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Hays County Water Development Board

Water Conservation and Drought Contingency Plan

October 1988

WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN

DRAFT PLAN

HAYS COUNTY WATER DEVELOPMENT BOARD

TABLE OF CONTENTS

PREFACE

In 1985, the Texas Constitution was amended requiring a water supplier to develop and adopt a water conservation and drought contingency plan in order to be eligible for financial assistance from the Texas Water Development Fund. The water conservation plan should address all feasible aspects of conservation for the particular entity including one or more of the following methods:

- Education and Information
- Plumbing Codes
- Retrofit Programs
- Water Rate Structures
- Universal Metering
- Water Conservation Landscaping
- Leak Detection
- Recycling and Reuse
- Implementation and Enforcement

The drought contingency plan must include the following six elements:

- Trigger Conditions
- Drought Contingency Measures
- Information and Education
- Initiation and Procedures
- Termination Notification
- Implementation Procedures

This document is a summary of the Hays County Water Development Board's policies which will meet the requirements of the law and are implementable within the board's powers and scope of operation.

HAYS COUNTY WATER DEVELOPMENT BOARD
WATER CONSERVATION PLAN

INTRODUCTION

Projected population and economic growth within Hays County has raised public awareness and concern about the adequacy of available water supplies to satisfy future needs. A particular concern relates to the adequacy of ground and surface water supplies to meet both current and projected demands during drought conditions. Based on the population and water demand projections for Hays County, it appears certain that the risk of disruptive costly water shortages will increase over time. Moreover, a portion of the cost of projects can be deferred by conservation of resources. Consequently, prudence dictates that the conservation and reuse of available water supplies must become a key element of Hays County's long-range water management strategy.

While perhaps not a complete solution, water conservation and reuse can provide a large and relatively inexpensive source of water "supply" for Hays County. At a minimum, water conservation can help mitigate the impacts of future population and economic growth on limited water supplies and minimize the risk of disruptive shortages. Water conservation can also favorably effect the timing and amount of future capital investments in water and wastewater facilities and reduce utility operating costs. Individual consumers also benefit directly from more affordable water and wastewater utility services and from reduced expenditures of time and money. Importantly, water conservation can also help mitigate the environmental impacts of population growth by preventing the harmful overuse of limited water supplies and by minimizing both point and non-point sources of water pollution.

PURPOSE AND OBJECTIVES

Recognizing the importance of a "balanced" water budget to the future of Hays County, the Hays County Water Development Board (WDB) established, in March of 1988, a Water Conservation Committee composed of WDB members and interested residents of Hays County. The Committee's assignment was to identify and evaluate various water conservation and reuse measures and implementation strategies and recommend a water conservation "plan" for adoption by the Hays County WDB. In part, the water conservation plan presented herein is intended to satisfy requirements for participation in the Texas Water Development Board's Planning and Research Grant Program. More importantly, however, the Water Conservation Committee viewed its task as being to formulate a workable and cost-effective water conservation plan that will be implemented throughout Hays County.

The specific water conservation goals adopted by the Committee are:

(1) To reduce future demands on limited freshwater supply sources;

(2) To reduce the magnitude of seasonal peak water demands;

(3) To reduce the magnitude of wastewater flows requiring treatment and disposal; and

(4) To fully integrate water conservation and reuse into long-range water resources planning and management and land use planning and development.

GUIDING PRINCIPLES

During the meetings and deliberations of the Water Conservation Committee, several underlying themes and principles emerged that would serve to guide the Committee's work and recommendations. Paramount among these is that water conservation and reuse strategies must become an integral part of the daily activities of Hays County residents, businesses, and institutions. Similarly, recommended water conservation and reuse strategies, and their effects, must be fully integrated into water resources management and planning at all levels - both in the near-term and the long-term. The actual implementation of the Committee's recommendations was therefore an overriding concern and priority.

The Committee's concern about the implementation of its recommendations arises from the fact that the Hays County WDB serves in an advisory capacity and does not itself possess the authority or the resources to enact legislation, set policies, or implement programs. Rather, the Hays County WDB is limited to providing guidance and assistance to those entities that have the legal authority and financial resources to implement water conservation and reuse policies and programs. These entities include the State Legislature and relevant state agencies, Hays County, municipalities, school districts and universities, special purpose districts, water supply corporations, and private businesses. Notwithstanding the limitations of the Hays County WDB, the Water Conservation Committee resolved to propose a comprehensive "multi-level" water conservation plan targeted broadly at all entities possessing capabilities to implement or facilitate the implementation of recommended water conservation and reuse strategies.

Other themes and principles that guided the Water Conservation Committee include:

(1) Generally, water conservation is defined as those measures that are intended to improve water use efficiency, increase beneficial reuse and recycling, and minimize waste. This definition focuses on the technical methods of reducing water demands through efficiency and reuse and should not be equated with sacrifice on the part of the end user. As such, the Committee chose to focus on strategies that will induce permanent reductions in water demand rather than temporary, emergency measures to be implemented only during drought conditions.

(2) The Committee recognized that its primary task was to identify and recommend appropriate strategies for encouraging or inducing the application of "technical" measures to improve water use efficiency, minimize waste and increase reuse.

(3) The Committee resolved that its recommendations should not be constrained by real or perceived institutional barriers to the implementation of particular conservation or reuse strategies. Rather, where such barriers are identified, the Committee would seek to identify and recommend such actions as are necessary to overcome or remedy implementation problems.

(4) Recognizing that future population growth within the county is of primary concern as it relates to the adequacy of water supplies, it was generally agreed that the overall water conservation strategy recommended for Hays County should focus particularly on conservation and reuse measures for new development. In part, a focus on future growth stems from the belief that the best opportunities to reduce future water demands will be realized, at the least cost, by incorporating efficiency and reuse into the planning, design, construction, and ultimate habitation of new developments. The focus on new development should not, however, be taken to imply that conservation opportunities in existing developments have not been pursued or recommended.

(5) The Committee also recognized that the most appropriate level at which to implement many water conservation strategies is locally through utility-supported programs. As such, local water conservation programs should be developed in consideration of local conditions, resources, and priorities. Nonetheless, the Water Conservation Committee strongly agreed that certain minimum standards, particularly for new development, should be applied throughout the county.

(6) Finally, the Committee recognized that private markets would naturally lend to compensate or adjust to future water supply conditions within Hays County. On one hand, inadequate water supplies would likely become a limiting factor on future population and economic growth. On the other hand, the increasing scarcity and "value" of water will tend to direct private markets towards improved water use efficiency and reuse. Recognizing such economic forces, the Committee resolved to recommend an "aggressive" water conservation and reuse strategy that will guide private markets towards efficiencies that otherwise may not be achieved by market forces alone. In other words, the role and functions of private markets should be fully marshalled in support of public efforts to achieve long-range conservation and reuse goals.

DESCRIPTION OF PLANNING AREA

The planning area for the report is shown in Figure 1. The area consists of Hays County, located in south-central Texas, and adjacent areas. Hays County is bordered by Travis County on the north, Comal County on the south, Caldwell and Guadalupe County on the east, and Blanco County on the west.

The location and physical characteristics of the County make it attractive for curent and future development. The county covers 428,800 acres, most of which is within 30 miles of Austin. The Balcones

