cave could not or should not embark in the water treatment business, but that it is a proposition with many legal, financial and technical problems yet to be worked out. The solutions to those problems may put a severe strain on the financial resources of Bee Cave.

3.0 SUMMARY OF AREA DEVELOPMENT REGULATIONS

Development capacity and the corresponding utility demand in the Bee Cave area is influenced by a variety of factors. These include but are not limited to area economy, area employers, proximity to retail centers, proximity and quality of schools, as well as housing availability itself. The availability and affordability of housing, whether it is single family, duplex, or multifamily, is directly related to the development capacity and regulations currently in effect or proposed for the area.

The Bee Cave regional water planning area includes portions of land which are under regulation by The Village of Bee Cave, the City of Austin, Travis County, the Lower Colorado River Authority, Texas Water Commission, and Texas Department of Health. Of these, the City of Austin imposes some of the more severe constraints upon development, particularly within major watersheds within Austin's ETJ. With the advent of Bee Cave's and Austin's agreement to a modified one-mile ETJ, it is probable that the entire planning area will be within Bee Cave's jurisdiction at some point in the future.

3.1 Village of Bee Cave

Bee Cave currently regulates land development through its subdivision ordinance. This ordinance limits the sizes of residential and commercial lots based on the availability of water and wastewater service. Residential lots which are to be served by an on-site waste disposal system shall have a minimum lot size of one-half (1/2) acre if serviced by central water supply and one (1) acre if served by private wells. The minimum lot size in a subdivision which shall be served by central sewer collection and water supply systems shall be fifteen thousand (15,000) square feet. In addition to the drainage criteria in the subdivision ordinance, there is enforcement of specific stormwater quality standards and controls. The Bee Cave watershed/water quality ordinance addresses source pollution abatement. There are direct impacts on development capacity depending on whether strict density limits are utilized (similar to the City of Austin) or whether structural water quality performance devices are employed by the developer.

The maximum density that could occur under current ordinances is three (3) units per acre which can be used to establish an outer limit for growth projections. Realistically, given the local constraints of rough and steep terrain, floodplains and on-site wastewater design requirements, a one (1) to one and one-half (1.5) units per acre may be a more reasonably anticipated density for planning purposes.

3.2 City of Austin

The City of Austin regulates development and water quality standards in various ways. The current Comprehensive Watershed Ordinance (CWO) restricts impervious cover on various slope gradients within different portions of a watershed. Development is prohibited altogether within the Critical Water Quality Zone (CWQZ) of a stream, severely restricted or prohibited on slopes greater than 15%, limited within the Water Quality Buffer Zone (WQBZ), and restricted in varying degrees for all remaining areas of the watershed. Additional development restrictions apply for sites within designated Water Supply Watersheds, classified as Suburban and Rural. Restrictions for Suburban Watersheds are more severe than those for Rural.

The Bee Cave regional water planning study area falls within three major watersheds: Barton Creek, Lake Travis, and Lake Austin. Each of these watersheds has been designated by the City of Austin as Rural Water Supply Watersheds. Because development is prohibited within the CWQZ and severely limited in the WQBZ, principal development will occur in the remaining area or Uplands Zone. Overall density within the Uplands Zone of a Rural Water Supply Watershed is limited to 1 single family unit per 2 acres with a minimum lot size of 3/4 acre. This overall density can be increased with certain development intensity transfers. Because of lot size restrictions associated with on-site septic systems, the presence of a centralized wastewater collection and treatment facility also plays a role in the calculation of overall development density of any given site or property.

3.3 Texas Department of Health

Development density regulations issued by the Texas Department of Health (TDH) restrict the minimum lot size for residential development with individual, on site sewage systems. Residential development with individual sewage systems

utilizing public water supply is limited to a minimum lot size of 15,000 square feet (0.34 acre). Residential development with individual water and sewage systems is limited to a minimum lot size of 20,000 square feet (0.46 acre). Poor percolation rates in underlying soils can require additional acreage for successful wastewater disposal. Existing small lot subdivisions are exempt from more recent lot size restrictions but still must meet percolation requirements prior to the construction of on-site systems. The recently updated Travis County and LCRA on-site disposal system regulations are more stringent than the TDH regulations and generally supersede the TDH rules.

3.4 Travis County

Travis County requires a minimum lot size of 1/2 acre per living unit for lots utilizing private sewage facilities. Where percolation rates are insufficient, lined evaporation systems are sometimes used. For this type of disposal, a minimum of 1 acre is required per living unit. As with TDH requirements, poor percolation rates of underlying soils can increase the necessary size of the lot even further.

3.5 Lower Colorado River Authority

In areas adjacent to Lake Travis and Lake Austin, the LCRA permits and regulates septic tank construction and associated lot size requirements. Generally, LCRA requirements for on-site systems are more restrictive than those of the Texas Department of Health.

3.6 Texas Water Commission

The Texas Water Commission imposes restrictions upon development in the form of the current moratorium on wastewater discharges to Lake Austin and Lake Travis, and the current Edwards Aquifer Rule. None of the Bee Cave regional water planning area lies over the defined Edwards Aquifer Recharge Zone; however, virtually all of the area is subject to the moratorium on lake discharges. This moratorium prohibits any new or additional wastewater discharges to Lake Travis or Lake Austin. In effect, this requires all development not served by the City of Austin or one of several smaller plants currently permitted to discharge, to utilize private on-site systems or centralized systems with

irrigation effluent disposal. Wastewater disposal is the limiting factor for development density either through large lot sizes or dedicated irrigation areas. The net effect of this moratorium is that development density is reduced significantly.

4.0 EXISTING WATER SYSTEMS

Travis County WCID No. 14, which currently obtains all of its treated water supplies from the City of Austin, represents the major existing water purveyor within the Bee Cave regional water planning area. Within this area are several other sources of raw and treated water such as WCID Nos. 14 and 17, LCRA and Uplands Water Supply Corp. By far the largest source of raw water is that purchased from the Lower Colorado River Authority and withdrawn from area lakes for use in local municipal water systems. Groundwater resources have proven themselves to be unreliable and of poor quality.

4.1 LCRA Water Contracts

All surface water rights within the Bee Cave regional water planning area with the exception of water rights held by the City of Austin are held by the Lower Colorado River Authority. The LCRA operates the various dams which create the Highland Lakes chain, and issues diversion contracts for raw water withdrawals from the lakes. This authority includes Lake Austin and Lake Travis, which are the principle raw water sources available in the Planning Area.

Travis County WCID No. 17 purchases its raw water from the Lower Colorado River Authority and draws its supplies from Lake Travis. The contract was negotiated in September, 1985 for 8,800 acre-feet/year. Based on the District's 1988 average annual production rate of 159,140 gallons per LUE, this contract should be sufficient to serve approximately 18,000 LUEs. Other Bee Cave area LCRA raw water contracts include West Travis County MUDs 3, 4 and 5, Uplands Water Supply Corporation and the Homestead Subdivision. Table 1 summarizes the raw water contracts in the Bee Cave area.

TABLE 1

Area LCRA Raw Water Contracts

Lake Travis	Acre-Feet/Year
City of Austin (WTP #4)	270,000
WCID No. 17	8,800
Hurst Creek MUD	1,600
Lakeway MUD	1,228
WCID No. 14	1,074
Orange Service Corp.	1,000
Lake Austin	
Steiner Ranch Dev. (WCID No. 17)	5,403
Riverplace MUD	3,528
West TCMUD #1 (Double J&T Ranch)	2,420
West TC MUD 3, 4 and 5 (Bohl's Ranch)	1,901
Hidden Valley WSC	20
Homestead	1,120

4.2 Raw Water Supplies

A reliable and treatable source of raw water is a key element in the planning process for a regional water supply system. All current suppliers of water within the Bee Cave are take raw water from one of three (3) potential sources: Lake Travis, Lake Austin and groundwater. Each of these sources is discussed below.

4.2.1 Lake Travis

Lake Travis is the largest surface water impoundment in Travis County. The Lake is formed by Mansfield Dam and has a normal pool elevation of 681 feet MSL. Average annual discharge from Mansfield Dam is 1,068,000 acre-feet per year. Water quality is very good and turbidity is low resulting in a source of water that is readily treatable. However, the nearest point of access for a potential raw water intake system is more than seven (7) miles away, posing an expensive pumping and raw water transmission problem for what would be a relatively small water utility. It is highly unlikely that Bee Cave would utilize Lake Travis water for its utility system unless Bee Cave were served by a water utility with the appropriate infrastructure in place to divert water from Lake Travis, treat the water and deliver potable water near the Village boundary.

4.2.2 Lake Austin

Lake Austin is much closer to Bee Cave, 1.4 miles away, although it has a 200 foot lower normal pool elevation than Lake Travis at 492 feet MSL. The Uplands Water Supply Corporation currently owns and operates a 42 inch diameter raw water intake structure, pump station and 19,000 foot, 30 inch diameter raw water transmission main that has an ultimate capacity of 16 MGD. The intake and transmission system pumps to an elevation of 900 feet MSL. From a treatability standpoint, Lake Austin water quality is somewhat less than Lake Travis water. Higher turbidity caused by sediment passing through the Mansfield Dam discharge and colder temperatures may potentially require a small amount of additional treatment time and chemical use. This however, is a very minor problem that can be dealth with. It is highly likely that Bee Cave could directly utilize Lake Austin water for its utility system because of the proximity of the lake.

4.2.3 Groundwater

Groundwater is the primary source of water for residential and commercial development in the Bee Cave area that is not served by WCID No. 14, WCID No. 17 or UWSC. In particular, this includes the Bee Cave West subdivision, Homestead and other development along Hamilton Pool Road and Highway 71W. Reliability and quality of groundwater have proven to be extremely poor and these factors are the cause of the current and potential future problems. The LCRA Lake Travis West Water Supply Project contained the following information with regard to groundwater:

> The Glen Rose and Trinity Peak aquifers are the major water-bearing units in the study area. Both are members of the Trinity Group Aquifer. Groundwater in this group of aquifers has been described as a calcium carbonate water in western Hays and Travis counties and becomes a sodium sulfate or chloride type as it moves downdip to the south and east-southeast. The fault zone near the eastern edge of the study area has greatly restricted the movement of water through the aquifer. Low permeability, restricted water circulation, and an increase in temperature causes the groundwater to become more highly mineralized in the downdip portion of the aquifer. Sulfate, fluoride, and total hardness have been the major problems, and a great number of water samples collected from the Trinity Group Aquifer could not meet the primary or secondary drinking water standards (TDWR, 1983).

> Groundwater also has quantitative limitations in this region. Unpublished Texas Water Development Board records show wells in the lower Glen Rose Aquifer have yields ranging from 5 to 30 gpm, averaging 10 gpm. Well yields from Trinity Sands Aquifer range from 10 to 80 gpm, averaging 20 gpm (Woodruff, 1975). The well yields generally are adequate for individual rural well systems but are considered inadequate for the future developments projected in the study area.

This excerpt indicates that groundwater alternatives are seriously limited by both quality and quantity within the Bee Cave Planning Area. Bee Cave should not attempt to develop groundwater sources to meet immediate or future needs. Rainfall and recharge uncertainties, groundwater pollution, pumping and treatment costs and lack of groundwater rights all combine to make this a highly infeasible alternative. Surface water resources are much more easily obtained, managed and treatable and should be the only resource given serious consideration by the Village of Bee Cave.

4.3 Review of Existing Area Water Systems

The Bee Cave Water Service Planning Area is part of or adjacent to several public water supply systems. Those systems include WCID No. 14, Uplands Water Supply Corporation and WCID No. 17. Existing water utilities are shown in Figure 2. A brief description of each follows.

4.3.1 Travis County WCID No. 14

Travis County WCID No. 14 is currently the primary potable water provider in the Village of Bee Cave. WCID No. 14 is essentially an extension of the City of Austin water utility system and is located in the very end of Austin's Southwest 'B' service area. There are presently 906 water connections in WCID No. 14's service area, 58 of which are in Bee Cave. Although this district owns its water facilities, the operations and maintenance are performed by the City of Austin.

The components of the WCID No. 14 water system which are within the Bee Cave corporate limits include the following items:

13,600 LF of 6 inch diameter water line in Highway 71 W from the eastern city limit line to Hamilton Pool Road

1,400 LF of 4 inch diameter water line along Hamilton Pool Road

1,700 LF of 2.25 inch diameter water line in Highway 71 W from Hamilton Pool Road

3,760 LF of 6 inch diameter water line in RR 620 from Highway 71 W to the northern city limit line

3,760 LF of 12 inch diameter water line along RR 620 from Highway 71 W to the northern city limit line. (This line extends another 1,240 LF beyond the city limits for a total length of 5,000 LF.)

The 6 inch diameter line is over 30 years old, having been installed in 1958, and the 4 inch and 2.25 inch diameter lines are over 20 years old. The 12 inch line in RR 620 is virtually new, having been constructed as part of the RR 620 widening project which was completed in 1988-89.

This system has been stretched to its capacity in recent years because of growth in the Oak Hill area and inadequate pumping and storage capability to supply more water to the Bee Cave area. It has been plagued by low system pressure, particularly in high demand months and can only provide limited fire protection. A major upgrade of storage, transmission and pumping facilities would be necessary to provide adequate service to the Bee Cave area. WCID No. 14 serves Bee Cave at a 1040 elevation MSL pressure plane which means that any property above elevation 950 MSL receives no or very inadequate water service.

4.3.2 Travis County WCID No. 17

Travis County WCID No. 17 is located to the north of Bee Cave and extends along RR 620, across Mansfield Dam and on to FM 2222 including Steiner Ranch and Comanche Trail areas. This district has three (3) water service pressure planes; 1031 MSL, 1130 MSL and 1200 MSL. The WCID No. 17 facilities nearest Bee Cave are the 300,000 gallon Lake Travis Independent School District (LTISD) standpipe and booster pump station which have an overflow elevation of 1200 MSL. The 1200 MSL pressure plane system will serve areas which range in elevation from 970 MSL (minimum) to 1120 MSL (maximum). These elevations are present throughout the west end of Bee Cave.

This district has a current treatment plant capacity of 2.16 MGD. All of the treatment capacity has been committed either through actual meter connections or by reservation through the payment of capital recovery fees by landowners in

the district. However, the WCID No. 17 anticipates beginning construction of a 3.0 MGD expansion of its water treatment plant in late 1989 or early 1990 resulting in 5.16 MGD of treatment capacity.

According to the WCID No. 17 Draft Regional Water Study dated March, 1989, the District serves 1225 single family and commercial or multifamily meters for a total service commitment of 1,486 Living Unit Equivalents (LUEs). The average use per connection in WCID No. 17 in 1988, a relatively dry year, was 13,100 gallons per month. The highest month was 21,260 gallons per connection (August) and the lowest was 8,580 gallons per connection (March). On average, the district pumps 648,000 gallons of treated water per day (gpd) which is thirty percent (30%) of the treatment capacity and slightly over a million gpd in peak months which is approximately half of the treatment capacity. This is expected to increase dramatically in the near future with the addition of Apache Shores, Comanche Trail and Montview Acres to the WCID No. 17 system; an addition of approximately 660 single family connections.

WCID No. 17 is in a better position to help solve the immediate problem in Bee Cave West because of the following points:

- Storage and pressure system at correct elevation
- Available treatment capacity
- Proximity to the area.

4.3.3 Uplands Water Supply Corporation UWSC

As previously discussed, Uplands Water Supply Corporation (UWSC) owns and operates raw water intake pumping and transmission facilities and water treatment, pumping and storage facilities, some of which are within the city limits of Bee Cave. The raw water intake structure, pump station and transmission line have an ultimate firm capacity of 16 MGD. The existing water treatment plant has a capacity of 1.8 MGD, slightly more than ten percent (10%) of the ultimate capacity.

The UWSC currently operates in two (2) pressure plane service areas, ,1115 feet MSL and 1,035 feet MSL. This situation will require additional engineering solutions and infrastructure to serve all of Bee Cave, including the west end, because the treatment plant is in the lower pressure plane. Treated water

would have to be boosted or pumped twice, once to 1,080 feet MSL and then to 1,240 feet to service the upper area of Bee Cave. In addition, to the elevation differences, UWSC has expressed concern about replacing WCID No. 14 water (treated by the City of Austin) with UWSC water and the effect it may have on the existing water piping system and plumbing fixtures and would want the Bee Cave Water Utility System to be isolated from the main body of the UWSC System by a series of check valves, reservoirs and pump stations.

Ultimate demand on the UWSC raw water intake, pumping and transmission system exceeds its capacity as follows:

UWSC ultimate raw water pumping capacity	16.00 MGD
Ultimate demand and contractual obligations of UWSC Uplands Subdivision Development	13.70 MGD
Barton Creek West	0.77 MGD
Eanes Independent School District	0.20 MGD
Sam Houston Square (Highway 71 West and Thomas Springs Road)	0.19 MGD
Bohls Ranch Development	1.874 MGD
Total Demand	16.734 MGD

This means that, in the future, when UWSC reaches its ultimate service demand, there may be water shortages unless other supplies or raw water pumping capacity can be secured. It is quite possible that Sam Houston Square could be served by WCID No. 14 due to its proximity to Oak Hill and that the Uplands development could substantially reduce the amount of planned golf course irrigation with potable water by utilizing wastewater effluent. This could result in a net reduction in demand of UWSC of over a million gallons per day. One million gallons per day could serve as many as 400 to 500 households per day. Barton Creek Country Club was recently a major UWSC customer. WCID No. 19 has completed a raw water transmission line to serve the golf course which substantially reduces the demands on the UWSC system.