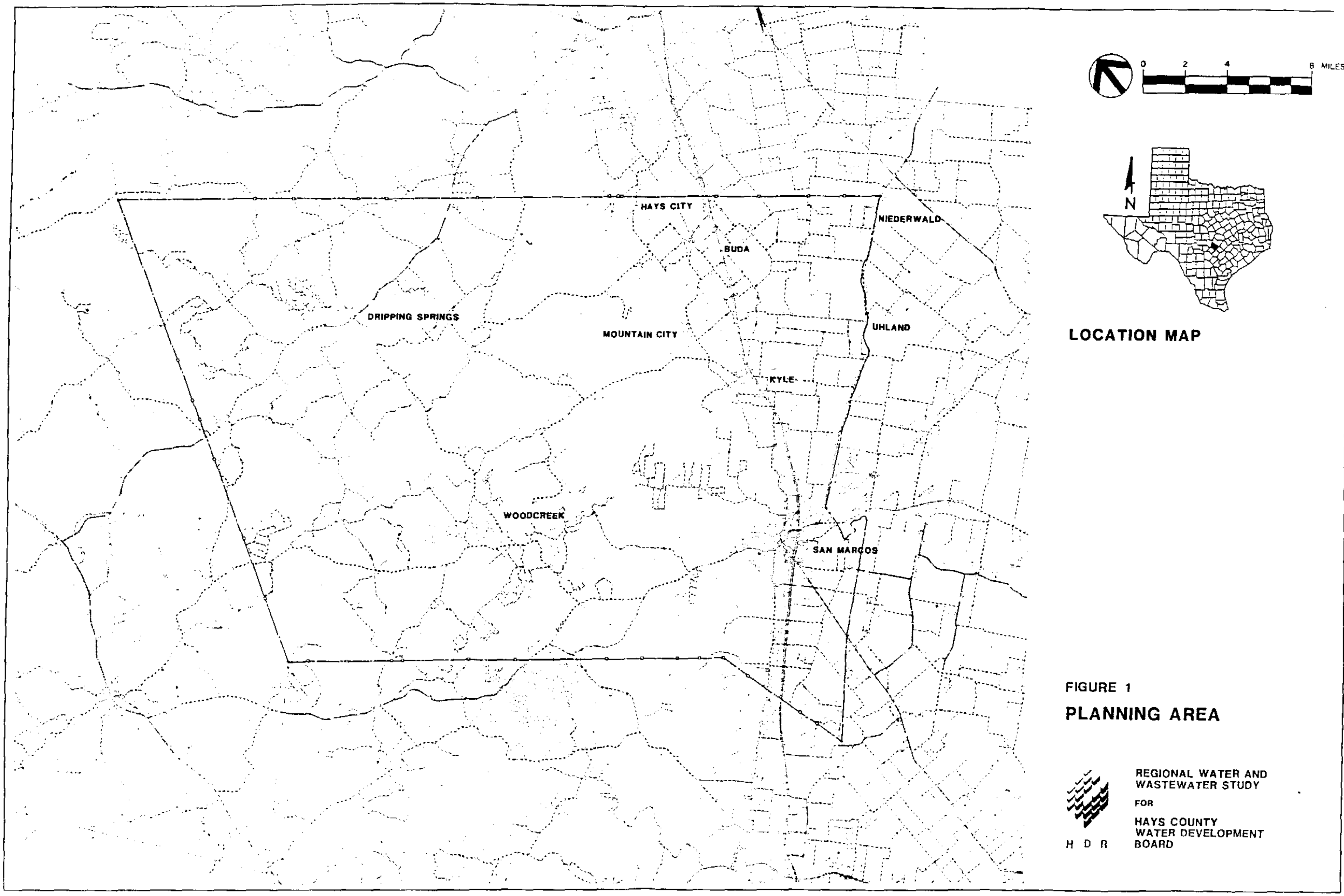
Escarpment extends through eastern Hays county, separating the Blackland Prairie (east) and the Edwards Plateau (west). The Blackland Prairie is characterized by rich farm land and gently sloping, deep clay soils. The Edwards Plateau, locally known as the "Hill Country", is characterized by shallow, stony clay and gravelly clay loam soils. The county straddles two major river basins, the Colarado River Basin and the Guadalupe-Blanco River Basin as shown in Figure 2. In Hays County, the Colorado River Basin includes the Pedernales River, Onion Creek, Barton Creek, and Bear Creek. The Guadalupe-Blanco River Basin includes the Blanco River and San Marcos River in southern Hays County.

Land use has changed rapidly in recent years. Land once used for agricultural purposes has since been converted to urban uses. This rapid change is associated with an increase in residential development in the county, primarily due to the expansion of nearby Austin and San Antonio. The growth of smaller urban areas around San Marcos, Kyle, Dripping Springs, and Buda, along with the growth of retirement communities near Wimberley and Woodcreek has also contributed to this rapid change in land use.

WATER RESOURCES

Water is an important natural resource for Hays County. There are no major surface water reservoirs in the county to date. The primary source of water in the County is groundwater. Groundwater resources in the County lie in three major aquifer systems, The Edwards Aquifer (San Antonio Region), the Barton Springs Edwards Aquifer, and the Trinity Group Aquifer. Figure 3 shows the location of the aquifers within Hays County and Figure 4 shows the location of the aquifers within the region.

The Edwards Aquifer provides a steady supply of good quality water to part of Hays County and to a large region of south central Texas. The Edwards Aquifer covers eastern Hays County and supplies approximately 80% of the total County demand. It is the primary source of water for San Marcos, Kyle and numerous water supply corporations in eastern Hays County. The aquifer is a major source of water for a six county region including Hays, Comal, Bexar, Medina, Uvalde, and Kinney. Bexar County, which includes San Antonio, exercises the highest demand on the aquifer followed by Uvalde and Medina Counties. A summary of estimated withdrawals from the Edwards Aquifer by county for 1986 is presented in Table 1. As seen in the table, the total pumpage in Hays County from the Edwards Aquifer amounts to less than 4% of the total aquifer pumpage. Also, over 90% of the Edwards discharge in Hays County is through springs. Municipal flows account for approximately 6% of the total, and domestic flows account for just over 1% of the total pumpage from the Edwards Aquifer.



LOCATION MAP

FIGURE 1

PLANNING AREA

REGIONAL WATER AND WASTEWATER STUDY

FOR

HAYS COUNTY WATER DEVELOPMENT BOARD

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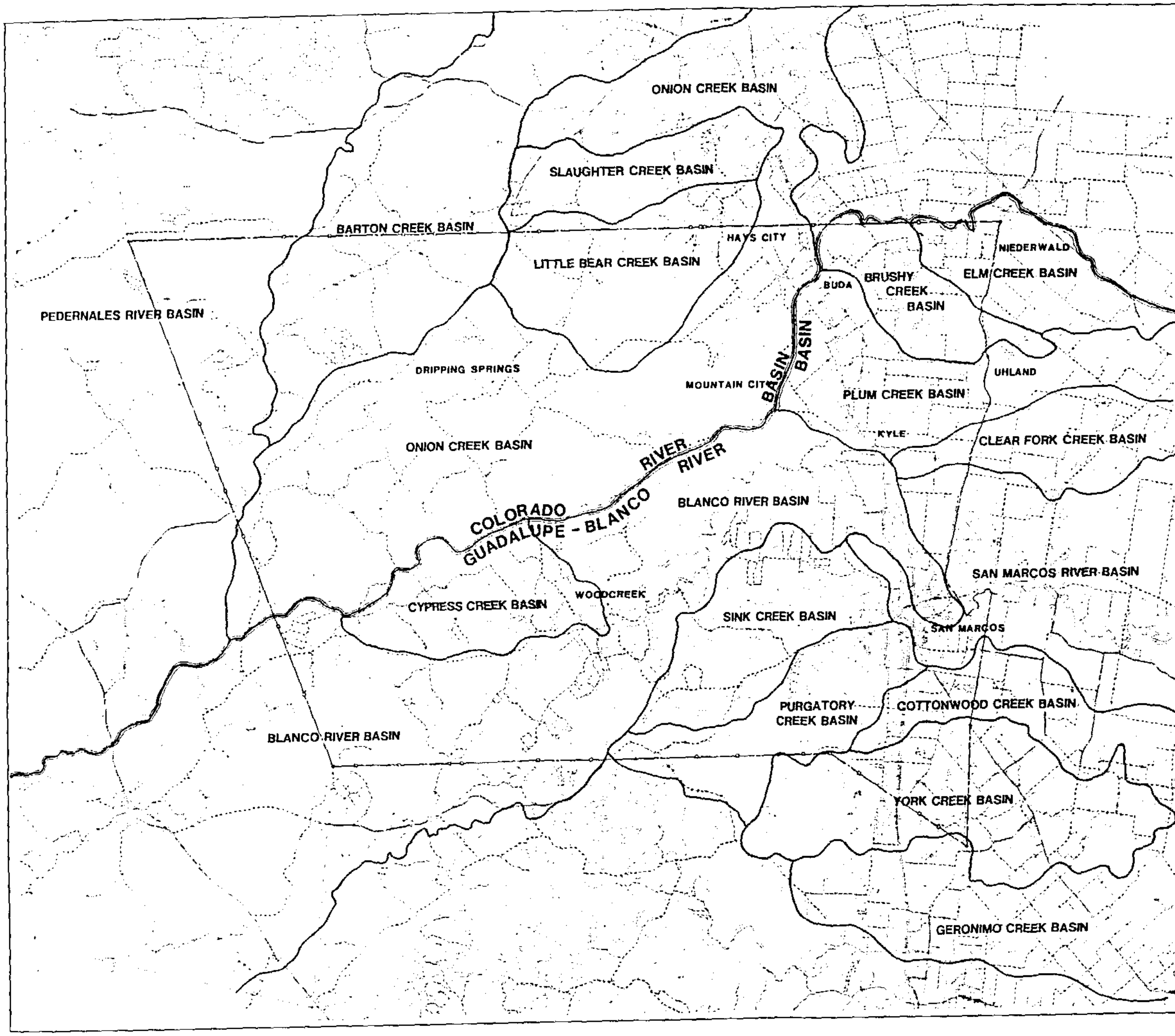