Another potential scenario involves the expansion of the UWSC raw water intake structure and pump station beyond the proposed ultimate 16 MGD capacity. According to UWSC officials, the primary limitation to this type of expansion is the size of the pump station tract and the limitations of impervious cover placed on that tract by the City of Austin Comprehensive Watershed Ordinance. According to UWSC and the design engineer of the original pump station, the pump station could be expanded to 24 MGD if the impervious cover limitations

on the tract size were modified. Given the development limitations on the tract size throughout the Bee Cave planning area, 24 MGD of raw water capacity could serve 15,000 to 16,000 households in an area as large as 30,000 acres.

Utilization of the UWSC facilities, either as a wholesale bulk customer or in a joint venture arrangement is a realistic mid-term to long-term future alternative for Bee Cave. It does not work as well as an immediate solution, though, because of the necessity of acquiring the WCID No. 14 facilities in Bee Cave and the construction of a parallel transmission system. Presuming that WCID No. 17 provides potable water for a short-term solution, discussions should be initiated and continued by and between Bee Cave, LCRA, UWSC, WCID No. 17 and West Travis County MUDs 3, 4 and 5 to evaluate and implement the long-term alternatives which optimize water service for all parties involved.

4.4 Potential Proposed Water Systems

4.4.1 LCRA Water System

The LCRA does not currently own or operate a water utility system within the Bee Cave planning area. However, the Board of Directors and staff are pursuing avenues which would place the LCRA in a position to be a wholesale supplier of potable water for re-sale by retail utility systems. As such, the LCRA is a co-sponsor of and participant in this Bee Cave-LCRA Regional Water Supply Planning Study. In 1985 the LCRA completed a report entitled Lake Travis West Water and Wastewater Feasibility Study. This study was very broad in scope and covered a 448 square mile area south and west of Lakes Travis and Austin, including the entire Bee Cave Regional Water Planning Area.

The study concluded that anticipated growth in the area would require a new water treatment facility located on southwest Lake Travis and a massive transmission and storage system. It also concluded that centralized wastewater collection and treatment would be too costly because of the lack of development density. No facilities were constructed nor were any other systems implemented from this study for many reasons including the following items:

- High initial user costs
- Service area was too large and did not focus on areas with critical needs such as Bee Cave

- Little cooperation existed among the various municipalities, utility districts and landowners. Bee Cave did not exist as an incorporated village.

In 1987 the Village of Bee Cave and Hill Country Water Supply Corporation requested that LCRA evaluate the potential for a potable water source for those two entities. This request, coupled with the proliferation of raw water sales contracts to various utilities and landowners along Lakes Travis and Austin led to an LCRA update of the 1985 study, an effort which was completed in April, 1988. The study update concluded that four (4) major water demand areas were in existence:

- Village of Bee Cave and areas adjacent to FM 2244 (Bee Cave Road) from Bee Cave to Commons Ford Road
- Lakeway MUD and Hurst Creek MUD
- Hill Country Water Supply Corporation
- Intersection of Hamilton Pool Road and RR 12.

A priority in those findings is the Bee Cave area, as evidenced in the following points:

- Utility systems have grown in the Bee Cave-Bee Cave Road areas. The proximity to Lake Austin has made it possible for utility districts to take raw water and construct treatment facilities near the raw water source.
- Demand in the various utility districts has not kept pace with growth projections resulting in excess treatment capacity and higher costs for the user.
- Groundwater resources, which supply a majority of the development in Bee Cave have failed and will continue to be unreliable.
- Travis County WCIDs No. 20, 18 and 17 and UWSC all have excess treatment capacity with the exception of UWSC on peak day demands.
- The northwestern end of WCID No. 14 and the Village of Bee Cave suffer from unreliable water service. Service to areas of higher elevation is expensive and will require a great deal of cooperation among the various utilities.

Based on these findings, LCRA proposed a regional water system which, in its essence, is a system of connects and interconnects between existing water treatment plants and transmission systems of:

Uplands
Travis County WCID No. 17
Travis County WCID No. 18
Travis County WCID No. 20
Hurst Creek MUD
Lakeway MUD No. 1

Phase I of the proposed project would be the connection of Travis County WCID No. 17 and UWSC to provide water to four primary areas:

Village of Bee Cave
Estates of Barton Creek (WCID No. 19)
Uplands Subdivision
Homestead Subdivision

It was envisioned that this project would require six months of design and nine months of construction to implement. Phase II of the project would interconnect two more water suppliers, WCID No. 18 and WCID No. 20 to the overall system and three more customers; West Travis County MUD's 3, 4 and 5 (Bohls Ranch), Senna Hills MUD and WCID No. 21.

These two phases are most crucial to Bee Cave and its planning area because of the immediacy of demand and the proximity of the water sources. LCRA is evaluating the purchase of water treatment facilities from WCID No. 20 and Uplands Water Supply Corporation, and purchase of "surplus" treated water from WCID No. 17. These efforts, if successful, would form the foundation of a regional water supply system in the Bee Cave area and resolve the immediate problems of unreliable groundwater sources.

4.4.2 West Travis County Municipal Utility Districts 3, 4 and 5

Another potential water supplier in the Bee Cave area is West Travis County MUDs 3, 4 and 5 which are the municipal utility districts created to provide water and wastewater utility service to the Bohls Ranch development. This utility system can be a potential water supplier to Bee Cave on either an independent basis or as an integral component of a regional system.

These MUDs will utilize raw water taken from the Uplands raw water intake pumping and transmission system. They are entitled by contract, to 1.874 MGD from the raw water system. Based on the land plan presented in the Preliminary Engineering and Creation Report prepared in September, 1987 by Murfee Engineering Company, Inc., the MUDs will create demand for a 1.15 MGD water treatment facility. The difference, 0.724 MGD, is obligated to other property owners outside the MUD boundaries. This amount of water would be sufficient to serve 400 to 800 LUE's of demand depending on the design criteria utilized and the type of land use present.

In addition, West Travis County MUDs 3, 4 and 5 are proposing wastewater collection, treatment and disposal via irrigation of treated effluent. The system, as proposed, will consist of a 0.47 MGD wastewater treatment plant, effluent holding ponds with a capacity of 144.2 acre-feet and 194 acres of irrigation area.

4.4.3 Bee Cave Water Utility

Bee Cave also does not currently own or operate a water utility system. However, the immediacy of need in west Bee Cave and, lack of sufficient pressure and flow available from WCID No. 14 in other areas of Bee Cave, will necessitate that Bee Cave establish a municipal water utility subject to the rules and regulations of the Texas Water Commission and Texas Department of Health. Implementation of any of the alternatives, with the exception of annexation into WCID No. 17 will require Bee Cave to form an organization that can plan, develop and manage a reliable water system.

Assuming all WCID No. 14 customers in Bee Cave would become Bee Cave Water Utility customers and that Bee Cave West and other areas along Highway 71 West and Hamilton Pool Road would be incorporated into the system, the utility operation would start with approximately 100 customers. Fifty-eight of those are existing WCID No. 14 customers and are listed as follows:

BEE CAVE AREA WCID NO. 14 COMMERCIAL AND RESIDENTIAL ACCOUNTS

Account Name	Account Address
McCoy Corporation	13602 Highway 71 West
Emerald Restaurant	13614 Highway 71 West
Bee Cave Country Store	14211 Highway 71 West
Barbara Ellen's	13129 Highway 71 West
Branding Iron	13101 Highway 71 West
Trading Post Exxon	12701 Highway 71 West
VFW Post 4443	2931 RR 620 South
Travis County	4001 RR 620 South
Hill Country Food Mart	13908 Highway 71 West
Dinky's Service, Inc.	14226B Highway 71 West
Lakeside Motors	13225 Highway 71 West
Hill Country Patio	12501 Highway 71 West
Bee Cave Baptist Church	13222 Highway 71 West
Rosie's Tamale House	13436 Highway 71 West
Longhorn Company	14118 Highway 71 West
Rosie's Take Out	13303 Highway 71 West
Lake Travis Independent School District	14502 Hamilton Pool Rd.
Hudson Bend VFD	14503 Highway 71 West
Southwestern Bell	13201 Highway 71 West
Blocker, Lee	3702 RR 620 South
Baldwin, Robert	3932 RR 620 South
Wells, Harriet	12721 Highway 71 West
Baldwin, Robert	12703 Highway 71 West
Timmermans, Jennifer	3930 RR 620 South
Jacobs, James	4019 RR 620 South
Puryear, Stanley	3801 RR 620 South
Baldwin, Robert	13208 Highway 71 West
Wallace, Randy	4005 RR 620 South
Caldwell, Robert	3910 RR 620 South
Thurman, Truman	3726 RR 620 South
Hill, Alford	3700 RR 620 South
Johnson, Weldon	3573 RR 620 South
Thurman, Marvin	3818 RR 620 South
Wagner, Tony	19709 Highway 71 West
Lackey, Donald	12303 Highway 71 West
Grove, Karen	14020 Highway 71 West
Hudson, W. A.	14226 Highway 71 West
Hurt, Jack	13702 Highway 71 West
Brumfield, Mary	13433 Highway 71 West

Account Name	Account Address
Hudson, Bennie	14226 Highway 71 West
Lallier, C. E.	14301 Highway 71 West
Skaggs, Tim	13618 Highway 71 West
Freitag, Boyd	14507 Highway 71 West
Freitag, George	14601 Highway 71 West
Freitag, Boyd	14623 Highway 71 West
Figer, Mrs. John	14907 Highway 71 West
Brown, Jr.	4813 Twin Acres Lane
Grumbles, Fannie	4812 Twin Acres Lane
Brill, Bill	4812 Twin Acres Lane
Grumbles, Willard	4814 Twin Acres Lane
Gaddy, Alvin	4610 Twin Acres Lane
Nowotney, Mamie	4600 Twin Acres Lane
Peek, John	14322 Hamilton Pool Road
Myers, Melvin	14501 Hamilton Pool Road
Zumwalt, John	14504 Hamilton Pool Road

These accounts and service addresses correlate to Figure 3 attached to this study which depicts real estate parcels and meter locations. As can be seen, current service is strung out along the major highways creating dead-ends in the transmission and distribution systems which are undesireable from a pressure, rate of flow and fire protection standpoint.

Total consumption by these 58 services for June, 1989 was 1.25 million gallons. Average daily consumption, was 717 gallons which is fairly high and reflects the large proportion of commercial accounts.

Assuming that the demand for the residential areas in west Bee Cave is approximately 400 to 500 gallons per day per connection, then the existing demand for the entire initial Bee Cave Water Utility (excluding Homestead) is approximately 58,400 gallons per day or 1.75 million gallons per month with no allowance for peaking factors and fire protection.

5.0 PROJECTED GROWTH OF THE BEE CAVE PLANNING AREA

One of the most important factors in the preparation of a utility serv
are accurate projections of future growth. Recent economic changes ma
task doubly difficult. Many different components impact growth and deve
within an area. These include, but are not necessarily limited to:

* Local and regional economy;
* Local development restrictions;
* Environmental constraints;
* Current housing inventory;
* Existing and proposed roadway networks;
* Proximity to employment, schools, etc.

This section describes the population and land use forecasts used to deve
the immediate, mid-term and long-term water systems. The forecast informati
was also used to estimate the future water demands of the Bee Cave Planni
Area.

Long-term projections presented in this study are intended to serve as a guide
only. Due to Bee Cave's layout, limited customer base, possibility of service
expansions through annexation, and changing political and economic climates;
projections beyond a five or ten year horizon are speculative at best. It is
essential, therefore, that projected water demands and system limitations be
evaluated and updated on a routine basis.

In order to project future growth in the Bee Cave Planning Area, several source
documents were utilized. Those included:

COMPREHENSIVE PLAN - VILLAGE OF BEE CAVE
Community and Regional Planning Program
School of Architecture - University of Texas at Austin September, 1988

PRELIMINARY ENGINEERING AND CREATION REPORT
West Travis County MUDs 3, 4 and 5
Murfee Engineering Company, Inc. September, 1987

LAKE TRAVIS WEST WATER SUPPLY PROJECT
Technical Memorandum
Water Resources Department
Lower Colorado River Authority August, 1988

TRAVIS COUNTY WATER CONTROL AND IMPROVEMENT DISTRICT NO. 17 REGIONAL WATER
STUDY - DRAFT
Haynie, Kallman & Gray, Inc. March, 1989

5.0 PROJECTED GROWTH OF THE BEE CAVE PLANNING AREA

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LAKE TRAVIS WEST WATER SUPPLY PROJECT
Technical Memorandum
Water Resources Department
Lower Colorado River Authority August, 1988

TRAVIS COUNTY WATER CONTROL AND IMPROVEMENT DISTRICT NO. 17 REGIONAL WATER STUDY - DRAFT
Haynie, Kallman & Gray, Inc. March, 1989

Each of these documents contained detailed projections and information about the Bee Cave area which will be referenced and further described. Other documents which were reviewed and utilized as appropriate include:

* Water and Wastewater Utility Interim Plan (Final Report, prepared for the City of Austin by Engineering Science, December, 1986;

* Transportation Plan for the Austin Metropolitan Area - Technical Report 1, Population and Employment Forecasts: Methodology and Preliminary Results, prepared for the Austin Transportation Study by Cambridge Systematics, Inc. and CRS Sirrine, Inc., January, 1985;

* Austin plan, Sector 21 and 22, Background Information, prepared by the City of Austin Study and Growth Management Department, June/July, 1987;

* Lake Travis (West) Water-Supply System - Long-term Plan, June, 1988, original study prepared for the Lower Colorado River Authority by Turner, Collie, and Braden, Inc., 1985.

Other resources were also identified and reviewed such as:

* Lake Travis Chamber of Commerce
  Economic Development Seminar March, 1989

* Lake Travis Independent School District
  Enrollment History (1981 - 1987)

5.1 Summary of Projected Growth Rates

Growth rates and projections of future growth in Bee Cave are relative to many indices but somewhat independent of those factors at the same time. Because the study area is relatively small and lightly populated, any amount of development will have a large impact on growth rates expressed as a percentage of existing development. Lack of a reliable water source also has a major adverse impact on growth rates because landowners and developers must decide to make a costly investment in a potentially unreliable well. After a review of available existing data observation of area housing starts and discussions with developers, the following compound growth rates were developed:

1989 - 1992	2% per year
1992 - 2003	15% to 25% per year (impact of Bohls Ranch development)
2003 - 2020	3%

It is important to note that unless centralized wastewater service is developed in the Bee Cave regional water planning area, the ultimate development capacity

of the area is approximately 6,000 LUE. Utilizing the projected growth rates, the number of LUEs in the Bee Cave regional water planning area by the year 2020 would be 2,860, slightly less than one half of the development capacity. Viewed in reverse, a compound growth rate of approximately 13 percent per year would be necessary to develop the entire area in a 30 year period. This level of sustainable growth is unprecedented and is shown only for comparison purposes.

As it is, the projected growth rates and their variables are the equivalent of an annual compound growth rate of 9% to 10%, which is relatively high. However, because the basis is fairly low (150 LUEs in the Bee Cave Planning Area in 1989), the impact of a development project like Bohls Ranch can be significant and drive the rate of growth up dramatically. Without Bohls Ranch, the total number of LUEs in the Bee Cave area would not exceed 1,000 by the year 2020.

The Bee Cave area can also expect some spin-off growth from job expansions at Motorola, 3M and Schlumberger, attractiveness of the Lake Travis Independent School District and the improvements to RR 620 and FM 2244 (Bee Cave Road). Primarily though, development should be enhanced by the fact that Bee Cave is now incorporated and has a one-mile ETJ area which is not subject to City of Austin land use controls and development processes. It must also be noted that Bee Cave is knowledgeable and protective of sensitive environmental areas in its ETJ and has enacted specific ordinances to maintain water quality and prohibit inappropriate land uses. Habitat of the Black-capped Vireo and Golden-cheeked Warbler identified by the Balcones Canyonland Regional Habitat Plan will also guide development to appropriate areas.

Even though the regional water planning study area is located entirely within Travis County, it does not directly follow any county wide or urban growth pattern. As is the case in many areas of western Travis County, and especially those areas near Lakes Travis and Austin, growth occurs in spurts and is dependent on water and wastewater utility availability, job creation and recreation. There is only one major development project, the Bohls Ranch, in the Bee Cave regional water planning area which is poised for development. The

Homestead subdivision is a secondary area which would develop at a faster rate if water and wastewater were available.

Current planning for the Bohls Ranch indicates that approximately 1,350 LUEs of mixed use development are anticipated. The proposed land uses include single-family residential, multi-family residential, commercial, office and research and development. Based on current market trends, the project is anticipated to develop over a ten year period from 1993 to 2003. This development is reflected in the projected growth rates previously indicated.

The Homestead, as platted, contains approximately 200 residential lots and a 30 acre commercial tract. Current development includes 56 single-family residences which have been built over a 10 year period. The rate of growth is restricted by the availability of potable water service. The entire subdivision should build out well within the long-term planning horizon.

Several preliminary and final plats for residential and commercial uses were approved in 1988 by the Village of Bee Cave along Bee Cave Road, RR 620 and Highway 71 West. No development has occurred since the plat approvals, however, because of a lack of market demand and a source of water. These projects may begin to show signs of activity in the mid-term, after land values and the financial industry have stabilized.

5.2 Bee Cave Planning Area Growth Projections

All of the preceeding information and resource data was taken into consideration to develop immediate, mid-term and long-range growth projections. These projections are made in terms of Living Unit Equivalents (LUEs) because LUEs best describe water demand and can be easily translated into water system planning and engineering design.

The baseline estimate of existing LUEs for the Bee Cave Planning Area was arrived at through the following steps:

* Tabulation of existing WCID No. 14 customers in Bee Cave
* Windshield survey of west Bee Cave area
* Windshield survey of Homestead and other areas adjacent to Bee Cave.

The result of this survey showed approximately 150 to 200 LUEs in the Bee Cave regional water planning area in 1989. This number can be utilized as an existing condition starting point for mid-term and long-range projections. It is important to note at this point, that there are approximately 40 LUEs of demand in the west Bee Cave area which are in immediate need of water. This demand should be taken care of separately, as soon as possible.

This estimate of LUEs also took into account commercial establishments with one-inch meters, which is the equivalent of 2.5 LUEs. It also considered those establishments such as Bee Cave Baptist Church and some of the very small retail establishments which use much less water than a standard single-family residence.

Table 2 and Figure 5 indicate the total number of LUEs, by year, of demand which could be expected to be experienced in the Bee Cave Planning Area. Several potential growth scenarios have been shown to demonstrate the impact of the Bohls Ranch development and the effect of various rates of development. Also shown are population projections using various ratios of persons per LUE. Figure 8 translates these LUE projections into peak day water demands.

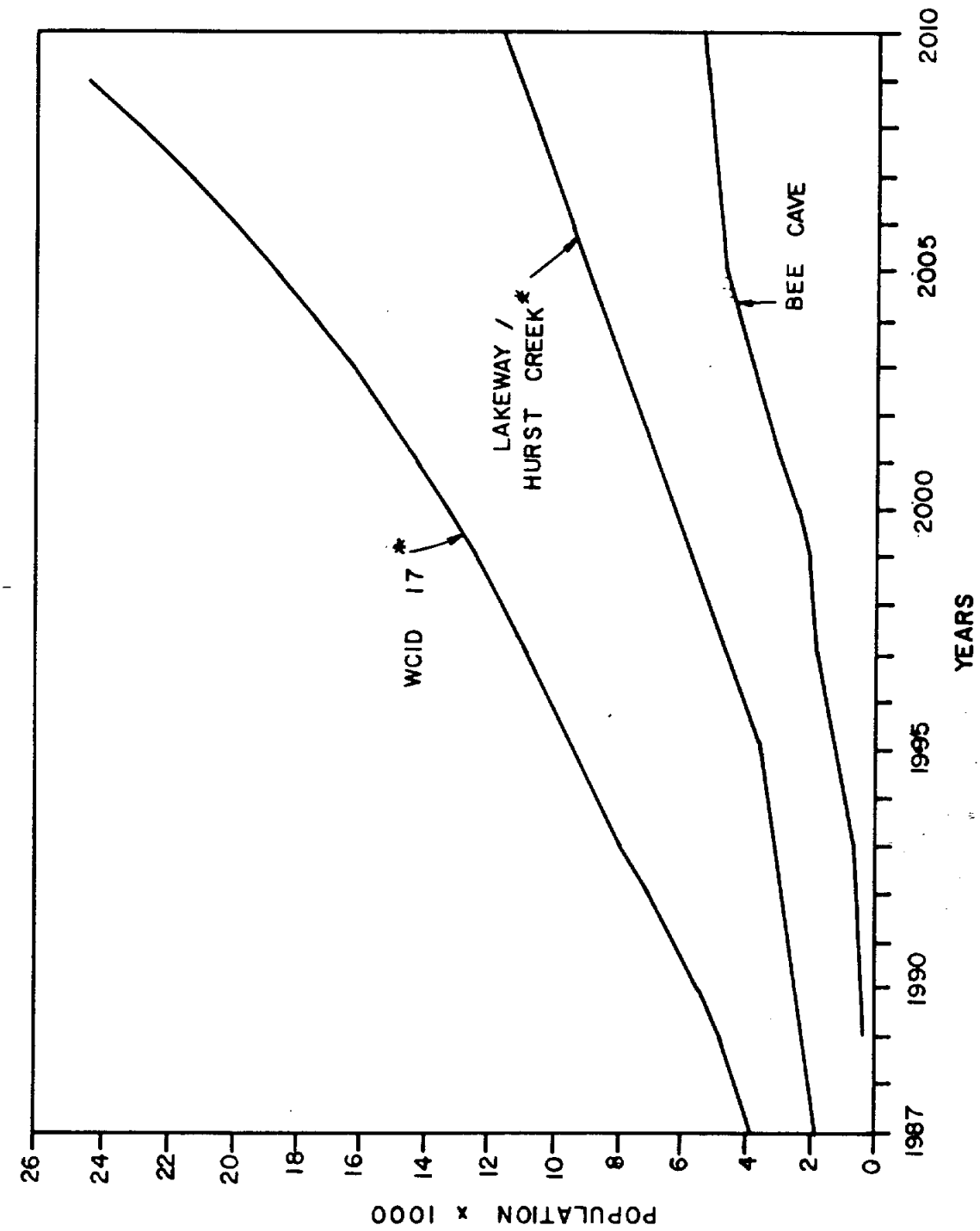
Again, it is important to note that these growth projections take into account the lack of centralized wastewater service, with the exception of Bohls Ranch. Should centralized wastewater service become available in some fashion, the growth rates and total units can be reasonably expected to increase due to the higher marketability of the land. The estimated development capacity of the Bee Cave regional water planning area is 6,000 LUEs; based on no centralized wastewater service, except in Bohls Ranch. This number would increase to 8,400 LUEs with the advent of wastewater service.

The 1985 Lake Travis West Study and its 1988 update both reported that projected development within the majority of this area would be too sparse during the next 15 years to support the construction of a centralized wastewater system. A review of existing developments, development restrictions and existing platted development, support this position. Areas which are not

TABLE 2

BEE CAVE-LCRA REGIONAL WATER PLANNING AREA
GROWTH PROJECTIONS

YEAR	NO. OF PROJECTED LUEs AT GROWTH RATE:				PROJECTED POPULATION BASED ON 75% SINGLE FAMILY		
	3%	10%	13%	2% 22% 3% (projected)	@ 2.7	@ 3.0	@ 3.2
1989	150	150	150	150	304	337	360
1990	155	165	170	153	310	344	367
1991	159	182	192	156	316	351	375
1992	164	200	216	190	385	428	457
1993	169	220	245	232	470	522	558
1994	174	242	276	283	572	636	679
1995	179	266	312	345	697	774	827
1996	185	293	352	422	852	947	1011
1997	190	322	399	515	1040	1156	1234
1998	196	354	451	628	1269	1410	1506
1999	202	389	510	766	1547	1719	1836
2000	208	428	576	935	1889	2099	2242
2001	214	471	650	1140	2302	2558	2732
2002	220	518	735	1391	2810	3122	3335
2003	227	570	830	1697	3428	3809	4068
2004	234	627	938	1748	3531	3923	4190
2005	241	690	1060	1800	3636	4040	4315
2006	248	758	1198	1854	3745	4161	4444
2007	255	834	1354	1910	3858	4287	4578
2008	263	918	1530	1967	3973	4414	4715
2009	271	1010	1728	2026	4093	4548	4857
2010	279	1110	1953	2087	4215	4683	5002
2011	287	1221	2207	2150	4343	4826	5154
2013	296	1343	2494	2214	4472	4969	5307
2014	305	1478	2818	2280	4606	5118	5466
2015	314	1625	3185	2349	4745	5272	5631
2016	323	1788	3599	2419	4886	5429	5799
2017	333	1967	4066	2492	5033	5592	5973
2018	343	2163	4595	2567	5185	5761	6153
2019	353	2380	5192	2644	5340	5933	6337
2020	364	2618	5867	2723	5500	6111	6527



*SOURCE: LAKE TRAVIS WEST STUDY, LCRA

BEE CAVE PLANNING AREA
POPULATION PROJECTIONS

FIGURE 5

likely to be centrally sewered within the next 20 years are limited to a maximum density of 1 unit per 1 acre of gross land.

5.3 Projected Water Demands

Historic water use records within the WCID No. 14 service area and historic use in WCID No. 17 offer valuable insights for the planning future facilities. Water usage and development of future customer water demands are discussed in the following sections.

5.4 Living Unit Equivalents (LUEs)

Recent growth trends have made the quantification and/or projection of water usage in terms of LUEs a necessary planning tool. By definition, a Living Unit Equivalent equates to a single-family residence as located in a typical subdivision. For purposes of this study it is assumed that LCRA and Bee Cave will adopt Austin's definition for LUE classification for both residential and commercial structures. Figure 4 depicts a summary of these classifications.

Situations may arise in which water users do not fit the specific classifications in the referenced list and will require quantification of a living unit equivalence. This has typically been accomplished by means of a fixture unit analysis. Individual plumbing fixtures are assigned a value based on their typical flow usage. The cumulative total of the service is then referred to a graph that compensates for a reduced average fixture demand as the number of fixtures increases. Table 4 and Figure 6 are reprinted from the American Water Works Association, Sizing Water Service Lines and Meters (M22), 1975.

Based on flow projections developed from the fixture unit analysis, service meter sizes are then calculated. Table 3 lists the standard meter size, flow rate and equivalent LUE. Conversely, based on the meter size, an approximate Living Unit Equivalent can be determined.

TABLE 3

Meter Sizes and Equivalent LUEs

Meter Size	Design Flow Rate (GPM)	LUEs
5/8 x 3/4"	16	1.0
3/4"	24	1.5
1"	40	2.5
1-1/2"	80	5.0
2"	128	8.0
3"	240	15.0
4"	400	25.0
6"	800	50.0
8"	1,280	80.0

FIGURE 4
City of Austin
Water & Wastewater
LUE Criteria

FIGURE 4

CITY OF AUSTIN
WATER AND WASTEWATER UTILITY
LUE CRITERIA

EFFECTIVE DATE: FEBRUARY 7, 1986

Definition: A living unit equivalent (LUE) is defined as the typical flow that would be produced by a single family residence (SFR) located in a typical subdivision. For water, this includes consumptive uses, such as lawn watering and evaporative coolers. The wastewater system does not receive all of these flows, so the flows expected differ between water and wastewater. The number of LUE's for a project are constant; only the water and wastewater flows are different.

ONE LUE produces: 2.2 GPM (Peak Hour) of water flow
1.3 GPM (Peak Day) of water flow
350 GPD (0.243 G.P.M.) average dry weather flow

PEAK FLOW FACTOR FORMULA:

$$PFF = \frac{18 + [0.0144(F)]^{0.5}}{4 + [0.0144(F)]^{0.5}}$$

F = AVERAGE FLOW (GPM)

RESIDENTIAL	LUE CONVERSION
One (1) Single Family Residence; Modular Home; Mobile Home	1 L.U.E.
One (1) Duplex	2 L.U.E.'s
One (1) Triplex; Fourplex; Condo Unit P.U.D. Unit (6+ Units/Acre to 24 Units/Acre)	0.7 L.U.E./Unit
One (1) Apartment Unit (24+ Units/Acre)	0.5 L.U.E./Unit
One (1) Hotel or Motel Room	0.5 L.U.E./Room

COMMERCIAL	LUE CONVERSION
Office	1 LUE/3000 Sq.Ft. of Floor
Office Warehouse	1 LUE/4000 Sq.Ft. of Floor
Retail; Shopping Center	1 LUE/1660 Sq.Ft. of Floor
Restaurant; Cafeteria	1 LUE/200 Sq.Ft. of Floor
Hospital	1 LUE/Bed
Rest Home	1 LUE/2 Beds
Church (Worship Services Only)	1 LUE/70 Seats
School (Includes Gym and Cafeteria)	1 LUE/13 Students

Ted Naumann, P.E., Branch Manager
Utility Developement Services
Water and Wastewater Utility

94/ms/luecriteria
REV 2/7/86

TABLE 4

PLUMBING FIXTURE WATER VALUES

FIGURE 6

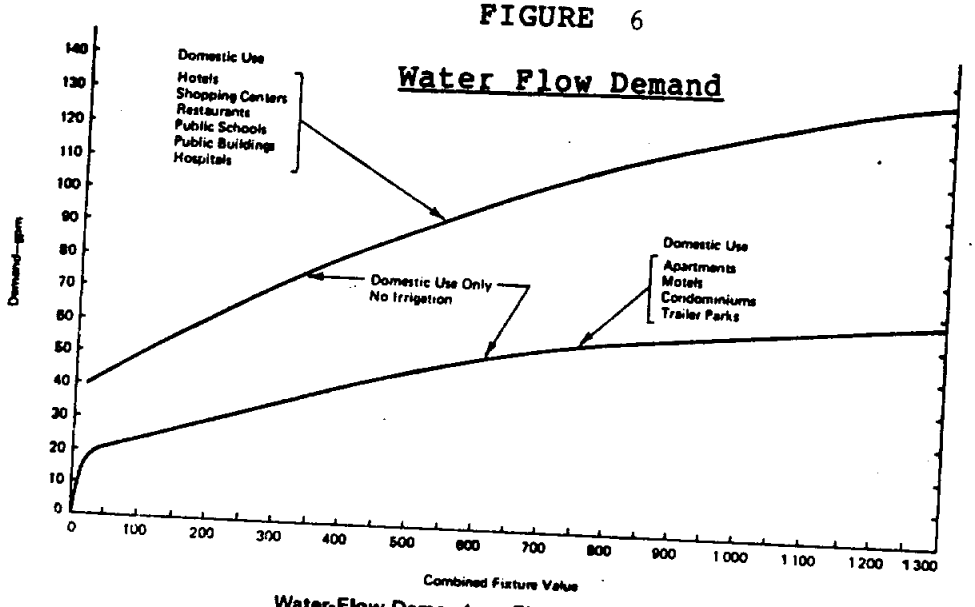
WATER FLOW DEMAND

TABLE 4

Plumbing Fixture Water Values

Fixture Type	Fixture Value Based on 35 psi at Meter Outlet
Bathtub	8
Bedpan washers	10
Combination sink and tray	3
Dental unit	1
Dental lavatory	2
Drinking fountain (cooler)	1
Drinking fountain (public)	2
Kitchen sink: 1/2-in. connection	3
3/4-in. connection	7
Lavatory: 3/8-in. connection	2
1/2-in. connection	4
Laundry tray: 1/2-in. connection	3
3/4-in. connection	7
Shower head (shower only)	4
Service sink: 1/2-in. connection	3
3/4-in. connection	7
Urinal: Pedestal flush valve	35
Wall or stall	12
Trough (2-ft unit)	2
Wash sink (each set of faucets)	4
Water closet: Flush valve	35
Tank type	3
Dishwasher: 1/2-in. connection	5
3/4-in. connection	10
Washing machine: 1/2-in. connection	5
3/4-in. connection	12
1-in. connection	25
Hose connections (wash down): 1/2-in.	6
3/4-in.	10
Hose (50-ft length—wash down): 1/2-in.	6
5/8 in.	9
3/4 in.	12

FIGURE 6



Water-Flow Demand per Fixture Value—Low Range

TABLE 5
AVERAGE WATER USAGE PER CONNECTION

WCID NO. 14 - BEE CAVE

Month	Flow
January	12,124
February	13,824
March	13,035
April	14,078
May	17,524
June	21,233
July	19,471
August	21,780
September	16,018
October	17,967
November	16,249
December	12,202
Total	195,505
AVERAGE	16,292

WCID NO. 17

Month	Flow
January	8,880
February	9,390
March	8,580
April	11,020
May	12,760
June	14,040
July	18,070
August	21,260
September	19,410
October	12,020
November	10,780
December	10,030
Total	156,240
AVERAGE	13,100

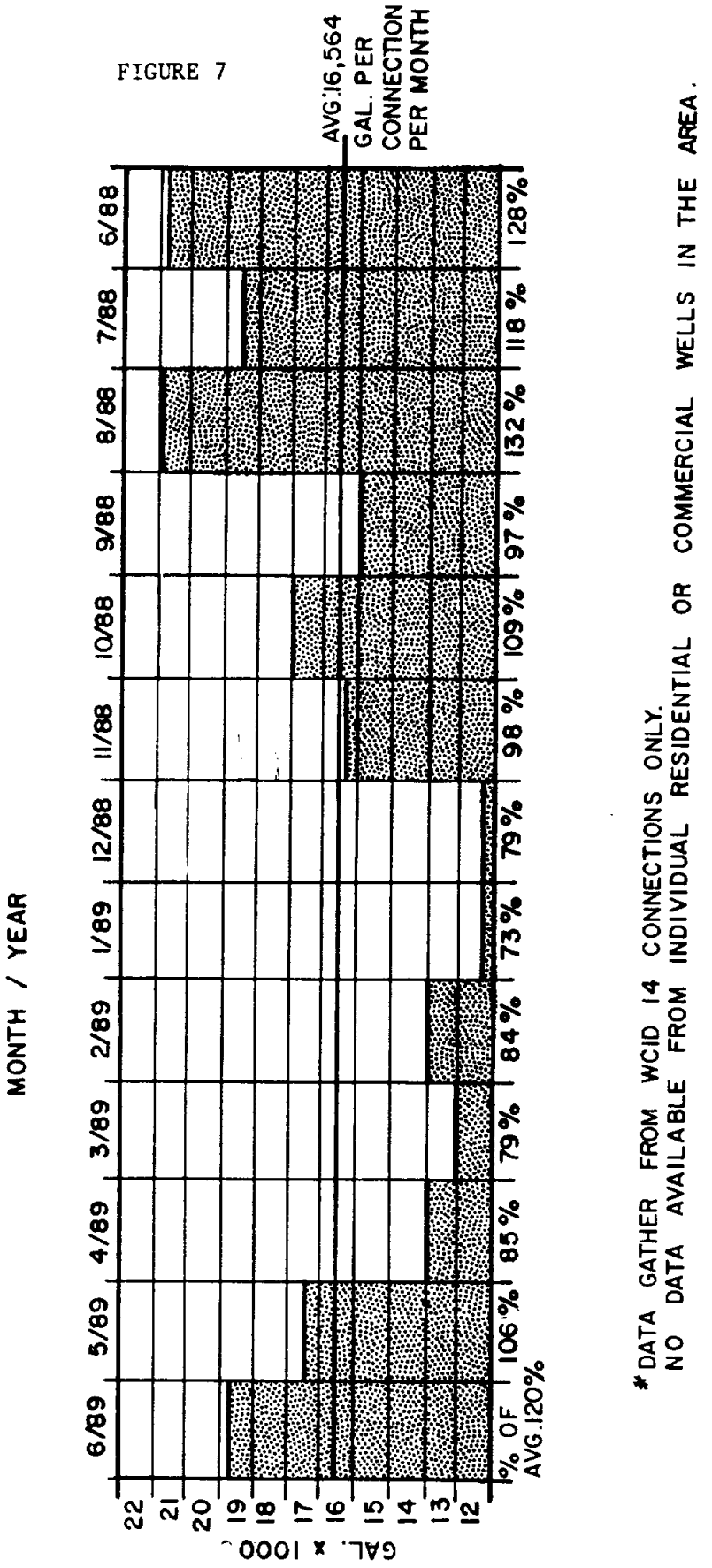
5.5 Historic Average Water Use

Average water use for 1988-89 in the WCID No. 14 service area in Bee Cave is depicted in the Figure 7 and reflects the seasonal peaks typical of most water systems. The same data is available for WCID No. 17 and is depicted in Table 5 and is useful as a regional planning tool. Table 5 also shows the average monthly water use per connection for this same period for both entities. As shown, average monthly water use is approximately 3,000 gallons per connection higher in Bee Cave than in WCID No. 17 as averaged over a 12 month period.