FIGURE 2
WATERSHED BOUNDARY MAP

REGIONAL WATER AND WASTEWATER STUDY
FOR
HAYS COUNTY WATER DEVELOPMENT BOARD

H D R

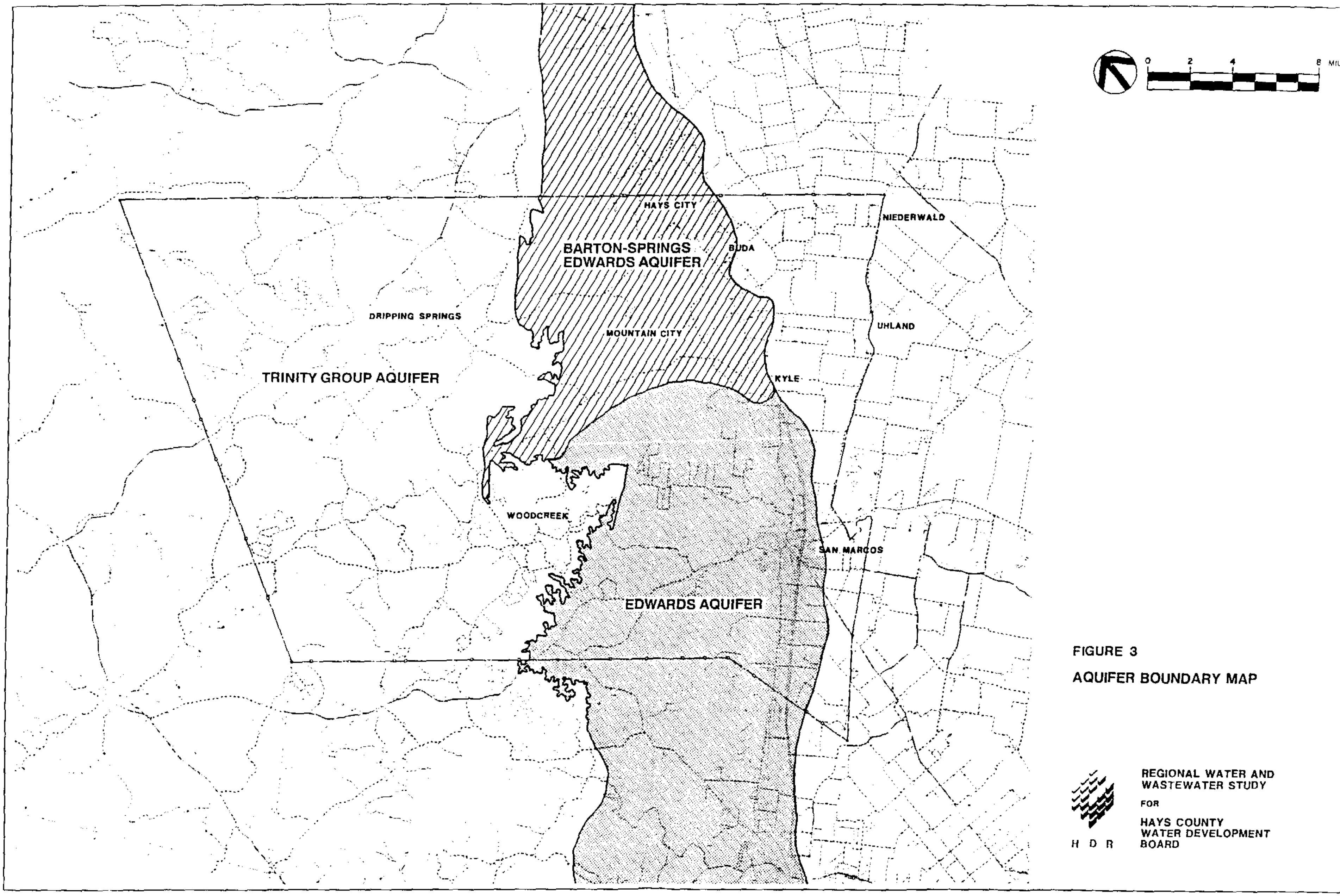

FIGURE 3

AQUIFER BOUNDARY MAP

REGIONAL WATER AND WASTEWATER STUDY
FOR
HAYS COUNTY WATER DEVELOPMENT BOARD

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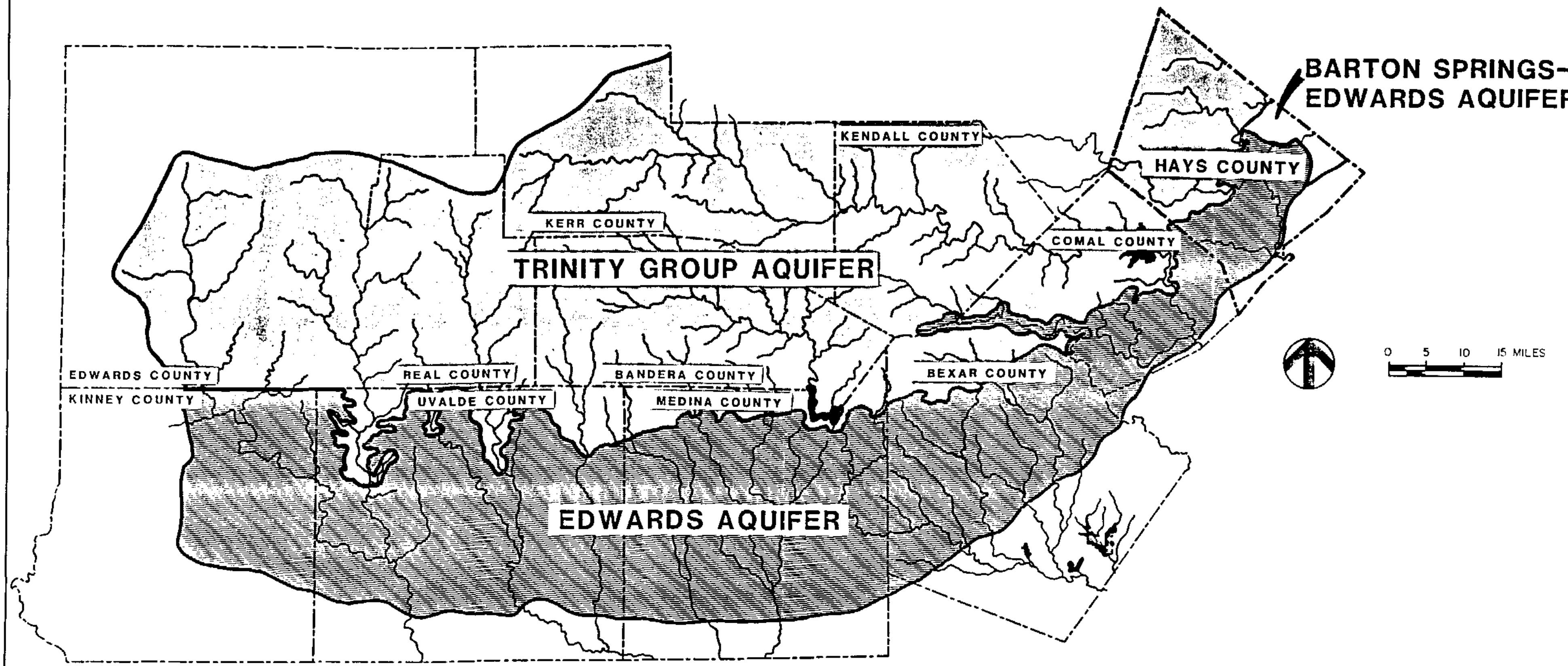

FIGURE 4

REGIONAL AQUIFER MAP

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REGIONAL WATER AND
WASTEWATER STUDY
FOR
HAYS COUNTY
WATER DEVELOPMENT
BOARD