FIGURE 7

Average Monthly Water Use Bar Graph

FIGURE 7



*DATA GATHER FROM WCID 14 CONNECTIONS ONLY.
NO DATA AVAILABLE FROM INDIVIDUAL RESIDENTIAL OR COMMERCIAL WELLS IN THE AREA.

VILLAGE OF BEE CAVE
MONTHLY WATER CONSUMPTION*

FIGURE 7

WCID No. 17 has experienced an increase in average water use per LUE over the past few years. In 1985 the average was 344 gallons per day per LUE and 436 gallons per day per LUE in 1988; a 27 percent increase over the three year period. One factor may have been below average rainfall; another, increased use of extensive landscaping around commercial projects required by City of Austin development ordinances and increased landscaping at new single-family residences. Average water usage is rising in WCID No. 17.

Due to a lack of pertinent data, it is not possible to determine whether the average LUE usage for the WCID No. 14 customers in Bee Cave has been increasing. However, due to the current high usage it can be anticipated that average consumption should decrease with an increase in single-family residences which, on average, should use less water than a commercial establishment on an LUE basis.

These discussions and factors are very important because average water consumption is the primary building block for determining required treatment, pumping and storage capacities. Water conservation programs can also impact average consumption and thus "squeeze" additional capacity from existing facilities.

Due to the limited number of water accounts (58) in the Bee Cave area, it is prudent to evaluate commercial use and residential use. The following Table 6 shows the differences in average consumption and rates of flow for residential and commercial customer categories:

TABLE 6

AVERAGE WATER CONSUMPTION BY CATEGORY

	Residential	Commercial
Average gallons/month/connection	11,485	24,500
Average gallons/day/connection	383	817
Average gallons/minute/connection	0.27	0.57

5.6 Peak Water Consumption

Peaking characteristics are also crucial system planning and design factors. Peak demand typically occurs on summer weekends for both residential and commercial uses. The primary factor in peak demand is lawn watering, followed by laundry, car washing and recreational use. The Texas Department of Health's minimum standard for peak daily water production is 0.6 gallons per minute per connection. The City of Austin utilizes 2.2 gallons per minute per connection which is extremely conservative. (See Figure 4.0)

Based on Bee Cave's current average flows of 0.49 gallons per minute per connection, it would be appropriate to adopt a peak design standard of 1.5 times the average; 0.75 gallons per minute per connection. This factor would be used to design treatment, pumping and storage facilities and provide for an allocation in any shared facilities. As an example, the 40 potential connections in west Bee Cave would require slightly more than 43,000 gallons of daily capacity to meet peak demand periods.

5.7 Design Standards

5.7.1 Texas Department of Health

"Rules and Regulations for Public Water Systems," as adopted by the Texas Department of Health, establishes the minimum water quality and quantity requirements for community type water systems. The minimum water quantity standards are set for system components to ensure a capability to maintain a minimum residual water pressure of 20 psi and a normal operating pressure of 35 psi. Treated storage requirements are set by the Health Department at the rate of 200 gallons per connection of ground storage capacity and; elevated storage capacity of at least 100 gallons per connection in lieu of other pressure maintenance facilities. Elevated storage in the amount of 200 gallons per connection may be substituted for ground storage and pressure tank installations. Booster pump station capacity must have two or more pumping units with a total rated capacity of 2.0 gpm per connection and be sufficient to meet peak demands.

5.7.2 Bee Cave Water Utility

Since Bee Cave has no water utility system it has no system design criteria. While WCID No. 14 owns facilities within Bee Cave, it is not certain what design criteria were utilized in the 1950's to size the system. What is known is that due to the long distances from major transmission mains, storage tanks and pump stations in Oak Hill; the resultant head losses in the 6 inch diameter transmission main and growth in demand in the Oak Hill area, the facilities cannot provide adequate volume or delivery pressure during peak periods and cannot serve the higher elevations at all without significant line improvements, booster pumps and storage. As a case in point, the recently constructed Travis County Precinct #3 Road Office could not be served by WCID No. 14 and had to have an 864 foot well drilled to provide sufficient water. Other recent commercial development such as Bee Cave Automotive, with a WCID No. 14 line in front of the property, is also served by wells.

While it is not anticipated that Bee Cave will immediately begin to design and construct water treatment, pumping and storage facilities it may be appropriate to review the design criteria of WCID No. 14 (City of Austin) and WCID No. 17 to prepare for future adoption of their own design criteria. Those typical design criteria are included for review and discussion. Figure 8, Projected Water Demand, indicates the amount of treated water than Bee Cave or LCRA will need to supply over time.

WCID NO. 17 DESIGN CRITERIA

Average Daily Demand	500 Gallons/LUE/Day
Peak Daily Demand	0.75 gpm/LUE
Peak Hour Demand	1.0 gpm/LUE (+) Fire Flow
WTP Capacity	0.75 gpm/LUE
High Service Pumps	1.0 gpm/LUE
System Storage	500 Gallons/LUE/Day (in addition to WTP clearwell)
WTP Clearwell	25% of System Storage (125 gallons/LUE/Day)

Elevated Storage:

* Standpipe (summation of following:)

A. Equalization	30% of Total Volume
B. Fire Flow	50% of Total Volume
C. Emergency	20% of Total Volume
where Total Volume =	500 Gallons/LUE/Day

* Suspended Elevated Tank

A. Fire Flow 250 Gallons/LUE/Day

where Fire Flow = minimum Texas State Board of Insurance

1. Principal Mercantile & Industrial - 3000 gpm
2. Light Mercantile - 1500 gpm
3. Congested Residential - 750 gpm
4. Scattered Residential - 500 gpm

Source: Travis County WCID No. 17
Regional Water Study - Draft March, 1989

6.0 PROPOSED BEE CAVE WATER UTILITY IMPROVEMENTS

Based on all of the foregoing data, identification of existing need projections of future growth and overall potential development in the Bee Cave area; several water utility development scenarios have been developed. These scenarios include alternatives to rectify the immediate public health problem in west Bee Cave, mid-term system improvements and long-range system development. Each of these is discussed separately later in this section.

6.1 Bee Cave Water System - Immediate Service

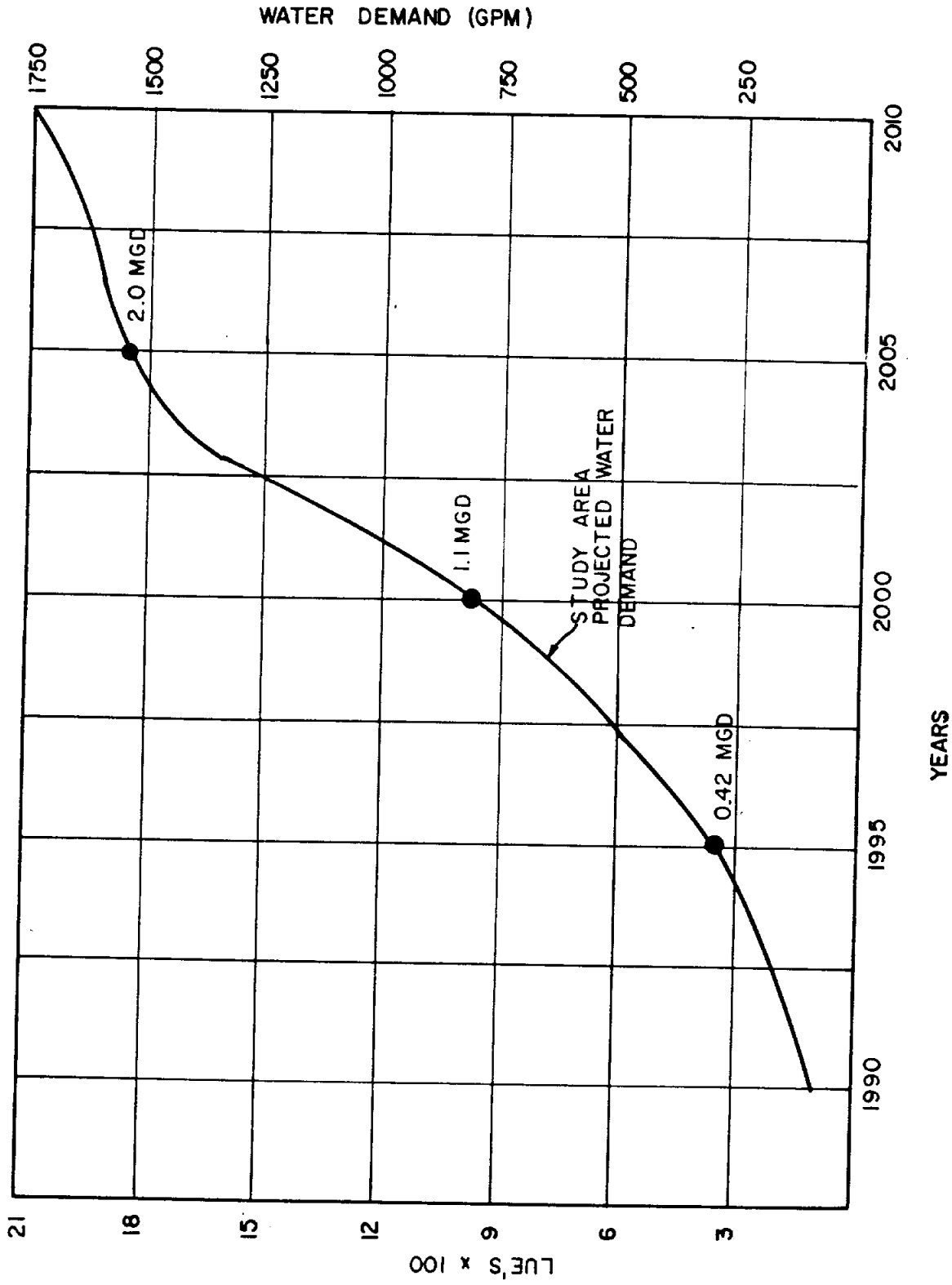
Regardless of the source of water to serve the Bee Cave area, a water storage, pumping, transmission and distribution system will have to be designed and constructed. This effort will be necessary to provide service to areas which have no water and to upgrade and improve service to those areas which currently have an inadequate supply through WCID No. 14. As will be further discussed, the water system designed to service Bee Cave and surrounding area can be designed to operate in conjunction with virtually any treated water source. Each step of the system development, immediate, mid-term and long-term are described in detail in the following paragraphs.

6.1.1 Immediate System Alternatives

As previously discussed, the area with the most acute need and demand for potable water service is the western part of Bee Cave. Portions of this area, such as the Bee Cave West subdivision are not within WCID No. 14 or its service area and have a recent history of well failures. There are other properties in the area that are in WCID No. 14's boundaries; some of which are taxed and others which are not; that do not receive service from WCID No. 14. WCID No. 14 does not currently have a plan to serve those properties.

There are essentially four alternatives to providing a solution for immediate service to these water distressed areas:

- Wholesale, bulk purchase of treated water from Uplands Water Supply Corporation for resale to Bee Cave Water Utility customers
- Wholesale, bulk purchase of treated, "surplus" water from WCID 17 for retail sale to Bee Cave Water Utility customers
- Expansion of WCID 14's transmission, storage and distribution system westward along Highway 71 W and Hamilton Pool Road



BEE CAVE PLANNING AREA
PROJECTED WATER DEMAND

FIGURE 8

- Utilization of existing LCRA raw water purchase contracts from Bohl's Ranch or Homestead to take raw water from the existing Uplands/Bohl's Ranch raw water intake and transmission system, construction of water treatment plant, storage, pumping and distribution system.

6.1.2 WCID 17 Alternative

This alternative takes advantage of the 300,000 gallon WCID 17 water storage tank adjacent to Lake Travis High School which is located at the extreme southwest end of WCID 17. The standpipe is fed by the Lake Travis ISD Booster Pump Station which consists of two 150 gpm centrifugal pumps which results in a firm capacity of 150 gpm and has an overflow elevation of 1,200 feet MSL. While this pressure plane elevation is not quite as high as is desired (1,240 feet MSL) for the ultimate Bee Cave water system it is sufficient to provide immediate service and should be able to serve until the future system is constructed.

One major advantage presents itself from this alternative; the transmission line and distribution system can be installed and put into operation independently of the existing WCID 14 water system. This is extremely helpful because Texas Department of Health regulations do not permit the co-mingling of potable water from treatment facilities which utilize differing treatment processes as is the case between WCID 17 and WCID 14. Essentially, it is possible to design, construct and have this system operational well before any conclusions or decisions are reached regarding long-term water supply relative to an LCRA regional water system, UWSC, West Travis County MUD's 3, 4, and 5, WCID 14 or WCID 17.

Within this alternative, three (3) versions were planned and evaluated:

IP-I This alternative represents the quickest, most direct way to deal with the acute water shortage problem in the western part of Bee Cave. Its basic component is 7,500 LF of 8-inch diameter water line fed directly from the WCID 17 standpipe to the Bee Cave West subdivision and other properties not currently served by WCID 14. It should be noted at this point that it may be possible to reduce the pipe size requirement from

8-inch to 6-inch or 4-inch in some areas over a distance of 2,000 LF which could create an initial cost savings of approximately 15 percent. These items will need to be explored in more detail in the design phase with various review and approval agencies.

The system would be designed and constructed as an integral portion of the ultimate water system. The 8-inch diameter transmission line from the standpipe to Highway 71 W would serve as the final portion of a looped system described in Alternative IP-II. The location of the 8-inch diameter transmission line in this alternate represents the most direct route from the standpipe to Bee Cave West. Several easements would have to be obtained and a bore made across Highway 71 W. These items have been included in the cost per linear foot of the transmission line. Approximately 3,000 linear foot of 8-inch diameter water line could be placed along Highway 71 W, in an easterly direction, to serve any demand between the highway crossing and the end of WCID 14's 6-inch line. This item may be optimal in the first phase depending upon demand for service.

IP-IA This alternate is a variation of alternative IP-I. The primary difference is in the layout where the 8-inch diameter water line follows the existing overhead electric line easement from the WCID 17 standpipe to Highway 71W and turns back westerly to the Bee Cave West area. Similarly to IP-I, an 8-inch diameter water line, approximately 3,000 LF in length, could be installed westerly along Highway 71 W to serve those areas not served by WCID 14.

IP-II This alternative assumes that the WCID 14 facilities in Bee Cave have been acquired and are available for use. It has also been set up to be complimentary to the WCID 17 for future system looping purposes from the standpipe to RR 620, 6,000 LF of 12-inch diameter water line along Hamilton Pool Road (sized to serve immediate and long term needs) and 3,800 LF of 8-inch diameter water line to serve the Bee Cave West area.

The primary advantage of this system is that it contains several components which will become integral parts of the Bee Cave water system and enables the Village to service a much larger area than just Bee Cave West. The primary disadvantages are the increased additional costs associated with the pipe installation and the need for Bee Cave to have operating rights to the WCID 14 system in Bee Cave.

6.1.3 Uplands Water Supply Corporation Alternate IP-III

The Uplands Water Supply Corporation (UWSC) currently owns and operates a 1.8 million gallon per day water treatment plant which is supplied by a 42-inch diameter raw water intake structure on Lake Austin and a 30-inch diameter raw water transmission line from the lake to the water treatment plant site on Bee Cave Road. The treatment plant is approximately 2,500 feet east of the intersection of Bee Cave Road and Highway 71 W.

UWSC currently serves portions of the Estates of Barton Creek, which is within WCID 19, Barton Creek West subdivision and an elementary school within the Eanes Independent School District. According to representatives of UWSC and AMCOR Development Corporation, the project manager of the Uplands project, the water treatment plant operates at or above design capacity throughout August when water demand is highest. Due to this high demand during the summer time period, the UWSC has expressed a concern about their ability to provide sufficient water to Bee Cave and meet all their treated water sales contract obligations. It appears that this particular problem could be resolved through negotiations with other UWSC customers and a detailed analysis of the operation of the water treatment plant to evaluate the optimal and maximum output levels. This evaluation would be performed to determine whether an additional 30 to 50 LUE's of service (36 gpm to 60 gpm).

Should this evaluation indicate that the UWSC water treatment plant can indeed provide the needed amount of treated water there are two methods of transporting the water to the west end of Bee Cave. The first IP-IIIA requires the use of the existing 6-inch diameter WCID 14 line. The second IP-IIIB assumes that an arrangement with WCID 14 cannot be worked out in a timely manner and a new, 12-inch diameter transmission line be installed adjacent to the water treatment plant and that a water storage tank (minimum size 5,000

gallons) be constructed in the vicinity of Bee Cave West. The booster pump station is required because the pressure plane of the water treatment plant is 1,150 feet MSL and the pressure plane of Bee Cave West is 1,240 feet MSL. The layout of this system is depicted in Figure 9.

6.1.4 Bee Cave/West Travis County MUD Alternative IP-IV

The service plan of this alternative is identical to that of the UWSC alternative with distinction that the UWSC raw water line would be tapped and a 50 gpm to 100 gpm water treatment plant be built to serve Bee Cave needs. It is possible that the initial plant size could be enlarged if West Travis County MUD's 3, 4, and 5 indicated that they needed the capacity.

6.1.5 WCID 14 Alternative IP-V

An upgrade of the WCID 14 system in the Bee Cave area and all the way back to Thomas Springs Road is necessary to make this alternative workable. WCID 14 could serve "a few more connections" by constructing a 5,000 gallon to 20,000 gallon storage tank near the intersection of Highway 71 W and Hamilton Pool Road. These improvements would not provide service to Bee Cave West, however, due to capacity limitations of the WCID 14 6-inch diameter transmission line. A new 12-inch diameter transmission line would need to be installed from Thomas Springs Road to a point near Bee Cave West along either Highway 71 W or Hamilton Pool Road, a distance of over 33,000 linear feet. Given the extraordinary cost of this project, lack of water demand between eastern Bee Cave and Thomas Springs Road and improbability of WCID 14 voters approving the bonds necessary for such a project, it is unlikely that this alternative would be a workable solution to the immediate problem.

6.2 Project Cost Estimates

Preliminary engineering cost estimates have been prepared for each of the various water system alternatives: immediate, mid-term, and long-term. The cost estimates are based on 1989 construction costs and no allowances have been made for timing of construction or future inflation. Contingency factors have been included which recognize that no detailed construction plans have been prepared and that several unknowns still exist. However, the cost estimates can be utilized as a general guide to ascertain the magnitude of costs involved for each alternative and to rank and compare the various alternatives.

6.2.1 Immediate Plan - WCID 17 Alternative IP-I

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	8-inch Water line	7,500 LF	$35/LF*	$262,500
2.	Subtotal			$262,500
3.	Construction Contingencies (15% of Line 2)			$39,400
4.	Construction Subtotal			$301,900
5.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 4)			$45,300
6.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			10,000
7.	**IP-I Project Cost**			**$357,200**
8.	Optional 8-inch Water Line along Highway 71 W	3,000 LF	$25/LF	75,000
9.	Construction Contingency (15% of Line 8)			11,200
10.	Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 8+9)			12,900
11.	**TOTAL PROJECT COST**			**$456,300**

*Unit cost includes allowances for boring, easement acquisition, meter vault at standpipe and other miscellaneous items.

6.2.2 Immediate Plan - Uplands Water Supply Corporation Alternative IP-III

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	300 GPM Pneumatic Booster System	1 EA	$45,000	$45,000
2.	100 GPM Pneumatic Booster System	1 EA	$25,000	25,000
3.	5,000 gal Ground Storage Tank	1 EA	$2,500	2,500
4.	6-inch Water Line	8,000 LF	$18/LF	144,000
5.	4-inch Water Line	4,500 LF	$9/LF	54,000
6.	Construction Subtotal			$270,500
7.	Construction Contingencies (15% of Line 6)			40,600
8.	Total Construction Cost			$311,100
9.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 8)			$46,700
10.	Acquisition of WCID 14 facilities			350,000
11.	Legal fees and miscellaneous expenses to establish Bee Cave Water Utility			30,000
12.	**TOTAL PROJECT COST**			**$737,800**

6.2.3 Immediate Plan - WCID 17 Alternative IP-I with Distribution System Pipe Reductions

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	8-inch Water Line	5,500 LF	$35/LF	$192,500
2.	6-inch Water Line	1,000 LF	$18/LF	18,000
3.	4-inch Water Line	1,000 LF	$9/LF	9,000
4.	Construction Subtotal			$219,500
5.	Construction Contingency (15% of Line 4)			32,900
6.	Total Construction Cost			$252,400
7.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 6)			$37,900
8.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			10,000
9.	**IP-I, 1 PROJECT COST**			**$300,300**
10.	Optional 8-inch Water Line along Highway 71 W	3,000 LF	$25/LF	$75,000
11.	Construction Contingency (15% of Line 10)			11,200
12.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Lines 10+11)			12,900
13.	**TOTAL PROJECT COST**			**$399,400**

6.2.4 Immediate Plan - WCID 17 Alternative IP-IA

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	8-inch Water Line	8,500 LF	$33/LF*	$280,500
2.	Subtotal			$280,500
3.	Construction Contingency (15% of Line 2)			$42,000
4.	Construction Subtotal			$322,500
5.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 4)			$48,400
6.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			10,000
7.	**IP-IA PROJECT COST**			**$380,900**
8.	Optional 8-inch Water Line along Highway 71 W	3,000 LF	$25/LF	$75,000
9.	Construction Contingency (15% of Line 8)			11,200
10.	Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 8+9)			12,900
11.	**TOTAL PROJECT COST**			**$480,000**

*Unit cost includes allowances for boring, easement acquisition, meter vault at standpipe and other miscellaneous items.

6.2.5 Immediate Plan - WCID 17 Alternative IP-IA with Distribution System Pipe Reductions

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	8-inch Water Line	6,500 LF	$33/LF	$214,500
2.	6-inch Water Line	1,000 LF	$18/LF	18,000
3.	4-inch Water Line	1,000 LF	$9/LF	9,000
4.	Construction Subtotal			$241,500
5.	Construction Contingency (15% of Line 4)			36,200
6.	Total Construction Cost			$277,700
7.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 6)			$41,700
8.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			10,000
9.	**IP-IA, 2 PROJECT COST**			**$329,400**
10.	Optional 8-inch Water Line along Highway 71 W	3,000 LF	$25/LF	$75,000
11.	Construction Contingency (15% of Line 10)			11,200
12.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Lines 10+11)			12,900
13.	**TOTAL PROJECT COST**			**$428,500**

6.2.6 Immediate Plan - WCID 17 Alternative IP-II

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	12-inch Water Line (Standpipe to RR 620)	6,500 LF	$40/LF	$260,000
2.	12-inch Water Line (Hamilton Pool Road)	6,000 LF	$40/LF	240,000
3.	8-inch Water Line	3,800 LF	$32/LF	121,600
4.	Construction Subtotal			$621,600
5.	Construction Contingency (15% of Line 4)			$93,000
6.	Total Construction Cost			$714,800
7.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 6)			$107,200
8.	Acquisition of WCID 14 facilities			350,000
9.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			30,000
10.	**TOTAL PROJECT COST**			**$1,202,000**

6.2.7 Immediate Plan - Bee Cave/West Travis County MUD Alternative IP-IV

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	100 GPM Water Treatment Plant	1 EA	$150,000/EA	$150,000
2.	450 GPM Pneumatic Booster System	1 EA	$55,000/EA	55,000
3.	150 GPM Pneumatic Booster System	1 EA	$35,000/EA	35,000
4.	20,000 gal Ground Storage Tank	1 EA	5,000/EA	5,000
5.	12-inch Water Line	8,000/LF	$40/LF	320,000
6.	8-inch Water Line	4,500/LF	$32/LF	144,000
7.	Construction Subtotal			$559,000
8.	Construction Contingency (15% of Line 7)			$83,800
9.	Total Construction Cost			$642,800
10.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 9)			$96,400
11.	Acquisition of WCID 14 facilities			350,000
12.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			30,000
13.	**TOTAL PROJECT COST**			**$1,119,200**

6.2.8 Immediate Plan - WCID 14 Alternative IP-V

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	12-inch Water Line	34,000 LF	$40/LF	$1,360,000
2.	8-inch Water Line	4,000 LF	$32/LF	128,000
3.	30,000 gal Ground Storage Tank	1 EA	5,000/EA	5,000
4.	150 gpm Pneumatic Booster System	1 EA	35,000/EA	35,000
5.	Construction Subtotal			$1,528,000
6.	Construction Contingency (15% of Line 5)			$229,200
7.	Construction Total			$1,757,200
8.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 7)			$263,600
9.	Legal Fees and miscellaneous expenses to establish Bee Cave Water Utility			$30,000
10.	**TOTAL PROJECT COST**			**$2,050,200**

6.3 Mid-Term System Improvements

Each of the potential mid-term system improvements assumes that Bee Cave acquires all of the WCID No. 14 facilities within Bee Cave, in fee simple, and has reached a conclusion with regard to the source of treated water. The options for treated water sources are: WCID No. 17, a Bee Cave water treatment facility. Each of these system alternatives is discussed separately.

6.3.1 WCID No. 17 Treated Water Alternative MTP-I

This alternative is workable as long as a firm intergovernmental agreement is entered into by Bee Cave and WCID No. 17 or Bee Cave is annexed into WCID No. 17. Either arrangement would stipulate certain financial considerations and arrangements between both parties with regard to ownership of facilities, debt service requirements, operation and maintenance expenses and capital recovery fees or capital improvement projects.

The mid-term improvements required by this alternative would be designed to serve approximately 1,500 LUEs in the Bee Cave area including a portion of Bohls Ranch, Homestead and continued development within the Bee Cave city limits. The system improvements would include booster pump station improvements, storage, transmission mains and water treatment plant expansions in addition to the immediate service system plan improvements. Several of these components would be built as expansions of existing WCID No. 17 facilities or new facilities which would be added to the WCID No. 17 system.

The existing Lake Travis High School pump station would be expanded from 300 gpm to 1,800 gpm to service the Bee Cave area. A 300,000 gallon standpipe would be constructed next to the existing 300,000 gallon standpipe on Flint Rock Hill, behind the high school. The standpipe would be connected to the Bee Cave water system by 6,500 LF of 12-inch diameter line from the standpipe to the existing WCID No. 14 12-inch line in RR 620. Another 8,500 LF of 12-inch line would be installed along Highway 71 West from RR 620 to a point beyond Hamilton Pool Road to tie into the immediate service plan 8-inch line which runs from the existing standpipe to Bee Cave West. This line would be available to serve areas on both sides of Highway 71 as well as including the Homestead.

Cost estimates for this alternative are as follows:

Mid-Term Plan - WCID No. 17 MTP-I

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	12-inch Water Line	15,000 LF	$40/LF	$ 600,000
2.	300,000 Gallon Standpipe	1 EA	0.35/GAL	105,000
3.	1,800 gpm Pump Station	1 EA		500,000
4.	1.6 MGD Water Treatment Plant Expansion	1 EA		2,000,000
5.	Subtotal			3,205,000
6.	Construction Contingency			$480,750
7.	Total Construction Cost			$3,685,750
8.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 7)			$552,860
9.	Other Project Expenses; legal fees, etc.			100,000
10.	**TOTAL PROJECT COST**			**$4,338,610**

6.3.2 Bee Cave Utility Treated Water Alternative MTP-III

An alternative which presumes that Bee Cave has its own water treatment facility has several subsets: Bee Cave participates in the expansion of UWSC treatment facility; Bee Cave participates in the construction of an LCRA regional water treatment plant (MTP-IIA); Bee Cave builds a water treatment plant jointly with West Travis County MUDs 3, 4 and 5 (MTP-IIB); or Bee Cave constructs its own water treatment plant (MTP-IIC). The relative cost of each of these alternatives is the same, although the prorata share of a larger facility may result in as much as a 25 percent cost savings on a per gallon basis. For planning purposes, the worst case which is Bee Cave building its own treatment plant, will be assumed for cost estimating purposes.

The system would consist of a 1.6 MGD water treatment plant, 1,200 GPM 1080' HGL pump station, 600 GPM, 1240 HGL pump station, 120,000 gallon 1240 HGL storage tank, 12-inch transmission line from the treatment plant site on Bee Cave Road to Hamilton Pool Road. This system would connect to the immediate service system and replace WCID No. 17 treated water with Bee Cave treated water.

6.3.3 Mid-Term Plan - Bee Cave Water Utility MTP-II

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	1.6 MGD Treatment Plant	1 EA	$2,400,000	$2,400,000
2.	1,200 GPM Pump Station	1 EA		325,000
3.	600 GPM Pump Station	1 EA		170,000
4.	120,000 Gallon Tank	1 EA		45,000
5.	12-inch Line	12,000 LF	$40/LF	480,000
6.	Subtotal			$3,420,000
7.	Construction Contingency (15%)			513,000
8.	Total Construction Cost			$3,933,000
9.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 8)			$589,950
10.	Other Project Expenses; legal fees, etc.			100,000
11.	**TOTAL PROJECT COST**			**$4,622,950**

6.4 Long Range Bee Cave Water Utility

It is extremely difficult to determine exact facility requirements, locations and time frames for construction until some of the preceeding alternative selection processes take place. Given that the LCRA's Lake Travis West plan is projected to provide service to western Travis and northern Hays counties and the prospects for continued development along Highway 71 West, RR 620, Bee Cave Road and Hamilton Pool Road, it is highly unlikely that the Bee Cave water utility would be a "stand alone" system. In fact, Bee Cave and LCRA, as well as other water suppliers and customers, will be compelled to cooperate and coordinate their efforts in an attempt to optimize water production and conservation at the most economical basis possible.

A long range Bee Cave water utility system which would be complimentary to a regional system has been developed to serve 6,000 LUEs. Although the actual location of treatment and storage facilities are subject to the regional concept, the specific components necessary to serve the Bee Cave service area have been identified in the following cost estimate.

The Bee Cave Ultimate Service Area - Conceptual Plan is shown as Figure 12.

6.4.1 Long-Term Bee Cave Water Utility LTP-I

Preliminary Engineering Cost Summary

	Item	Quantity	Unit Cost	Total
1.	6.5 MGD Treatment Plant	1 EA		$ 13,000
2.	6,500 GPM 1240 Pump Station	1 EA		2,000,000
3.	6,500 GPM 1080 Pump Station	1 EA		2,000,000
4.	300,000 Elevated Storage Tank	3 EA	100,000	300,000
5	650,000 Gallon Ground Storage Tank	1 EA		227,500
6.	24-inch Water Line	8,000 LF	$80/LF	640,000
7.	20-inch Water Line	11,000 LF	68/LF	748,000
8.	16-inch Water Line	19,500 LF	$55/LF	1,072,500
9.	Subtotal			$19,988,000
10.	Deduct Cost of Mid-term Improvements			(3,420,000)
11.				16,568,000
12.	Construction Contingency (15%)			2,485,200
13.	Total Construction Cost			$19,053,200
14.	Design Engineering, Surveying, Geotechnical, Construction Administration (15% of Line 8)			2,857,980
15.	Other Project Expenses; legal fees, etc.			500,000
16.	**TOTAL PROJECT COST**			**$22,411,180**

While it is obvious that neither Bee Cave or LCRA will immediately embark on the design and construction of the ultimate long range water system it is helpful, as a guide, to understand the magnitude of expenditures involved. The Village of Bee Cave will ultimately invest over $32 million in a water system to service approximately 6,000 LUEs of development in its service area. This is an endeavor not to be undertaken lightly and will require prudent financial planning and engineering.

7.0 WATER CONSERVATION

As previously discussed, water conservation can play a major role in system design and operation. The Texas Administrative Code (TAC) 31 Section 355.15(b)(7) under which Bee Cave and LCRA have received funding for this study, requires that a water conservation plan be developed as a part of the effort. Water is our most important natural resource, and probably the most abused. A water conservation plan should be developed and implemented for every water supply service area. This approach and concern are evident in recent policy directives at the Texas Water Development Board and the Lower Colorado River Authority.