Table 1

Calculated discharge from the Edwards Aquifer by county and by water use, 1986

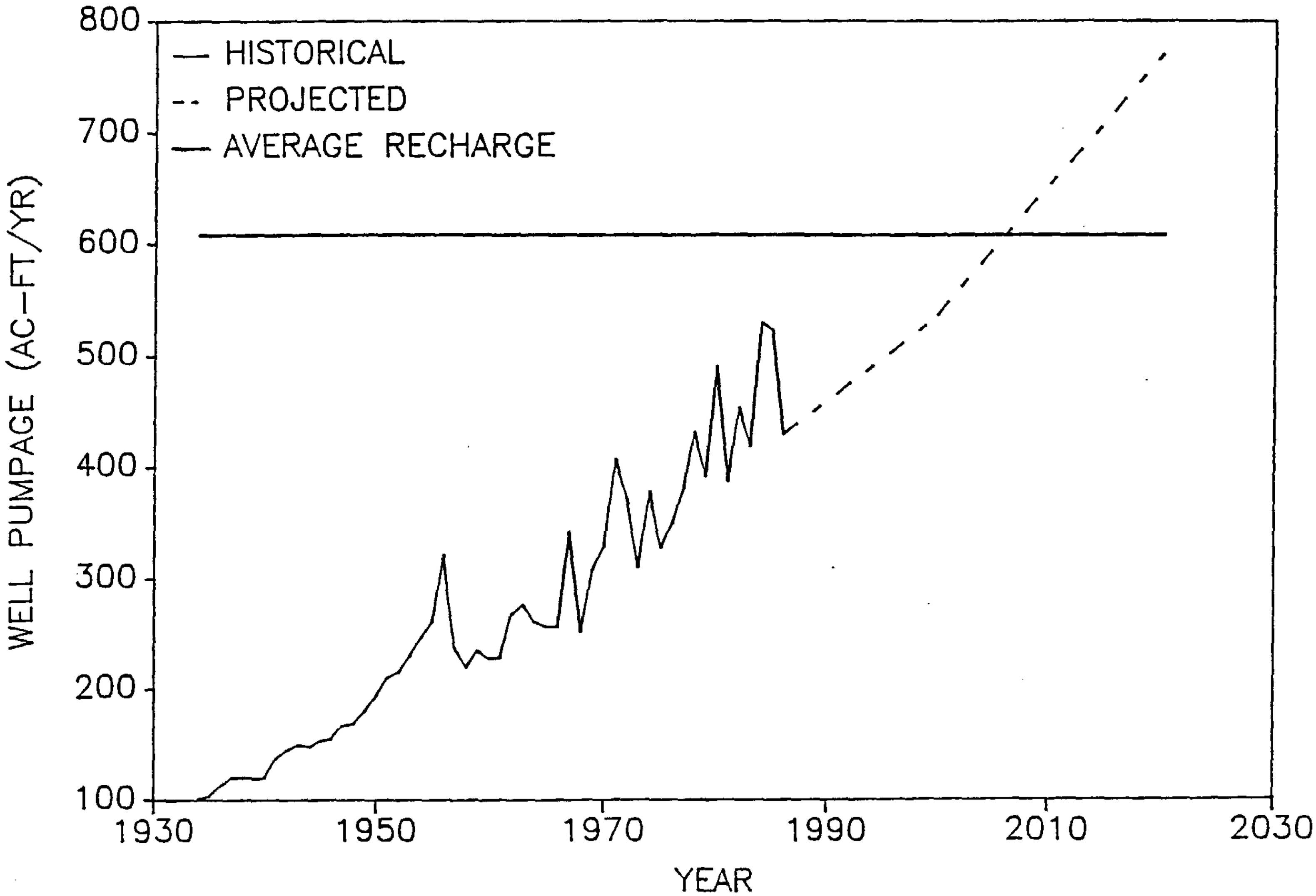
County	Springs (mgd)	Municipal (mgd)	Irrigation (mgd)	Industrial (mgd)	Domestic (mgd)	Total (mgd)
Kinney			0.2		0.2	0.4
Uvalde	36.1	4.2	53.0	0.6	2.9	96.8
Medina		4.3	32.5		0.6	37.4
Bexar	6.3	208.3	6.8	9.7	31.4	262.5
Comal	188.7	12.1	0.3	3.0	0.6	204.7
Hays	130.7	8.8	0.2	1.7	1.8	143.2
Total	361.8	237.7	93.0	15.0	37.5	745.0

Source: Edwards Underground Water District.

Current projections for the Edwards Aquifer region show that unless other sources of water are utilized in the future, the demand will exceed the safe yield of the Edwards Aquifer by the year 2015 (Figure 5). If this occurs, the groundwater supply would decrease, average water levels would drop, pumping costs would increase, spring flow would be reduced, and the quality of water could deteriorate. Springs, such as San Marcos springs which now produce an average of 107 million gallons per day, would gradually decrease and could eventually cease to flow. These conditions may not affect all users in the region at the same time, but eventually all areas would be adversely affected.

The Barton Springs Edwards Aquifer is located in northeast Hays County and extends into the southern part of Travis County. The aquifer covers 155 square miles of which 151 square miles discharge to Barton Springs, currently the fourth largest spring in Texas. Recent studies show that the surface recharge and the groundwater discharge (springflow and pumpage) are reasonably balanced. In 1982, the estimated total groundwater pumpage of about 3,800 ac-ft/yr represented approximately 11% of the average annual discharge of 36,000 ac-ft to Barton Springs. Increased pumpage associated with future groundwater development could result in a reduction in the discharge at Barton Springs, reduce groundwater availability, and possibly allow migration of "bad water" into the aquifer.

The Trinity Group Aquifer is another major water supply which covers most of western Hays County. It is the primary source of water for the Dripping Springs area, Wimberley, Woodcreek, and the surrounding rural area. The Trinity Group Aquifer extends across several counties and supplies several cities in south-central Texas. This aquifer is estimated to receive recharge at a rate of 200,000 ac-ft/yr. However, much of this recharge is believed to re-emerge as natural stream and springflow in area streams which in turn recharge the Edwards Aquifer. These complex interactions of the aquifer make it difficult to quantify the amount of water available from the aquifer. Additional pumpage of the Trinity Group Aquifer may result in a decrease in the baseflow of area streams, with a corresponding decrease in recharge to the Edwards Aquifer.



Source: Edwards Underground Water Dist.

EDWARDS AQUIFER HISTORICAL AND PROJECTED WELL PUMPAGE

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REGIONAL WATER AND WASTEWATER STUDY FOR HAYS COUNTY WATER DEVELOPMENT BOARD

FIGURE 5

WATER QUALITY

The quality of water in the Edwards Aquifer and the Barton Springs-Edwards Aquifer is generally very good. Although relatively high concentrations for a few contaminants have been detected at various sites, no regional contamination problems have occurred. Water quality in the Trinity Group Aquifer varies throughout the county. Groundwater from the Trinity Group can vary from fresh, as low as 236 mg/l total dissolved solids (TDS), to slightly saline, as high as 2273 mg/l TDS. The aquifer yields characteristicly very hard water and some of the wells have exhibited excessive sulfate and flouride contents. Historically, several wells located in the Trinity Group Aquifer within Hays County have displayed an increase in sulfate, TDS, and hardness since the late 1930's.

The aquifers in Hays County are generally producing good quality water, however future water quality is a concern for Hays County. The Edwards Aquifer, Barton Springs-Edwards Aquifer, and the Trinity Group Aquifer are threatened by contamination. Septic tanks are the most commonly used method of wastewater treatment in the county, even though soil conditions are generally poor for this type of treatment. As the population of Hays County expands, contamination in by septic tanks will become more of a threat. Another threat to water quality in the aquifer is an increase in groundwater pumpage. Additional pumpage of the aquifers could lower water levels, with the potential for causing an increase in subsurface flow into the aquifers in the form of "bad water" encroachment and leakage from underlying aquifers.

POPULATION AND WATER DEMAND PROJECTIONS

Projections for Hays County indicate that water consumption will increase rapidly due to residential development within the County. The current population of Hays County is estimated to be 66,330. By the year 2000, the population should reach 98,725 and by the year 2040 the population is projected to be 252,565. Figure 6 shows historical growth along with projected growth for Hays County. Table 2 lists the population projections for Hays County along with a breakdown by area and city.

Water demand projections are presented in Table 3. Water demand projections were based on individual area statistics and their corresponding population projections. The average per capita water usage in Hays County is 182 gallons per day with most of the water demand being almost entirely residential consumption with a small amount of industrial usage.