While the supply of clean, usable water has diminished over the past thirty years, the per capita water use has increased by about four gallons per person per day per decade. In several areas of the state and nation, mandatory water rationing and restrictions have become a part of everyday life. Travis County currently enjoys large supplies of fresh water supplied from the Colorado River basin and various underground aquifers. With proper conservation measures, this supply will sustain projected County growth well into the next century.

Water conservation for Bee Cave is a two step process. The first step is a water conservation plan utilizing techniques such as public education and awareness, local building and plumbing codes to reduce water consumption, and rate structures which discourage excessive water use. The second step is called a drought contingency plan. This includes mandatory measures aimed at reducing water consumption to a level consistent with available supplies in drought conditions. A drought contingency plan may include such measures as economic incentives for conservation or penalties for excessive use; restrictions on non-essential water uses; and in extreme cases; civil enforcement of emergency water rationing regulations.

In theory, if the first step measures are implemented, then, hopefully, the second level requirements will not be necessary. However, extended extremely dry weather conditions or a catastrophic impact on the Colorado River could require a drought contingency plan to be implemented regardless of how well a general water conservation plan is followed.

Water conservation policies are currently in effect in many areas of the country, including Texas. Reductions in residential, commercial, and industrial water use as high as 25 percent have been achieved with conservation measures. However, reductions of 5 to 15 percent are more typical. A drought contingency plan, which includes more serious conservation measures, can reduce water usage by 50 percent during emergency conditions.

Reduction of water use can have significant impacts. Obviously, it can lower water bills; but since much of the water saved is hot water, it can also mean energy savings. Less water consumption can also result in smaller and longer lasting septic tanks or other on-site wastewater treatment systems. For centralized water and wastewater collection systems, water savings can translate into smaller facilities and less capital cost for expansions. Water conservation may also have a potential negative effect on some suppliers which depend upon water sales to generate revenues, particularly if their debt repayment is revenue based. The full impacts of water conservation however, are much more far reaching.

Another benefit of water conservation is decreated wastewater production. With an effective conservation program, the costs of wastewater treatment facilities are often reduced. Until conservation effects are adequately documented, wastewater collection systems are usually required to be designed for peak flows and no real savings are seen. When water and wastewater facility costs are reduced, taxes and utility bills should be lowered. Risks associated with wastewater pollution of surface and ground waters are reduced.

7.1 Water Conservation Plan

Residential water use has two components; 65 percent for personal use, washing, laundry, etc. and 35 percent for exterior uses such as lawn watering and car washing. Several methods of water conservation will be described in this section relative to this break down of usage. Those methods are:

* Use of WATER SAVING DEVICES AND APPLIANCES by existing customers;
* Revising PLUMBING CODES to encourage the use of water conservation devices and appliances in new construction and remodeling;
* RETROFIT PROGRAMS to improve water use efficiency in existing buildings or appliances;

* Conservation oriented LANDSCAPING AND OUTDOOR WATER USE;

* RATE INCENTIVES which encourage conservation;

* Installation, monitoring, and repair of METERS;

* Instituting a LEAK DETECTION AND REPAIR program;

* Encouraging RECYCLING AND REUSE of wastewater; and

* Reducing water use through EDUCATION AND INFORMATION (i.e. changing water use habits).

To be effective, each of these methods must be implemented with a program of public information and marketing and perhaps most importantly, enforcement. Not all methods are applicable to every type of water system or stage of development; but most can be utilized to some degree or another.

7.1.1 Water Saving Devices and Appliances

Approximately 40 percent of the total in home residential water useage is consumed in toilet flushing and another 35 percent is used for bathing. The difference between using 50 gallons of water a day as opposed to 80 gallons a day may be as simple and inexpensive as installing a flow restricting shower head and volume displacement device in the toilet. Tests with such devices have proven successful in saving water and have presented no inconvenience or significant adjustments for the people using them. Being conscious of the use of water and making small changes in personal habits, like taking shorter showers and not letting water run while washing dishes, can result in even greater water savings.

For one person, the typical five gallon flush toilet contaminates about 13,000 gallons of fresh water each year to move only 165 gallons of actual waste. Through the use of toilet dams, tank displacement devices, and low flush toilets, the average flush can be reduced to 3.5 gallons or less; a savings of approximately 2,740 gallons per person, or 8,760 gallons per year for an average family.

After the toilet, the heaviest water user in the house is the shower. Approximately 30 percent of the total household water consumption goes for

showering and bathing; roughly 80 gallons a day for a family of four. Flow rates in shower heads generally vary between 3 gpm to about 10 gpm.

Sizeable water savings can be obtained by installing a flow restricter for shower heads and sink faucets. Because flow restricters increase water velocity, the reduction in water volume is usually not noticeable, yet water savings are in the neighborhood of 30 to 50 gallons per day. Assuming a savings of 30 gallons per day, the yearly amount of water savings would be approximately 10,950 gallons.

Faucet aerators mix air with the water as it leaves the faucet. This gives the illusion of more water flowing from the tap than actually is. Faucet aerators are inexpensive, easy to install, and most types use about 50 percent of the water of a regular faucet.

Automatic clothes washing machines account for about 15 percent of the water consumed in households where they are present. Top loading models which are most common require about 35 to 50 gallons per cycle. Water and energy savings can be achieved by using the proper water and temperature setting for the size and type of load being washed. Many appliance makers offer models which use less water and energy to clean an equivalent load. Publications such as Consumer Reports can be helpful in comparing conservation features when purchasing a washer.

7.1.2 Plumbing Codes

Adoption or revision of plumbing codes to standardize the use of water saving devices and appliances in new home construction is perhaps the most effective method of achieving long-term flow reduction within a community. Prior to the adoption of code revisions, a comprehensive study should be done to research specific items available on the market and determine which ones are effective (and cost effective) enough to mandate specifying in new home construction. This process can be simplified somewhat by obtaining copies of similar codes already being used in other communities to use as a beginning point. This product evaluation needs to be updated periodically as products are introduced and redesigned. The City of Austin has an excellent water conservation plumbing code which works well for consumers and builders.

Revision of the existing plumbing code will necessitate cooperation with area builders. Although one of the side effects of a plumbing code revision of this type may be to slightly increase the price of a new home, the long-term benefits of lower net utility bills and fewer tax increases should outweigh this price increase. Also, it should be noted that a flow reduction program can make up to 23% more wastewater service available for proposed development. This is particularly important in areas such as Bee Cave where water and wastewater service may be the limiting factor on growth.

7.1.3 Retrofit Programs

Incentives such as discounts can be incorporated into water rate structures to encourage customers to replace their existing appliances with less water intensive models. Local regulatory authorities which review and approve remodeling projects should be urged to require water saving appliances in all reconstruction.

7.1.4 Outdoor Water Use

A large percentage of residential water consumption goes to outdoor uses such as landscape maintenance and car washing. A change in public attitudes about landscaping can have significant effects upon the total amount of residential (and commercial) water use. Virtually all residential outdoor water use consists of watering vegetation. Choices made in selecting lawn grasses, trees, and shrubs are probably the most important factor in the effectiveness of outdoor conservation measures.

Xeriscaping, the use of native plants in landscaping, can provide lawns that are not only attractive but are also less labor and water intensive and blend with the surrounding environment. Planting, or leaving existing, native trees rather than using fast growing, short life, exotic species should be encouraged whenever possible. Less water intensive grasses such as Bermuda should be suggested instead of varieties like St. Augustine which require constant attention and abundant amounts of water.

Many attractive native species of shrubs and trees are available from local nurseries. Some suggested tree varieties include Live Oak, Texas (Spanish) Oak, Shumard (Red) Oak, Redbud, Little Walnut, Flameleaf Sumac, Texas (Mexican)

Persimmon, and the Texas Mountain Laurel. Many hardwoods such as Oaks, which are usually considered slow growing are capable of fairly rapid growth with the added moisture provided by typical lawn watering.

Most of the Bee Cave planning area will be developed as large lots unless centralized wastewater service is available. These types of Hill Country lots lend themselves particularly well toward natural areas. By leaving the existing vegetation and topography intact, the natural environment is preserved and a majority of the site is maintenance free. This concept should be encouraged whenever possible.

Another area in which outdoor water use can be reduced is the methods in which vegetation is watered. The typical "set and forget" method of lawn watering is inefficient and expensive. Hand watering, when possible, is the most efficient way to get the proper amount of water where it is needed most. Soaker hoses can be an efficient way to distribute water because they are not as subject to evaporation. Sprinklers which offer greater flexibility in directing spray allow the user to water more yard and less driveway. Automatic sprinkler systems, when used properly can be one of the most efficient methods of watering because the duration can be timed and the application period can be set to occur in the early morning when evaporation is less and water pressure is best. Automatic sprinkler systems must be monitored however to be sure they don't water when it is not needed. Otherwise, they can be as wasteful as they are efficient. Commercial systems are especially guilty of this. Watering is most efficient in the early morning while the ground and air are still cool and should be avoided on especially windy days if possible. Perhaps most important is to apply the correct amount of water. Watering less, on a more frequent basis, will benefit vegetation much more than periodic overwatering.

7.1.5 Rate Incentives

Rate incentives intended to encourage participation in flow reduction programs can either be positive or negative in nature. Positive incentives, such as lower rates or rebates on utility bills for retrofitting existing homes and businesses with water saving devices or appliances, can be effective in reducing water consumption in communities where a great deal of the development has already taken place. This form of incentive however, can also reduce the

supplier's revenue from water sales and should be examined carefully to determine the true cost effectiveness of this portion of the program.

Negative rate incentives are seldom popular and should only be used as a last resort. Arbitrarily raising water rates in order to promote conservation can produce many negative side effects which can outweigh the effectiveness of the incentive. Changes in pricing structure from the traditional declining block rate to either a uniform unit rate or increasing block rate can achieve the same results with less opposition.

Bee Cave is in a unique position to establish water rates that will encourage conservation. Due to the limited development in the area and the small initial customer base (approximately 100 customers), it should be relatively easy to implement plumbing codes and retrofit programs which will improve water conservation. The same program can be applied to the Homestead once it becomes a water customer area as well as to new construction and new subdivisions such as Bohls Ranch.

7.1.6 Metering

Effective metering is the key to monitoring water use and conservation measures. Metering key points in the system, combined with water sale records can indicate areas of water losses which might otherwise go undetected. Because of the nature of fractured limestone, major water leaks can pour hundreds of thousands of water into underground cracks and porous rock without any surface signs. When leaks are indicated through metering records, a leak detection program should be instituted to pinpoint the exact location so repairs can be made. As with any equipment, the data is only as accurate as the meter which produces it. Meter calibration and replacement should be included as part of the Bee Cave water utility regular maintenance program.

7.1.7 Recycling and Reuse

Reuse of wastewater is also a method of conserving raw water supplies. Usually these are applications in which treated wastewater effluent is used for irrigation instead of potable or groundwater. In some areas, certain industrial users have initiated processes which use treated wastewater effluent. The Bee Cave Planning Area does not lend itself to either

significant areas of agriculture or industry. Recycling and reuse of wastewater will not be a practical water conservation measure until centralized wastewater service is available.

7.1.8 Education and Information

The most important part of any water conservation plan is public education and acceptance. No conservation plan will be effective without adequate public support. The key to gaining acceptance is through education. Customers of a water supply system should understand both the long-term benefits of conservation as well as the immediate impacts upon their water bill. Public education is not a one time endeavor but, rather, a continuing process. Many authorities fall short in implementing conservation measures becuase of lack of follow through. Conservation policies can be legally enacted much faster than they can be effectively implemented and monitored. Water conservation is a slow, on-going process that must be continually stressed until it becomes habit. There are many mediums for water conservation education. Notices included along with utility bills often get customer's attention. Utility or developments newletters, local newspapers, and even radio and television spots are also common methods of providing public information.

7.2 Effects of Water Conservation

As can be seen in the following table, indoor water use can be reduced up to 23% through such simple measures as shower head inserts and water saving appliances. When those same percentages of reduction are applied to the projected growth of the Bee Cave area, the full benefits of water conservation can be seen. Table 14 shows the effects of indoor water conservation measures on overall projected water demand. When the effects of outdoor water conservation are added, potential savings can be increased even further.

TABLE 7

Indoor Residential Water Use And
Water Savings With Conservation

Indoor Water Use	Total Indoor Use (Percent)	Without Conservation (GPCPD)	With Conservation (GPCPD)	Reduction (Percent)
Toilet Flushing	40	25	17.5	30
Bathing	30	20	16.0	21
Lavatory Sink	5	3	3.0	-
Laundry & Dishes	20	13	9.5	27
Drinking & Cooking	5	4	4.0	-
TOTAL	100	65	50.0	23

NOTES: 1) Original data: USEPA
2) With Conservation assumes the use of toilet dams, plastic shower head inserts, and water conserving dishwashers and washing machines.
3) GPCPD - gallons per capita per day.

TABLE 8

Possible Water Demand Reduction
Through Water Conservation Measures (1)

Indoor Water Use	Total Indoor Use (Percent)	Without Conservation (GPD)	With Conservation (GPD)	Reduction (Percent)
Toilet Flushing	40	357,500	250,250	107,250
Bathing	30	268,125	211,820	56,305
Lavatory Sink	5	44,690	44,690	-
Laundry & Dishes	20	178,750	130,490	48,260
Drinking & Cooking	5	44,690	44,690	-
TOTAL	100	6,120,000	4,590,000	211,815

NOTES: * Original data: USEPA.
* With Conservation assumes the use of toilet dams, plastic shower head inserts and water conserving dishwashers and washing machines.
* GPD - gallons per day
(1) Projected for the year 2020 (2,750 LUEs @ 500 gpd/LUE)

An effective conservation program can provide long-term benefits to Bee Cave as well as the individual consumers. Justification for initiation of such a program can be made in terms of short-term or long-term benefits but need not be justified by both. Long-term monetary benefits to Bee Cave can result from reductions in capital costs of treatment and storage facilities over time. The short-term effect of reducing Bee Cave's water use may be to decrease potential

revenues without substantially lowering the initial costs of installing, operating and maintaining a water system. Potential lost revenues can be recovered through the addition of new customers or by rate increases. Potential lost revenues can also be avoided or at least compensated by gradual implementation of this type of program.

Individual users can also benefit in the long run in terms of capacity. Lower fixed costs associated with constructing and operating a smaller facility, or delaying facility expansion, theoretically translate to lower (or smaller increases in) water and wastewater bills as well as property taxes to pay for such improvements.

7.3 Drought Contingency Plan

The second phase of a comprehensive water conservation program is a Drought Contingency Plan. This plan includes specific emergency provisions which would be enacted in the case of a severe drought or other serious impact on Bee Cave's water supply. Because impacts on water supplies can occur rapidly and with little or no warning, planning ahead can save time and valuable water resources in such an event.

The most obvious circumstance which might require implementation of such a plan is a severe drought which impacts Lake Travis or Lake Austin and/or the watersheds which feed the Colorado River Basin. During the late 1980s, Lake Travis has experienced several level fluctuations due to LCRA operating characteristics to fulfill downstreet commitments and area weather conditions. Although droughts do not occur suddenly, emergency measures are often not enacted until the situation has reached critical stages. Other circumstances which might call for emergency conservation measures include biological or chemical contamination of water supplies, acts of God, or sabotage affecting water supplies or key water production or distribution components. Although these types of emergencies could be attacked and resolved in shorter time periods, prior planning could make the difference between residents having little to no water for several days.

7.3.3 Initiation and Termination Procedures

Just as Bee Cave must be prepared with established triggering conditions for stages of the Drought Contingency Plan, they must also outline in advance what the initiation and termination procedures of these stages are. By what authority is each phase initiated? what steps will be taken in each phase and in what order? What are the triggering mechanisms that signal the end of a phase? All of these questions should also be addressed in the Plan.

The final step of the Drought Contingency Plan is the establishment of policies and procedures by which the Plan is begun and terminated. Development of these policies and procedures will be the responsibility of the governing body that owns and operates the water utility system, in this case the Bee Cave Village Commission.

7.3.1 Drought Contingency Measures

Drought contingency measures can take a variety of forms depending upon the severity of the situation. General measures, in the order of implementation include:

1. Banning non-essential water uses;
2. Reducing essential useage;
3. Water rationing;
4. Enforcement through utility rates;
5. Enforcement through civil/criminal penalties;
6. Location of alternative sources of water.

7.3.2 Triggering Conditions

The triggering mechanisms for various phases of a Drought Contingency Plan are specific to each utility. They can be tied to lake levels, percent of actual versus projected demand, or other utility specific factors. Whatever the agreed upon mechanisms, the Plan should include triggers for mild, moderate, and severe conditions. Typical measures for each stage include:

Mild Conditions:

* Notification and suggestions by mail;
* Activate information center, call news media;
* Remind public of condition daily;
* Initiate voluntary lawn watering schedule;

Moderate Conditions:

* Mandatory lawn watering schedule;
* Fines for wasting water;
* Excessive use fees and surcharges;
* Prohibit non-essential uses;
* Request/require help from non-municipal users;

Severe Conditions:

* Prohibit all outdoor water use;
* Mandatory water rationing, fines for non-compliance;
* Decrease/stop water for all non-municipal uses (industry, commercial, etc.)