CITY OR REGION	HAYS COUNTY POPULATION PROJECTIONS 1990	2000	2010	2020	2030	2040
Hays County	70,427	98,790	126,831	159,586	200,051	250,801
Colorado R. Basin	13,523	20,417	27,816	37,871	52,232	72,965
Guadalupe-Blanco R. Basin	56,904	78,374	99,016	121,715	147,820	177,837
Edwards Aquifer	52,341	72,869	92,115	113,236	137,238	165,449
Trinity Group Aquifer	18,086	25,921	34,716	46,350	62,813	85,352
San Marcos ETJ	35,400	50,700	63,350	76,000	88,650	101,300
Kyle ETJ	5,129	7,592	11,238	16,634	24,623	36,448
Dripping Springs ETJ	6,314	12;120	18,385	27,215	40,284	59,630
Buda ETJ	1,930	2,260	2,580	2,910	3,240	3,562
Hays City ETJ	633	857	1,080	1,303	1,527	1,750
Woodcreek ETJ	1,004	1,349	1,813	2,436	3,274	4,400
Uhland ETJ	213	320	446	584	766	1,004
Mountain City ETJ	400	490	590	720	860	1,040
Wimberley WSC	3,276	4,176	5,376	6,600	8,100	9,000
Goforth WSC	3,746	4,873	6,000	7,000	8,000	9,000
Plum Creek WSC	3,224	3,861	4,624	5,537	6,630	7,940
County Line WSC	834	997	1,192	1,425	1,703	2,036
Rural Areal, Other WSC	8,325	9,196	10,158	11,221	12,395	13,691
Outside Hays Co.	17,227	23,006	30,918	41,778	56,715	77,297
Hays Co. including Outside	87,564	121,796	157,749	201,364	256,766	328,098

TABLE 2
HAYS COUNTY POPULATION PROJECTIONS

	HAYS COUNTY WATER DEMAND PROJECTIONS (MGD)											
	1990		2000		2010		2020		2030		2040	
CITY OR REGION	Avg. Day	Peak Day	Avg. Day	Peak Day	Avg. Day	Peak Day	Avg. Day	Peak Day	Avg. Day	Peak Day	Avg. Day	Peak Day
Hays County	12.85	21.86	17.85	30.26	22.78	38.58	28.21	48.20	34.80	59.92	42.86	74.47
Colorado R. Basin	1.86	3.84	2.83	5.73	3.85	7.76	5.25	10.52	7.25	14.45	10.15	20.12
Guadalupe-Blanco R. Basin	10.99	18.01	15.03	24.52	18.85	30.81	22.96	37.67	27.55	45.47	32.71	54.35
Edwards Aquifer	10.25	16.59	14.14	22.79	17.74	28.63	21.59	34.96	25.84	42.05	30.66	50.26
Trinity Group Aquifer	2.61	5.27	3.72	7.47	4.96	9.95	6.62	13.23	8.96	17.87	12.20	24.22
San Marcos ETJ	6.36	9.55	9.14	13.70	11.41	17.09	13.68	20.51	15.95	23.93	18.24	27.35
Kyle ETJ	0.71	1.37	1.07	2.05	1.57	3.02	2.33	4.47	3.45	6.62	5.10	9.80
Dripping Springs ETJ	0.87	1.70	1.71	3.28	2.58	4.97	3.81	7.35	5.63	10.88	8.35	16.11
Buda ETJ	0.21	0.46	0.25	0.56	0.28	0.62	0.32	0.70	0.36	0.78	0.39	0.86
Hays City ETJ	0.07	0.13	0.09	0.20	0.12	0.24	0.14	0.29	0.17	0.34	0.19	0.39
Woodcreek ETJ	0.22	0.49	0.30	0.65	0.40	0.88	0.54	1.18	0.72	1.58	0.97	2.13
Uhland ETJ	0.02	0.03	0.03	0.06	0.04	0.08	0.06	0.11	0.08	0.14	0.10	0.18
Mountain City ETJ	0.06	0.25	0.08	0.31	0.09	0.38	0.12	0.46	0.14	0.55	0.17	0.67
Wimberley WSC	0.38	0.82	0.48	1.07	0.62	1.36	0.76	1.67	0.93	2.05	1.04	2.28
Goforth WSC	0.43	1.07	0.47	1.17	0.63	1.55	0.74	1.81	0.84	2.07	0.95	2.32
Plum Creek WSC	0.29	0.52	0.35	0.65	0.42	0.77	0.50	0.92	0.60	1.10	0.71	1.31
County Line WSC	0.08	0.14	0.10	0.18	0.12	0.22	0.14	0.26	0.17	0.30	0.20	0.36
Rural Area, other WSC	1.25	2.49	1.39	2.77	1.52	3.05	1.68	3.37	1.86	3.72	2.05	4.11
Industrial	1.90	2.85	2.40	3.60	2.90	4.35	3.40	5.10	3.90	5.85	4.40	6.60
Outside Hays Co.	1.77	3.54	2.36	4.71	3.16	6.31	4.25	8.50	5.75	11.50	7.82	15.64
Hays Co. including Outside	14.62	25.40	20.21	34.98	25.86	44.90	32.46	56.70	40.55	71.42	50.68	90.11

Note: Water demand projections do not include water conservation.

TABLE 3
HAYS COUNTY WATER DEMAND PROJECTIONS

TABLES 2 & 3

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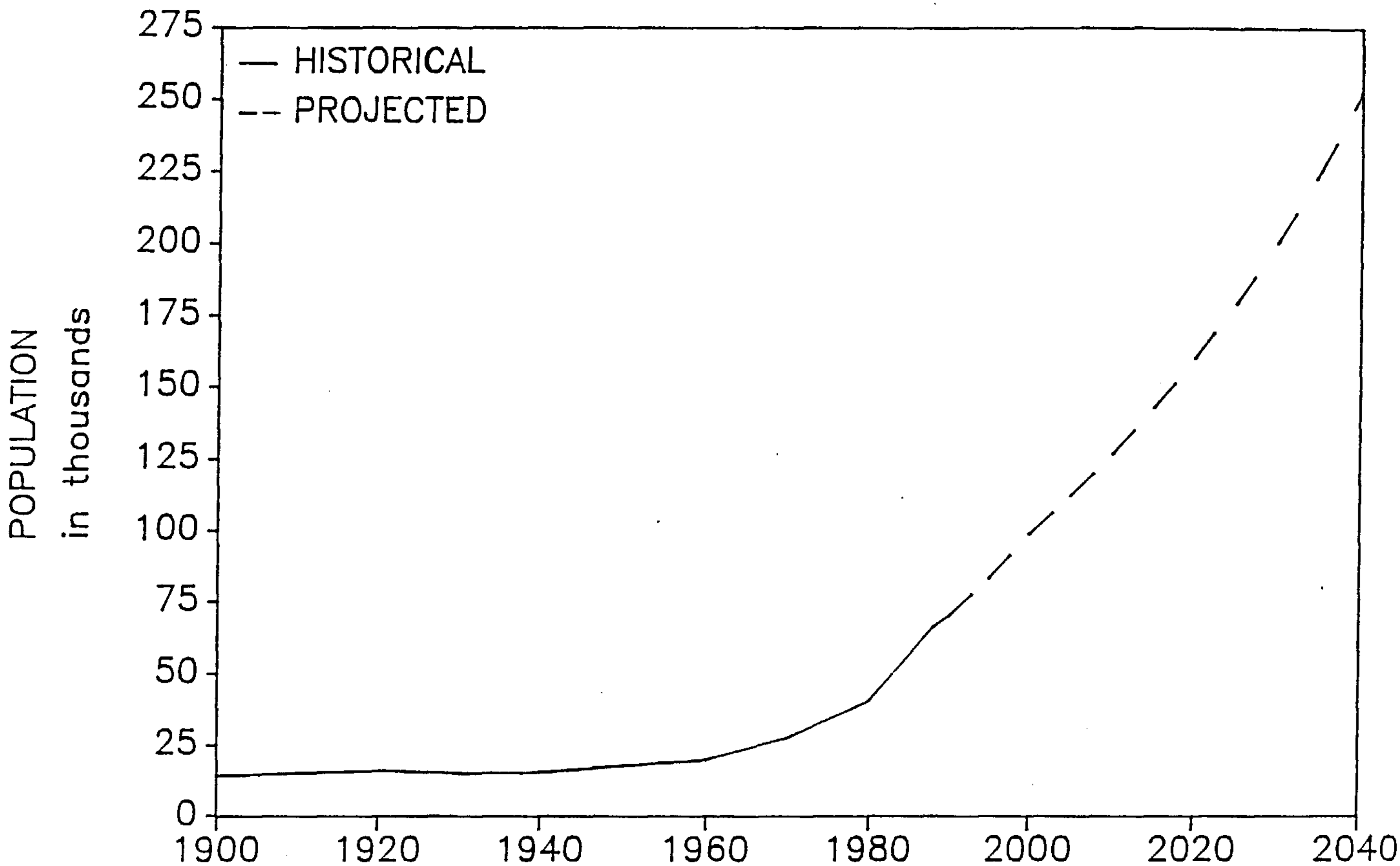
REGIONAL WATER AND WASTEWATER STUDY FOR HAYS COUNTY WATER DEVELOPMENT BOARD