8.0 WATER UTILITY SYSTEM FINANCE

Perhaps the most crucial issue facing the Village of Bee Cave, LCRA and other water utilities is that of financing the capital investment to establish a system and producing adequate revenue on an annual basis to provide debt service coverage and pay for operations, maintenance and management. In Bee Cave's case, the concern is compounded by the fact that a portion of the Village is within WCID No. 14's boundaries and subject to an ad valorem tax for that entity. Other areas of Bee Cave are in no taxing entity other than Travis County, Lake Travis ISD and the rural fire district. The Village of Bee Cave does not currently impose an ad valorem tax within the city limits but finances its operations from sales tax revenues which average between $5,000 and $6,000 per month.

In order to pay for a water system and its operation, Bee Cave will have to secure funding from one or more of the following sources:

- Rates and charges for water service to customers
- Capital recovery fees
- Ad valorem taxes
- Benefit taxes
- Grants or loans from state or federal agencies
- Property assessments.

8.1 Bee Cave Revenue Base

The two square mile area of Bee Cave is appraised on an annual basis by the Travis Central Appraisal District. For 1988 the values are as follows:

Account Type	Number of Accounts	Appraised Value
Real	184	$26,445,125
Business	33	1,853,135
Personal	N/A	
Total		28,298,260
Total of Bee Cave in WCID No. 14 (1987)		22,666,872
Exemptions (AG/Historial, etc.)	26	7,985,406
Exemptions of Bee Cave in WCID No. 14 (1987)		6,644,507
Net Taxable Value		20,312,854
Net Taxable Value of Bee Cave in WCID No. 14 (1987)		16,022,365

For comparison the next taxable value of all property in WCID No. 14 of in 1987 included 1,337 individual accounts valued at $118,734,728. Assuming that WCID No. 14 experienced a 5 percent to 10 percent decrease in values for 1988 the total would be $109,829,670. Therefore, Bee Cave represents approximately 13.5 percent of the WCID No. 14 tax base.

Based on a WCID No. 14 tax rate of $0.17 per $100 in valuation Bee Cave generated $27,238 in revenue to WCID No. 14 from ad valorem taxes. If Bee Cave applied the same rate to all property in the city limits, the Village would have generated approximately $34,500 in revenue which could have supported a debt of approximately $320,00. A tax rate of $0.25 per $100 valuation will support a debt of nearly $450,000. These numbers are presented to indicate a range of debt which could be incurred and supported by an ad valorem levy over the entire Bee Cave tax base which will be helpful when formulating a plan to acquire the WCID No. 14 facilities through deannexation and cash payment.

Current WCID No. 14 customers in Bee Cave pay an average of $2.60 per 1,000 gallons for water. For a 1988 consumption of 11,528,500 gallons, $29,975 in revenue was generated. The combination of water service revenues and tax revenues is approximately $57,200.

8.2 Immediate Service Alternative

Because of the peculiarities of the Immediate Service Plan to provide water to Bee Cave West and other unserved areas utilizing WCID No. 17 on a temporary basis, the potential financing schemes will be discussed in as detailed fashion as possible. Even though the initial expense is lowest; approximately $300,000 to $400,000, the potential customer base is also very small. In all likelihood the initial number of customers will be between 25 and 40, and even though they do not currently pay WCID No. 14 taxes, the Village cannot impose a differential tax unless a defined area bond district or a Public Improvement District is created. Both are certainly possible alternatives in this case.

Creating either a defined area or Public Improvement District would allow the non-WCID No. 14 service areas of Bee Cave to elect to be taxed on an ad valorem

basis or benefit basis to repay debt incurred to install a water system. A defined area bond issue essentially allows a specified area within a political subdivision to tax itself at a rate necessary to pay for improvements which serve only that area. A Public Improvement District does the same thing but also allows for other improvements beyond utilities.

Assuming that all of the property in Bee Cave which is not in WCID No. 14 would be available for a defined area or Public Improvement District debt issue; then the following situation would exist:

- Estimated net taxable value of approximately $4.3 million
- Number of parcels of approximately 45

If this area is to be initially encumbered to pay the debt for the new water system installed, it appears that a benefit basis tax will be more equitable than would an ad valorem tax. The basic principal behind this is that each parcel of real estate receives equal benefit from the water system whether it is improved or not. In the case of the Bee Cave West subdivision each lot would be assessed the same benefit under the theory that, had the original developer installed a water system, the cost would have been divided equally among all the lots and included in the sales price of the lots.

At current market rates, the annual revenue required to service a $300,000 debt is between $35,000 to $37,000 per year. This debt service, when combined with the cost of treated water from WCID No. 17 and the administrative, operations and maintenance costs of running a water system will determine the total amount of revenue which will have to be generated on an annual basis to operate the system in a prudent manner. The only practical way to reduce this annual revenue requirement is through the implementation of capital recovery fees or property assessments. As an example, if each of the 45 properties that would immediately benefit from the installation of a water system were to pay a capital recovery fee, the amount of money to be borrowed would decrease substantially. Conversely, more water system could be built with the same amount of debt.

8.3 Capital Recovery Fees

These fees, usually paid at the time of water service commitment allow a water utility to more quickly recover or defray system capital costs. Those facilities generally include treatment plants, pump stations, storage reservoirs and transmission facilities. They do not include the cost of facilities to extend service to individual customers or distribution system costs.

Determination of a capital recovery fee cannot be made by Bee Cave alone. The Village will need to petition the Texas Water Commission with a proposed capital recovery fee schedule and supporting documentation for ratification by the Water Commission. This would be done after the initial project selections have been made and capital items and customers and/or properties identified.

Senate Bill 336 regulates the use of capital recovery fees. The intent of the legislation is to determine how the fees are derived and utilized. In typical fashion, however, the language is broad and subject to interpretation in several areas. It is very clear, however, that punitive damages will be applied to governmental entities that improperly change or improperly utilize those fees.

Because of the complexities of all of the immediate and mid-term service options it is not prudent to attempt to calculate an appropriate capital recovery fee for a Bee Cave Water Utility. Depending on which projects are selected for implementation the capital recovery fee could range from $500 per LUE to $2,000 per LUE in the future.

8.4 Water Rates

Calculation of water rates for all of the immediate service options is dependent on several items:

- Source and charges for treated water
- Amount of debt to be supported by ad valorem or benefit taxation
- Operations, maintenance and administrative costs
- Initial cost of system.

Three alternate rate structures for purchase of treated water from WCID No. 17 have been prepared. Each of the preliminary estimates includes a debt service component to attempt to create an equivalency for out-of-district service. As a basis for comparison, WCID No. 17 recently approved a contract to sell Lakeway MUD "surplus" water at a rate of $1.25 per 1,000 gallons. The calculated rates for bulk purchase of treated water from WCID No. 17 are as follows:

DEVELOPMENT OF WHOLESALE WATER RATES FOR PURCHASE
OF WATER FROM WCID NO. 17 AND SALE OF WATER TO BEE CAVE

APPROACH #1

Assume LCRA purchases water from WCID No. 17 under large meter rates currently in effect. Rates would be adjusted to make Village of Bee Cave residents pay an additional amount to reach parity with WCID No. 17 district members.

Current minimum large meter charge		$354.90 per month
6-inch meter includes		150,000 gallons
Cost of water in excess of minimum		$2.40 per 1,000 gallons
Average annual debt service		$355,059 per year
Average consumption for Bee Cave		
30.00 connections @ 150 gpcd		300,240 gallons per month
120.00 gal/day/cap/conn		
2.78 cap/conn		
Variable O&M costs		$115,640 per year
O&M RATE	=	$2.38 per 1,000 gallons
DEBT SERVICE RATE	=	$2.19 per 1,000 gallons
LCRA DEBT SERVICE	=	$1.76 per 1,000 gallons
TOTAL RATE		$6.33 per 1,000 gallons from WCID No. 17

*This assumes that LCRA will construct the 8-inch transmission main from WCID No. 17 to Bee Cave.

APPROACH #2

Assume LCRA pays the current large meter rate but does not pay the full cost of debt service. A five year contract is assumed.

Average annual debt service due		LCRA participation	Total
1959 series	$63,675	0.00%	$ 0
1980 series	40,125	100.00%	40,125
1986 series	309,138	50.00%	154,569
		AVERAGE =	$194,694

O&M RATE	=	$2.38 per 1,000 gallons
DEBT SERVICE RATE	=	$1.20 per 1,000 gallons
LCRA DEBT SERVICE	=	$1.76 per 1,000 gallons
DISTRICT RATE	=	per 1,000 gallons
TOTAL RATE	$5.34 per 1,000 gallons from WCID No. 17	

APPROACH #3

Assume that the impact of adding 30 - 50 connections to WCID #17's system will have an insignificant impact on the District's operation, especially since these connections will be associated with only one meter. Therefore, O&M costs will be the only measurable costs associated with this service. As an incentive to the District, a contribution to offset the fixed costs incurred by the District could be offered. This contribution could be as high as $2,00 per 1,000 gallons.

VARIABLE O&M RATE	=	$0.73 per 1,000 gallons
FIXED RATE	=	$2.00 per 1,000 gallons
LCRA DEBT SERVICE	=	$1.76 per 1,000 gallons
DISTRICT RATE	=	per 1,000 gallons
TOTAL RATE		$4.49 per 1,000 gallons

Assuming that the entire debt service and operations, maintenance and administrative costs are to be derived from water rates, the Bee Cave Water Utility would need to generate approximately $3,000 per month in addition to the revenue necessary to pay for WCID No. 17 water. This results in a rate of nearly $10 per 1,000 gallons. When combined with the estimated rates for purchase of WCID No. IV water potential average monthly water bills can be estimated:

Approach	Rate per 1,000 Gallons	Average Monthly Bill
1	$16.33	$163.30
2	15.34	153.40
3	14.49	144.90
4 ($1.25 per 1,000 gallons)	11.25	112.50

As can be seen, these rates result in extraordinarily high water bills. It is not feasible to burden only the initial system customers with the entire cost of the system. Some combination of tax (preferably a benefit basis tax), revenue and water rate revenue will need to be utilized to make the financial burden workable and equitable.

Assuming that one half of the necessary $3,000 per month revenue is for debt service ($1,500) and 30 to 50 parcels would benefit, each parcel would pay an annual water benefit basis tax of $360 to $600 and the water rate per 1,000 gallons would drop by $5.00. The average monthly water bills would then be as follows:

Approach	Rate per 1,000 Gallons	Average Monthly Bill
1	$11.33	$113.30
2	10.34	103.40
3	9.49	94.90
4	6.25	62.50

The key to lowering water rates is to add more customers as quickly as possible because operations and maintenance costs do not rise in direct proportion to the number of connections although the cost of treated water does.

Other rates for treated water in the area can be used for comparison:

Utility System	Water Rates	Tax Rate
WCID No. 17	$1.20 for first 3,000 gallons 1.70 per 1,000 for 3 to 11,000 1.90 per 1,000 for 11 to 20,000 2.40 per 1,000 for over 20,000	$0.17 per $100 valuation
WCID 14	$2.65 per 1,000 gallons	$0.17 per $100 valuation
UWSC	$2.50 per 1,000 gallons	N/A

8.5 Funding Sources

A reliable water system for Bee Cave will be expensive, in a relative sense, because the customer base is spread over a broad area and the terrain requires a two pressure plane system. This expense is one that can, and should be financed over a twenty year period with ad valorem taxing authority as collateral for the debt. The immediate benefits of this type of system are tremendous - safe, clear, good tasting water at continuous delivery rates and pressures. Long-term benefits include increased property values because of a guaranteed water supply. This report has presented several options for making the system more affordable and these can be investigated in detail with the various water suppliers.

It is apparent that Bee Cave will need to seek funds from sources with lower than market interest rates or grant funds which do not have to be repaid in order to make the initial steps of establishing a water utility an economically viable undertaking. The first preference is for grant funds, followed by low interest, long-term loans.

Potential sources of these types of funds include:

Texas Water Development Board
Texas Department of Commerce
U. S. Department of Housing and Urban Development
U. S. Environmental Protection Agency]

9.0 ENVIRONMENTAL INFORMATION

This section is included to provide background information on general environmental features in the Bee Cave area and to identify potential reviews or permits that may be required to implement a water utility system. Bee Cave, as a municipality, may be subject to certain local, state or federal regulations during the course of design and construction of water system facilities. More detailed, site specific studies and evaluations may be necessary in the future for certain improvements in environmentally sensitive areas. This section should not be construed to be an environmental assessment, but rather a description of the environmental nature of the Bee Cave Water Planning Area.

9.1 Environmental Features

9.1.1 Topography

Bee Cave is located within the physiographic region of the Austin area generally referred to as the Edwards Plateau. Bounded on the east by the Balcones Fault Zone, this region is highly dissected by the Colorado River, Lakes Travis and Austin and its tributaries such as Barton Creek. Slopes within this region generally range from 5 to 15 percent, with slopes greater than 15 percent occurring in areas adjacent to the Colorado River and Barton Creek. Major drainageways in the Bee Cave area include Little Barton Creek, Limekiln Creek and Bohls Hollow. Slopes normal to the direction of flow are extremely steep in some areas due to the generally stairstepped topography associated with localized rock outcropping. Slopes parallel with the direction of flow are not generally as severe and may range from 5 to 40 percent.

9.1.2 Vegetation

Located within the Edwards Plateau region, the vegetation in the Bee Cave area is generally characterized as the juniper-oak assemblage. The juniper-oak assemblage consists primarily of mountain cedar with oaks, hackberry, and persimmons also common. In general, the cedars, oaks, and hackberries have attained heights of 15 to 30 feet, while persimmons in this area are shrub-like and under 6 feet in height.

Six primary categories of vegetation areas were identified in the Comprehensive Plan - Village of Bee Cave prepared by graduate students of the Department of Urban and Regional Planning, School of Architecture, University of Texas - Austin in 1988. The following excerpt described the six categories:

Lowland Woods

This type occurs in long, narrow valleys or near stream beds where slope alluvium has accumulated, representing volente-like soils. Most areas occur along drainages that empty into Lake Austin or Barton Creek. Trees are predominantly elm, sycamore, pecan and cottonwoods.

Dense Mixed Woodland

Juniper and mixed hardwoods in 50/50 mix 20% (DBH = 4" to 24") is characteristic of this category. Hardwoods include Texas oak, live oak, shin oak, Texas ash, cedar elm, sumac, Texas persimmon, rusty blackhaw, mountain laurel, eastern red bud and black cherry with canopy closure of greater than 60%. In creek beds, occasional sycamore occur. This upland type occur on moderate slopes and in the tops of drainages where soils are slightly deeper and have slightly more water available than dense juniper woodland areas. Low on slopes and adjacent to creek beds some slope alluvium is present.

Dense Juniper Woodland

Species composition is primarily juniper (DBH = 4" to 24") with up to 30% hardwoods with greater than 60% canopy closure. Hardwoods are typically Texas oak, live oak, shin oak and Texas ash. This upland class occurs on moderate to steep dry slopes, benches, plateaus and breaks. Soils are mostly steep Brackett and steep Tarrant soils.

Juniper - Live Oak Savanna

This type occur on relatively deep, well-drained soils which are gently sloping. Clusters of spanish oak, live oak and juniper with DBHs from 4" to 27" predominate over grassy understory, and tree canopy closure is less than 50%. Most areas are disturbed, and mid and tall grasses have been replaced with herbaceous invader species.

Managed Grasslands

Managed grasslands are defined as areas that have been generally cleared of native vegetation and are used primarily for grazing purposes. Sparse native grasses and erosion areas are usually over-seeded with improved species of bermuda grass. Grasslands often include large specimens (DBH = 12" to 27") of live oak, spanish oak, sycamore, soapberry, cedar elm and occasional post oak. Soils are of varying depths and include gravelly clay loam, clay and gravelly sandy loam.

Sparse Juniper

Less than 90% of overstory vegetation is juniper and is less than 10' tall (DBH = 4" to 8") with crown closure less than 50%. Two situations exist: (1) very shallow, gravelly soils with greater than 50% exposed limestone on plateaus and ridges. These soils resemble Tarrant and Speck soils, 0 to 2% slopes. Herbaceous ground cover is less than 20%. On these sites juniper is very slow growing and appear somewhat stunted. (2) The site has generally more potential than (1). Soils are deeper and less gravelly. There is little exposed limestone and herbaceous ground cover is greater than 60%. Here juniper grown more quickly and will reach much larger stature than in the first situation.

9.1.3 Geology and Soils

The Bee Cave area is located atop the Glen Rose Formation west of the Balcones Fault Zone. The Glen Rose Formation consists of alternating marl, dolomite, and limestone strata which were deposited during the Cretaceous Age (approximately 120 million years ago) and are the oldest units which are exposed within the Austin area. Gray/tan, fine to medium grained, hard mixed limestone is the predominant rock type in the area displaying moderate to deep dissection in various drainageways. Small bands of grayish brown/gray, porous dolomite and dolomitic limestone are also present in the upper reaches of Little Barton Creek, Limekiln Creek and Bohls Hollow.

The soils in the area consist primarily of the Brackett (BlD and BoF) and Tarrant Tad, TcA and Tdf) series. The Brackett series consists of shallow, well-drained soils that developed under a prairie vegetation of mid and tall

grasses and some trees. Brackett soils mostly have a gravelly surface layer and are underlain by interbedded limestone and marl. The surface layer is light brownish-gray, gravelly clay loam about 6 inches thick followed by a layer of very pale brown clay loam about 12 inches thick. Moderately slow permeability and low available water capacity are indicative of the Brackett soils.