HAYS COUNTY HISTORICAL AND PROJECTED POPULATION GROWTH

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REGIONAL WATER AND WASTEWATER STUDY FOR HAYS COUNTY WATER DEVELOPMENT BOARD

FIGURE 6

CONSERVATION MEASURES

PUBLIC INFORMATION AND EDUCATION

Public acceptance of this conservation plan is based upon information and education. Informed and supportive citizens are necessary to implement the conservation plan. The primary goals of the education program are to:

a. Create an awareness of local water problems and issues.

b. Inform the citizens of the benefits of water conservation which include:

   1. Reduced risk of severe water supply shortages.
   2. Optimize use and efficiency of available water supplies.
   3. Cost savings in reducing, delaying or eliminating utility system expansion.
   4. Reduction of utility costs to customer.
   5. Protection of the economic viability of the area.

c. Educate the citizens on water conservation techniques, low water use landscaping (Xeriscape), low water use fixtures and reuse/recycling benefits.

d. Educate the citizens on the benefits and opportunities of reuse and recycling of water.

To accomplish the necessary education of the citizens of Hays County requires identification of the target groups for education. These groups are diverse and served by a variety of media, local organizations and institutions. The following target groups include most citizens and water users of Hays County.

- Governments (town, county, subdivision approval authority, planning & zoning, architectural control)
- Water suppliers
- News Media
- Property owners associations (These associations include some with little authority and control to very active associations with considerable control and influence over the residents)
- Farmers/ranchers
- Industry
- Students/teachers (public schools, private schools, university)
- Community leaders/influential citizens
- Professionals/tradesmen (landscape architects, architects, builders, nursery owners, etc.)
- Other golf course operators, launderies, high water use businesses, motels, hotels, restaurants

To educate and inform the citizens of Hays County will require developing a plan tailored to the resources available in Hays County. The effectiveness of the plan will depend on how well each institution, organization, and group is utilized.

Following is a list of suggested Public Education "Forums":

- Government meetings
- Media (newspaper-radio-TV-property owners associations newsletters, etc.)
- Regional authorities, districts, organizations, (LCRA, EUWD, GBRA)
- Billings (telephone, gas, electric, water)
- Property owners association meetings
- Agricultural agencies (publications, meetings, etc.)
- Classroom grades (3-12 and university)
- Professional publications (farmers, ranchers, builders, architects)
- Service and social clubs (Lions, Rotarians, womens clubs, senior citizens, etc.)
- Garden club meetings

Implementation

For the Hays County education program to be effective, the following actions are necessary.

1. Designate responsibility for establishing an ongoing education program. Since this is a county endeavor, the County Judge should appoint a committee composed of dedicated, committed and respected citizens. Each community or geographical area must be represented on such a committee. The committee would be responsible for the following:

   - Provide qualified individuals to speak at institutions, organizations and groups throughout the county at regular intervals.

   - Conduct or sponsor exhibits on conservation, water saving devices and other methods to promote water conservation and efficiency.

   - Provide and distribute brochures and other materials to the citizens of Hays County. These materials are frequently available from an assortment of agencies such as the Texas Agricultural Extension Services and Texas Water Development Board.

- Work in cooperation with builders, developers, and governmental agencies to provide exhibits of Xeriscape Landscaping on new homes in highly visible locations.

- Work in cooperation with schools and Southwest Texas State University (SWTSU) to establish an education program within these institutions and provide these institutions with landscape videos, brochures and other training aids.

- Develop welcome packages for new citizens to educate them on the benefits of conservation and the plants, trees, shrubs and grasses best suited to the area which are water efficient.

2. The effectiveness of the education program must be measured at regular intervals. This measurement must first determine what public awareness and knowledge existed at the start of the education program and then at regular intervals. One proven method to accomplish this is as follows:

   - Commission a statistically valid public opinion survey to establish a "baseline" of public awareness/attitudes and knowledge about water problems, conservation, efficiency and retrofits.

   - Conduct periodic surveys to develop "time series" data to evaluate and measure education effects.

   - Utilize SWTSU to accomplish the surveys and evaluate the data.

3. Adequate funding of the education program is vital. An education program should be cost effective and funded by both state and local agencies. Use of existing resources will substantially reduce expenditures. Conservation education must have the same priority for funding as other services which are considered necessary for the health, safety and general welfare of our citizens.

WATER CONSERVING PLUMBING CODE

INTERIOR WATER USE EFFICIENCY

Interior water use in both residential and commercial settings is largely "technology based" that is, the amount of water required to accomplish a function is determined in great measure by the water use rates of fixtures and appliances. As a result, enhancing the efficiency of these devices can produce significant reductions in water demand. For example, and old toilet installed under codes prevailing before about 1980 would draw about 5.5 gallons per flush. Currently, toilets using 1.5 gallons per flush or less are becoming available. So the same function can be accomplished using about a quarter of the water. End use efficiency enhancement of interior water demands is therefore one of the major means of conserving water supplies.

This section examines the various methods of increasing interior water use efficiency. Two basic categories into which these efforts can be classified are retrofitting of existing structures and code standards for new construction. The ultimate water savings potential per structure in each category is similar, since either depends upon similar hardware substitutions to achieve these savings. However, they differ in the institutional/regulatory issues important to each and their impact upon water savings actually realized. Hardware options are discussed first, noting their apparent water saving potential, the category to which they are relevant, and the cost effectiveness of each. Benefits other than direct fiscal advantages to the end users are also discussed.

TECHNOLOGIES FOR EFFICIENCY ENHANCEMENT

As an aid to surveying the hardware options and their water savings potential, five generic scenarios are presented:

1) The "non-conserving" scenario, reflecting the type of hardware prevalent prior to the institution of current plumbing codes, generally meaning the structures were built before 1980.

2) The "low-cost retrofit" scenario, in which the residential hardware assumed in the first scenario is retrofit as follows: toilet dams in toilet tanks, toilet tank leakage is minimized, and low-flow showerheads are substituted for "non-conserving" ones. Commercial fixtures remain unchanged in this scenario.

3) The "current practice" scenario, which reflects just that--a structure with plumbing fixtures simply conforming to currently prevalent construction practices, which in some cases are more water conserving than present codes strictly require.

4) A "moderate conservation" option. which could be viewed alternatively as "high-cost retrofit" scenario. This assumes an "advanced" plumbing code, mainly relating to toilet fixtures, with a 1.5

gallon per flush unit being assumed for both residential and commercial fixtures. A more efficient washing machine and a high efficiency dishwasher are also assumed.

5) A "high conservation" option, incorporating the most advanced, maximum water saving fixtures which are currently commercially available. For residences, these include a 0.5 gallon per flush air assisted toilet with zero toilet leakage, a 0.5 gallon per minute specialty showerhead, and a high efficiency washing machine. Commercial sector usage is assumed to be the same as the "moderate conservation" scenario.

The water demands per capita implied by each of these scenarios are displayed in Table 4. This shows the "base" use per capita in old construction to be 80.4 gallons for residences and 20.0 gallons in commercial settings.

Table 4

Interior Water Demand

Conservation Option	Water Demand (gpcd) Residential	Commercial
Base Use	80.4	20.0
Current Practice	61.8	10.3
Moderate	50.4	5.8
High	29.4	1.3

The low-cost retrofit gains a savings in the residential sector of about 13 gallons per capita per day (gpcd), or a 16% savings. The current practice scenario results in a demand of 61.8 gpcd in the residential sector and 10.3 gpcd in the commercial sector. This can be considered the "base" demand for all recent and new construction. Moderate conservation measures in new construction result in a demand of 50.4 gpcd in the residential sector and 5.8 gpcd in commercial buildings. This represents an 18% decrease in residential demand and a 44% decrease in commercial demand from the current practice base. If these measures were pursued as retrofits to old construction, a 37% decrease in residential demand and a 71% decrease in commercial demand would be realized. The high conservation option yields a residential demand of 29.4 gpcd--a 52% decrease from current practice--and a commercial demand of 1.3 gpcd--an 87% decrease.

This analysis, though admittedly simplistic and based upon "global" usage rates, etc., indicates a very large potential for enhancing the end use efficiency of interior water uses in the residential and commercial sectors. The impacts of these savings go well beyond the savings in water rates to the end users, as the following discussion outlines.