Within the Brackett series, two groups are identified. The first is the Brackett soils, rolling (BlD). These soils occupy gently undulating to rolling topography with slopes ranging from 1 to 12 percent. Approximately 20 percent of the soil area consists of rock outcrop with the remainder of the area being covered by broken limestone fragments. Due to the limestone outcropping associated with this soils series, a large part of the annual rainfall is lost through runoff and seepage. The second of the Brackett series is the Brackett soils and rock outcrop, steep (BoF). This series exists in areas with slopes ranging from 15 to 30 percent with a majority of the surface area being covered by 2 to 4 inch limestone fragments. Surface layers are light brownish-gray gravelly clay loam 4 inches thick followed by a layer of pale-brown clay loam that extends to a depth of about 15 inches.

The Tarrant series consists of shallow, well-drained, stony, clayey soils overlying limestone. Large limestone rocks cover 25 to 85 percent of the surface. These soils occupy nearly level to gently sloping ridges, rolling side slopes and steep, hilly breaks with complex slopes ranging from 0.5 percent on ridges to 70 percent on breaks. The top soils are characteristically dark grayish-brown stoney clay underlain by limestone. The soil occupied by this series is considered poorly suited for crops, is not suited for pasture and has only limited suitability for range.

The Tarrant series present in the Bee Cave area include the Tarrant and Speck soils (TcA), the Tarrant soils with rock outcropping (TdF) and the Tarrant soils rolling (TaD). The Tarrant and Speck soil (TcA) is an undifferentiated soils group occupying long, narrow, broad and irregular areas on ridges with about 70 percent of the ground surface covered with large limestone fragments. It consists of about 63 percent Tarrant soils, 32 percent Speck soils, 4

percent dark-gray clay that is 18-inches thick, and a small amount of Crawford clay and rock outcrop. The Tarrant soil with rock outcropping (TdF) is an undifferentiated soils group occupying breaks and ravines along major drainageways.

9.1.4 Water Resources

The Bee Cave planning area is situated within the Lake Austin and Barton Creek watersheds. A very small portion of the westernmost ETJ drains to Bee Creek and onto Lake Travis. Discharge and water quality records are maintained for Lake Austin by the U.S. Geological Survey, upstream of the proposed District just below Mansfield Dam at gaging station 08154510. Discharge and water quality records have been maintained at this location since October 1974 and June 1980, respectively. Discharge for this period of record has ranged from no flow at times, to 25,300 cfs in April of 1977. The average discharge for the period of record is approximately 1,500 cfs. Lake Austin currently has a regulated 100 year storm flow of 90,000 cfs. Water quality records indicate that Lake Austin water quality is generally good and is characterized as hard, i.e. above 150 mg/1 hardness or $CaCO_3$. The pH of the water is described as slightly basic to neutral. Discharge and water quality records for Barton Creek are not currently maintained in the Bee Cave area. The Glen Rose Formation in this area is not conducive to groundwater recharge by classical definition. Instead, subsurface percolation on the site occurs through infiltration of the soil and then downward movement through porous limestone until impermeable layers of the Glen Rose Formation transfer the movement laterally, eventually resulting in a seepage at an outcrop. Due to the different properties of the strata composing the Glen Rose Formation, groundwater yields are highly variable. Water quality also varies markedly owing to localized mineralized zones and their effects of dissolved solids. Glen Rose groundwater is often very hard and can be high in sulfates and chlorides, sometimes in excess of the water quality standards of the Texas Department of Health (TDH).

Groundwater quality from the Lower Trinity Aquifer is generally fair to good. Well yields are significantly higher than those from the Glen Rose, however, the water is sometimes high in sulfates and total dissolved solids.

9.2 Regulatory Considerations

9.2.1 U.S.C.E. 404

Section 404 of the Clean Water Act as administered by the U.S. Army Corps of Engineers regulates the placement of dredged (excavated) or fill material in "Waters of the U.S." Waters of the U.S. are defined in Section 404 rather broadly as any body of surface water (such as oceans, bays, rivers), all surface tributary streams with a defined channel (including intermittent waterways), any in-stream impoundments (i.e. lakes and ponds), many off-channel impoundments, and wetlands. "Dredged or fill material" has also been given rather broad meaning to include just about any material or object used for construction such as dirt, rocks, concrete, piles, pipes, etc.

The Ft. Worth District U.S.C.E. can issue either general permits which cover construction and waterway crossings in a large area, or a full permit for individual projects. Pipeline projects are usually covered under a general permit because of their minor nature, unless they cross large water bodies. Individual permits may be required for specific facilities such as pump stations and intake structures located near large water bodies. Individual permits require assessments of impacts to cultural resources, threatened or endangered species and the public health and welfare.

9.2.2 Cultural Resources

Bee Cave is a political subdivision of the state under the provisions of the Texas Antiquities Code and, therefore, must consider the effects of its actions upon possible archaeological sites. Under the code, all archaeological sites, either historic or prehistoric, and significant historic structures on lands belonging to or controlled by political subdivisions of the state are automatically considered to be State Archeological Landmarks (SALs) and may be eligible for protection. Construction projects by the Village will require a Texas Antiquities Permit and coordination with the Texas Antiquities Committee (TAC).

Cultural resource studies may be coordinated through the Texas Water Development Board (TWDB) where TWDB funds are utilized, or coordinated directly through the TAC. Because of the relatively high density of sites in the Lake Travis/upper Lake Austin and Barton Creek regions, it is anticipated that either agency will arrange for archaeological surveys of planned facilities in previously unsurveyed areas.

9.2.3 Threatened and Endangered Species

Bee Cave and its ETJ would not be subject to the City of Austin's proposed Endangered Species Ordinance. However, with the current focus on the Golden-Cheeked Warbler and Black-Capped Vireo there remains the possibility of their habitat occurring in the Bee Cave area. U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, LCRA, Travis County, City of Austin and area landowners have joined forces to conduct a regional habitat study. Bee Cave should monitor this process and decide what actions may be appropriate to be in compliance with the results of the study.

10.0 IMPLEMENTATION PLAN

The most crucial part of this regional water service planning study are the alternative implementation plans. Of utmost importance is the resolution of the immediate water shortage and public health problem in the Bee Cave West area. There is at least one component common to all the potential implementation plans; acquisition of the WCID No. 14 facilities in Bee Cave.

10.1 WCID No. 14 Facilities

As previously described, WCID No. 14 owns and operates water lines within the Bee Cave city limits. Those facilities will be integral components of a Bee Cave water system and, under several immediate service scenarios, can be used to solve the immediate problems. However, since WCID No. 14 water (provided by City of Austin) cannot be mixed with WCID No. 17 or Uplands water Bee Cave must acquire those facilities if another water source is to be utilized.

The key element of Bee Cave acquiring WCID No. 14's lines is the bonded indebtedness of WCID No. 14. Real estate which lies within both Bee Cave and WCID No. 14 is used as collateral, through ad valorem taxes, to repay the bondholders. In order to avoid potential double taxation without a corresponding doubling of benefits, Bee Cave must be deannexed from WCID No.14 and take title to the water lines.

There are essentially two methods to accomplish this:

- WCID No. 14 could annex additional land with equal or greater value into the district and then deannex Bee Cave or
- Bee Cave could make a lump sum payment to WCID No. 14 for a reduction in the outstanding debt equivalent to the value of the prorata share of the total tax base to the total debt. This may or may not be equivalent to the "value" of the water lines.

Execution of either of these will require approval from WCID No. 14 and, most importantly, the bondholders. Preliminary indications from WCID No. 14 are that the second method is preferable because of the unlikelihood of finding additional property owners to be annexed into the district. It has been estimated that the cost of the second method would range from $200,000 to $400,000.

Based on 1987 tax information, it appears that the land which lies within both Bee Cave and WCID No. 14 generated approximately $27,800 in tax revenue for SCID No. 14. The total tax revenue for WCID No. 14 in 1987 was $200,140; therefore, Bee Cave represents 13.9 percent of the district's revenue base.

With WCID No. 14's outstanding bonded indebtedness being approximately $2,500,000, Bee Cave's prorata share would be $347,260. While the calculation of an estimate is rather straight forward, locating all of the bondholders and gaining their approval to allow WCID No. 14 to accept a cash payment and deannex the real estate may be a formidable financial and legal effort. Informal conversations with various attorneys and financial advisors who routinely handle WCID affairs have indicated that a minimum of 12 months would be necessary to accomplish such a task and, if any obstacles are encountered, two years or more may be required. This is not to suggest that the task is impossible but that it is time consuming, laborious and potentially expensive. It will require extreme diligence and effort from the Bee Cave Village Commission and WCID No. 14 Board of Directors.

10.2 WCID No. 17 Potable Water Service

WCID No. 17 may provide potable water to Bee Cave under two scenarios: temporary contracts for sale of "surplus" water until a long range, permanent water system solution is resolved or as the first step in Bee Cave receiving long-term service from WCID No. 17 after Bee Cave is deannexed from WCID No. 14. Since the time frame for the latter is not stabilized, this report will focus on the first.

WCID No. 17 has had a long standing policy of not providing "out-of-district" service and that application for new service be accompanied by payment of capital recovery fees and tap fees at the time meters are set. In this case it is proposed that WCID No. 17 provide "out-of-district" service on a temporary basis - temporary until such time as Bee Cave secures treated water from other sources or becomes a part of WCID No. 17. In order to be equitable, Bee Cave "out-of-district" water customers should be amenable to paying for WCID No. 17 water at the normal WCID No. 17 rates plus an amount equivalent to the ad valorem tax revenues that the serviced properties might generate. In return, WCID No. 17 is able to generate revenue from water production for which there

is no demand today or in the next few years and also receive a small amount of "unearned" income from the tax equivalency component of the water rate. Additionally, this will effectively reduce the obligation of the District's other water customers as there will be new customers over which to spread costs.

However, Bee Cave may want to determine the source of funding for the proposed immediate service plan alternatives prior to finalizing "out-of-district" service rates from WCID No. 17. The basic points of concern are as follows:

* Bee Cave will not be able to impose an ad valorem tax on the entire Village to repay the capital debt on the immediate service plan improvements until the deannexation from WCID No. 14 takes place.

* Revenue to repay the debt would come solely from rates and charges from a very small customer base.

* The average monthly water bill for the Bee Cave West customers could exceed $150 per month without some reduction in rates from WCID No. 17 or reduction of the initial capital cost through grants or capital recovery fees.

Because of some of the continuing unknowns regarding sources of funding, Bee Cave may want to present this information to WCID No. 17, in conjunction with an LCRA proposal to become a wholesale customer of WCID No. 17, and request that a final rate determination be delayed until Bee Cave has determined what sources of funds are available.

10.3 Uplands Water Supply Corporation

Bee Cave should submit formal inquiries and requests to become a water customer of UWSC. As previously discussed, UWSC may currently have limited surplus capacity in off-peak months but has expressed concerns about long-term capacities for both raw and treated water. A joint effort between Bee Cave, LCRA, UWSC and West Travis County MUDs 3, 4 and 5 will be necessary to implement this alternative.

10.4 West Travis County MUDs 3, 4 and 5

Bee Cave should submit formal inquiries and requests to either supply water or become water customers of West Travis County MUDs 3, 4 and 5. These MUDs have no existing facilities but have raw water contracts and the rights to access UWSC raw water intake, pumping and transmission facilities. A joint effort

between Bee Cave, LCRA and West Travis County MUDS 3, 4 and 5 may be appropriate to create economies of scale for all parties if this alternative is chosen.

10.5 Strategic Plan

In order for Bee Cave to begin to implement the creation of a water utility to serve Bee Cave residents and a surrounding service area, several policy decisions must be reached. Those policy points and pros and cons, if any, of each are presented below:

Policy 1: It shall be the policy of the Village of Bee Cave to provide water service to Bee Cave West and other unserved areas as soon as possible.

Pros - Does not adversely impact any other mid-term or long-range planning alternatives.

- WCID No. 14 cannot serve these areas today.
- WCID No. 17 has surplus water available.
- Connecting to the WCID No. 17 system is the least expensive, short-term solution.
- Bee Cave does not have to be deannexed from WCID No. 14 or "own" the WCID No. 14 system to implement the plan.
- Could be accomplished in 12 to 15 months.

Cons - Requires that a transmission main connection be built from Lake Travis High School standpipe to Bee Cave which would be delayed in non-WCID No. 17 alternatives.

- Does not provide any improved water service to any other areas of Bee Cave.
- Initally creates limited customer and tax base to support capital expenses and operations and maintenance costs.

Policy 2: It shall be the policy of the Village of Bee Cave to provide water service to Bee Cave West and other unserved areas as a portion of an overall Bee Cave water utility with no priority of time given to the unserved areas.

Pros - Establishes Bee Cave water utility either singly or as a joint venture with other water providers on a long-term, permanent basis.

- Creates larger initial customer and tax base to support capital expense operations and maintenance costs.

Cons - Requires that Bee Cave be deannexed from WCID No. 14 which may be a lengthy process.

- Requires that treatment plant capacity be built by Bee Cave alone or in conjunction with LCRA, UWSC, West Travis County MUDs 3, 4 and 5 or WCID No. 17. Uncertainties about each of these entities may cause the time frame to extend from 24 to 36 months.

- Most expensive of the immediate service alternatives because of purchase of WCID No. 14 facilities and pump stations to serve western Bee Cave.

These two policies have been presented as mutually exclusive. However, the most practical strategic plan is to pursue both, which, in essence will provide for an immediate solution to non-serviced areas and begin the implementation of a long-term Bee Cave water utility at the same time. There are several key points which allow this conclusion to be drawn.

- It cannot be absolutely determined, today, what the "best" or optimal long-term solution is. WCID No. 14 does not appear to be a viable option at this point. A stand alone Bee Cave system or a joint venture system with LCRA, UWSC or West Travis County MUDs 3, 4 and 5 are all viable depending on the legal, financial and political status of each entity. Having Bee Cave totally annexed into WCID No. 17 is also a viable option.

- The stand-alone or joint venture water utility system options give Bee Cave the greatest amount of control over its own water destiny. These will be slower to implement, thus leaving western Bee Cave without service in the interim period.

- WCID No. 17 has surplus treated water available today and should reasonably expect to have a surplus supply available for the next 2 to 3 years barring any unexpected increase in development activity within the district. Given the small number of new customers (less than 40 or 43,200 gpd), WCID No. 17 should be able to supply treated water until a long-term Bee Cave decision can be reached. If WCID No. 17's defined area bond issues for Steiner Ranch, Apache Shores, Montview and Comanche Trails are successful, it may be that WCID No. 17 is the optimal long-term solution for Bee Cave although Bee Cave's control over water is then minimized.

- At such time as Bee Cave is deannexed from WCID No. 14, owns the facilities and has secured treated water capacity from one of the alternative sources, Bee Cave could disconnect from WCID No. 17 service if applicable and connect the old WCID No. 14 system to the western Bee Cave system. An emergency interconnect should remain in place between the Bee Cave water utility system and the WCID No. 17 system.

11.0 ACTION STEPS

In order for Bee Cave to move into the next series of steps toward implementation of a water utility system, the Village needs to determine precisely the availability and negotiate the cost of treated water, determine the availability of outside funding and select an alternative or alternatives to pursue. The following actions should be taken to begin the process of water system implementation:

1. Select an immediate service plan to pursue.

2. Submit an official request to WCID No. 14 to have Bee Cave deannexed from that District. This will start the process of establishing the legal procedure and locating bond holders.

3. Submit an official request to WCID No. 17 to purchase surplus, treated water on an interim basis to serve Bee Cave West and other unserviced areas. This will supplement and augment the proposals prepared by LCRA to be a bulk purchaser for resale to Bee Cave.

4. Submit an official request to Uplands Water Supply Corporation to purchase treated water and/or to purchase the entire raw water and water treatment system. This may be done alone or as a joint effort with LCRA.

5. Request the Village attorney to brief the Village Commission on the legal ramifications of creating a water utility system.

6. Secure the services of a financial advisor to assist in the loan process.

7. Prepare loan and grant applications for funding from state or federal agencies.

8. Authorize either the Mayor or a Commissioner or the attorney or engineer or some combination of these positions to negotiate directly with WCID No. 14, WCID No. 17 and UWSC.

9. Prepare a joint venture proposal to West Travis County MUDs 3, 4 and 5 to construct water treatment, pumping, storage and transmission facilities.

10. Support the LCRA in their attempts to acquire water facilities from WCID No. 20 and UWSC.

11. Implement an ad valorem tax at the rate of $0.15 per $100 valuation to generate $30,000 of revenue to cover implementation expenses until such time that grants or loans are approved or until the water system begins to generate revenue.

12. Work with property owners in the Homestead subdivision to have that subdivision annexed into Bee Cave. This would create a larger tax and customer base to support a water system.

VILLAGE OF BEE CAVE, TEXAS
LOWER COLORADO RIVER AUTHORITY
REGIONAL WATER SUPPLY PLANNING STUDY

Contract No. 9-483-714

The following maps are not attached to this report. Due to their size, they could not be copied. They are located in the official file and may be copied upon request.

Tumco Consultants
Job No 89-016-10 – Immediate Plan Alternatives I & II

TCI- Interim Service Plan (Alternative I) Service To West Village Of Bee Cave

TCI – Interim Service Plan (Alternative II) Service To West Village Of Bee Cave

Existing Utilities – Figure 2

TCI – Conceptual Plan ultimate Service Area

Village Of Bee Cave One Mile E.T.J.

Please contact Research and Planning Fund Grants Management Division at (512) 463-7926 for copies.