BENEFITS OF INCREASED INTERIOR WATER USE EFFICIENCY

As noted, end use efficiency enhancements would save money for the user through reduced water bills. Certain actions would also result in savings in energy bills due to a reduced demand for hot water. One result of decreased demand for interior water uses is reduced wastewater flow. This imparts a general environmental benefit due to lower volumes of effluent to be assimilated. It also provides direct tangible benefits to the wastewater system. An on-site system would operate better with lower flows, and in many cases the disposal field could be safely downsized in recognition of the lower volume of flow. A collective system could benefit through smaller component sizes throughout the collection and treatment system.

Likewise, lower demands upon the water system might allow downsizing components of that system as well. Attaining a practical benefit would undoubtably require some regulatory changes, however, since "stock" line sizes are usually stipulated.

Perhaps the greatest potential benefit of increasing efficiency of end uses is that this may forestall the need to expand the capacity of water supply and/or wastewater treatment systems. Note that decreasing wastewater flow per capita 30%, for example, is equivalent to decreasing the contributing population 30%, allowing that much more capacity to accommode growth before a plant expansion would be required. This benefit appears to be particularly valuable in terms of water supply expansion, since it appears that any new sources of supply for Hays County would be quite costly relative to current water rates.

Implementation

Improved technology has made it possible to accomplish considerable water savings through the use of more efficient plumbing fixtures. Among these fixtures are improved low flow shower heads, low volume toilets, water saving washing and dishwashing machines, and flow controlled or aerated faucets. Use or specification of these plumbing fixtures would fall under the "moderate conservation option". Under the "moderate conservation option", an 11.4 gpcd decrease in residential demand and a 4.5 gpcd decrease in commercial demand from the current practice can be realized.

Due to the potential water savings available through the use of more efficient plumbing fixtures and the fact that these fixtures are commonly available at most plumbing supply centers in the area, the following plumbing code and standard should be established.

REQUIREMENTS FOR ALL NEW RESIDENTIAL AND COMMERCIAL CONSTRUCTION

(a) Toilets: Toilets shall be designed, manufactured, and installed so the maximum flush will not exceed 1.6 gallons of water.

(b) Urinals: Urinals shall be designed, manufactured, and installed so the maximum flush will not exceed 1.5 gallons of water. Adjustable type flushometer valves may be used provided they are adjusted so the maximum flush will not exceed 1.5 gallons of water.

(c) Showerheads: Showerheads, except where provided for safety reasons, shall be designed, manufactured, and installed with a flow limitation device which will not allow a water flow rate in excess of 3.0 gallons per minute. The flow limitation device must be a permanent and integral part of the showerhead and must not be removable to allow flow rates in excess of 3 gallons per minute.

(d) Faucets: All lavatory, kitchen, and bar sink faucets shall be designed, manufactured, installed and equipped with a flow control device or aerator which will not allow a water flow rate in excess of 2 gallons per minute. In addition, all lavatory faucets located in restrooms intended for use by the general public shall be of the metering or self-closing type.

(e) Hot Water Piping: All hot water lines not in or underneath a concrete slab shall be insulated.

(f) Automatic Dishwashers: All automatic dishwashers installed in residential dwellings shall be of a design that uses a maximum of 13 gallons per cycle.

REQUIREMENTS UPON CHANGE OF OWNERSHIP OR USE

All existing residential dwellings and commercial structures shall be retrofitted at the time of change of ownership, if not already so, with toilets, showerheads, and faucets under the requirements of new residential and commercial construction.

REQUIREMENTS FOR REPLACEMENT OR RENOVATION OF PLUMBING FIXTURES

All new plumbing fixtures that replace or renovate existing plumbing fixtures shall follow the requirements for new residential and commercial construction.

WATER CONSERVATION RETROFIT PROGRAM

APPLICATIONS

Water conservation retrofit programs are generally targeted at up-grading the efficiency of plumbing fixtures in structures whose construction pre-dates the adoption of prevailing national plumbing code standards for water conservation (approximately 1980). Most utility-sponsored retrofit programs have been implemented to achieve "wastewater flow reduction" objectives rather than water conservation per se. The most common situation has involved a hydraulically over-loaded wastewater collection and/or treatment system. Water conservation retrofits are intended to provide some near-term relief or perhaps enable a delay in wastewater system improvements. Retrofit programs have also been implemented to reduce water use during a water supply shortage or other emergency (e.g., contamination of a well). Retrofitting existing structures served by private sewage facilities (i.e., septic systems) is another possible application. Research has shown significant improvements in the overall performance of septic systems when hydraulic loadings are reduced through water conservation retrofits.

IMPLEMENTATION ALTERNATIVES

As with the technologies for water conservation retrofits, a wide-range of options exist for implementing retrofit programs. A few "generic" implementation alternatives are identified below:

I) <u>Voluntary Retrofit Programs</u>:

Utility (or other public agency) encourages and promotes retrofitting of existing structures by the property owners at property owners expense. Requires educational and promotional effort regarding the need for and benefits of retrofits. Overall program effectiveness likely to be low.

II) <u>Manadatory Retrofit Programs</u>

Appropriate governmental entity mandates, by ordinance, the retrofit of all existing structure according to prescribed standards. Options include retrofit by a prescribed date or at point-of-sale. Requires inspections to insure compliance. Overall program effectiveness likely to be high if public resistance can be overcome.

III) <u>Utility Sponsored Retrofit Programs</u>

Water and/or wastewater utility is directly involved in the procurement and distribution of retrofit "kits." Most utility-sponsored programs entail free distribution to all utility customers and installation by the customer. Distribution methods include; direct mail, depot and door-to-door. Some programs have included assistance with device installation to some or all customers. In a few examples, retrofit kits are sold to the utility customer at or below cost. Overall program effectiveness will vary according to types of devices provided and distribution method.

Recommendations

Upgrading the water use efficiency of existing residential and commercial developments through water conservation retrofits can provide significant benefits to the citizens of Hays County. However, utility or other publicly-sponsored retrofit programs are not recommended for implementation county-wide. Rather, publicly-sponsored retrofit programs should be implemented on a case-by-case basis in response to local water and wastewater utility service problems. In particular, publicly-sponsored water conservation retrofit programs should be considered as a method of achieving reductions in wastewater flows to wastewater systems that are at or near hydraulic overload. Assistance with the design and implementation of local water conservation retrofit programs should be available from the Texas Water Development Board and appropriate regional water management agencies.

Not withstanding the above recommendation, it is strongly recommended that the benefits of and technologies for water conservation retrofits be included in public education and information programs. The objective would be to motivate individual consumers to undertake voluntary retrofits of their homes and businesses. The educational effort should focus on low and moderate cost "do-it-yourself" retrofits and underscore the favorable cost payback of such retrofits. Information regarding the improved performance of on-site wastewater treatment and disposal systems (i.e., septic tank systems) should also be included. Additionally, adoption and enforcement of plumbing code standards for new construction and rehabilitation will provide a gradual up-grading of plumbing fixtures in existing structures.

WATER CONSERVATION-ORIENTED RATE STRUCTURE

Water rates and water pricing as tools in an aggressive program of water conservation for Hays County will be effective to the extent that cities and other water purveyors initiate and carry out simultaneous programs of rate setting and customer education designed to deal with local site specific circumstances. For county-wide water demand reduction to reflect these local initiatives, the County can take actions and provide incentives for compliance with goals of demand reduction and improving the effectiveness of management of the limited water resources available.

The key issues that must be addressed to achieve the County's objectives of demand reduction are conservation pricing and marginal cost pricing. These are described below, followed by recommendations for actions by the County and by individual water purveyors. Some of these actions may require new legislation, but they deserve consideration in a county wide approach to the problem.

Conservation Pricing

The success of price as a method to achieve conservation depends largely on the specific water use and the conditions of water supply. Price elasticity, which measures the change in demand that occurs for every one percent change in price, is a tool which measures the sensitivity of consumption to changes in price. Most studies have found consumption somewhat responsive to price changes, although the change in consumption tends to be proportionally less than the associated price change. As might be expected, essential water uses are generally less responsive to price changes than nonessential uses. For example, water use within the home is less responsive than exterior water use to changes in price.

Estimates of price elasticity from other areas are a useful way to examine the potential effectiveness of pricing measures. These estimates vary widely as shown in the following table. Estimates range from -.01 to -.60 for residential use up to -.27 to -.70 for sprinkler use. A price elasticity of -.02 means that water use should decrease 2 percent with a 100 percent increase in price.

PRICE ELASTICITY OF WATER

Water Use	Elasticity	Location
Municipal	-.27	Phoenix
Municipal	-.41	Tucson
Municipal	-.35	Southwest U.S.
Residential in-house	-.20 to -.38	Colorado
Sprinkling	-.27 to -.53	Colorado
Municipal	-.335	Las Vegas
Residential	-.225	dispersed
Residential	-.03 to -.29	Mississippi
Residential	-.10	dispersed
Residential	-.15 to -.24	Minnesota
Industrial cooling	-.894	New Jersey
processing	-.745	New Jersey
steam generation	-.741	New Jersey
Sprinkling	-.703	dispersed
Municipal	-.6	Midwest
Municipal	-.37	Massachusetts
Municipal	-.02 to -.28	Illinois

These elasticity measurements are point estimates, meaning they reflect the charge for a given price-quantity relationship. In fact, as prices rise, elasticity estimates tend to increase as excessive water use is cut back, then decrease as the minimum water use requirements are approached.

Elasticity estimates for semi-arid areas indicate relatively low price elasticities, most likely in the magnitude of -.10 to -.20. Water is relatively inexpensive compared to other household purchases. This tends to limit the reduction in water use when price increases.

These studies over the long-term indicate that consumer behavior can be modified with price but that permanent behavioral adjustment may take several years to occur.

Marginal Cost Pricing

Historically, water rates have been set to reflect the average cost of water. That is, the total cost for the water is divided among the users, without regard to how different users influence the costs for expanding the water system. Some utilities have recognized that the addition of new users results in the expansion of facilities and the acquisition of new, and usually more expensive water. To more fairly assess the cost of obtaining new water, utilities charge new customers substantial fees for a connection to the system. These fees provide the utility with income that can be used for expansion. However, developers and community boosters sometimes oppose high connection charges on the grounds that they inhibit growth and development. Conservationists sometimes argue on behalf of such fees because they do tend to limit growth and protect the investment of present customers.

Economists have argued that water rates should reflect not the average cost of water today but the cost of the next unit of water to be obtained by the utility, or the marginal cost. Marginal cost is usually defined as the cost of water from the most recently constructed or next increment of plant capacity and supply. Thus, the charge for water from a new and expensive supply source should reflect that additional cost even if it is greater than the average cost. If rates were based on marginal costs, then, they would increase to reflect the increasing scarcity and delivery cost of new water. As a tool in rate setting, marginal cost pricing may be very useful as Hays County looks at its options for the future.

Specific Measures

Governmental agencies and water supply corporations should, after evaluation of their particular environment, establish rates and incentives to encourage water conservation. Each entity should set conservation goals and then tailor their program to attain the set goals.

1. Rates: There are several different rate structures that each entity should consider when setting rates to encourage water conservation.

*Increasing block rates

*Rate rachet for peak demands

*Seasonal rates - flat rate with higher monthly charges during high use months

1) Increasing block rates, e.g., less than 2,000 gal./mo., 2,000-10,000 gal./mo.

2) Customer determined increasing block rates, e.g., anything above average usage by customer during December, January and February -- time of least consumptive use--is charged at higher rate.

3) Seasonal rates, e.g., flat rate regardless of gallonage but higher in summer--time of higher peak demand--than in winter, when demand is lower.

4) Demand charge, as is done with electric customers, e.g., month with highest sets a demand charge for the next 12 months.

5) For water providers, a pumpage fee or surcharge--could be somehow worked in as "value added" tax--to be passed on to customers to encourage individual conservation efforts. Fee could be "modulated" based upon loss rate of system.

2. Incentives: A variety of incentives are available to governmental entities and water supply corporations to encourage and promote water conservation.

*Lower permit fees and hook up fees for new homes equipped with plumbing fixtures which meet the requirements of an "advanced" plumbing code.

*Rebate of a portion of permit fees and hook up fees for new single or multi-family homes and commercial developments when approved Xeriscape landscaping is installed.

3. Incentives to Homeowners, Builders & Developers

1) Cash rebate program for installation of ultra-low volume toilet. Might be in form of reduction in "capital recovery" fees for development, direct rebate to homeowner, unless sufficient rate structure incentives instituted.

2) For developments not within area served by existing "organized" wastewater system, grant increased density or decreases in development fees (increase county platting fees to make this incentive meaningful) for water reusing wastewater management. Might include:

*"Improved" on-site systems, e.g., pressure-dosed designed to obtain some irrigation benefit or true drip irrigation.

*Collective systems with irrigation disposal in some manner which displaces what would have been supplied with potable supply.

3) For developments within area served by existing "organized" wastewater system, grant some form of development credit--definitely a decree in "capital recovery" fee, perhaps density increase, setback relaxation, impervious coverage waiver, etc.-- for separately plumbing greywater, treating it on-site and using it for irrigation of grounds and/or toilet flush supply.

4) Rebate or decrease in fees for installation of xeriscape on common areas of multi-family, P.D.D./P.U.D.'s, or on commercial/industrial grounds.

5) Reduction or rebate of fees for implementation of commercial or industrial reuse/recycle operations.

6) Some sort of revolving loan program to finance water saving appliances and fixtures or water reuse programs, e.g., greywater irrigation system. System operator would split savings with purchaser until loan is repaid.

7) Allow decrease in size of water supply pipes relevant to expected decrease in demand from conservation measures, but require proof of reduction effectiveness.

8) Reduction or rebate of fees for commercial or industrial users who install reuse/recycle equipment.

9) Penalties for water systems whose water sales consistently falls below 85% of pumpage.

Implementation

Water conservation-oriented rate structures have been shown to reduce water use. The HCWDB requires that each water supplier establish an increasing block rate structure. The HCWDB also encourages any of the other water conservation incentives listed above.

UNIVERSAL METERING AND METER REPAIR AND REPLACEMENT

Universal metering of all accounts is becoming routine practice among most water suppliers in this area. In order to enforce a stand of system integrity, this would have to be mandatory, of course. It would also be of practical benefit in terms of water conservation in two ways. First, studies show that metering results in lower water use, since the customer becomes "sensitized" to the amount of water used through the effect it has on the water bill. Second, metering is an aid to detecting leaks--on both sides of the meter. For the system side, the difference between water production and metered use is, by definition, the amount of system losses. On the customer side, an unexpected increase in metered demand may indicate a break in the customer's line.

Maintenance programs for water meters are essential to assuring that an accurate measure of system integrity is being obtained. A common approach is to change out a given percentage of total meters in the system every year, running the meters that are "pulled" through a preventative maintenance program, then using them for replacements. Another benefit of this strategy to the water provider is that under-registration by meters may result in significant loss of revenue.

Implementation

The following actions are necessary:

- Universal metering is required by all water suppliers.
- A meter replacement/testing schedule be developed and implemented by each water supplier.

WATER CONSERVING LANDSCAPING

EXTERIOR WATER USE EFFICIENCY

Exterior water use for landscape irrigation represents the largest single water use in residential developments. Analysis of water utility billing data for residential developments in Central Texas indicates that the average annual water use for landscape purposes is approximately 35 to 40 percent for single family residences.

SEASONAL WATER DEMAND

Landscape irrigation creates seasonal peak water demands. Seasonal water demands represent the incremental demand above base (interior only) levels, primarily for landscape irrigation during the summer months. For residential developments, peak demands during the summer months are sometimes four times greater than normal (interior only) demands. Commercial uses typically show lower peak water demand factors than residential developments. Because landscape irrigation use is largely dependent on weather conditions, large variations in peak demand occur between wet, normal and dry years. Drought conditions typically result in an overall increase in total water use and peak water demands.

Communities often rely on water supply sources which are highly dependent on favorable climatic conditions. Typically there is reduced inflow to or recharge of the supply source during the low rainfall periods accompanied by an increase in overall water demand due to increased water use for landscape irrigation. The requirement to size the water supply system to meet peak water demands with adequate reserve for fire fighting purposes means that facilities are oversized with respect to normal demands and are underutilized most of the year. The costs for oversized facilities must be borne by the rate payers. Reducing the magnitude of seasonal peak water demands through water-conserving landscaping offers the greatest potential for optimal sizing of water treatment and distribution facilities.

FUNDAMENTALS OF WATER CONSERVING LANDSCAPING

The key elements of low-water demand landscaping are contained in a program called Xeriscape developed in Denver, Colorado. The Xeriscape program is based on seven fundamentals of water conserving landscaping. The seven fundamentals are:

- Planning and Design

  Perhaps the most important fundamental is a good design which will ensure both the resident's long term satisfaction and water conservation. Key considerations include the functions (recreation, shading, aesthetics, etc.); maintenance requirements; priorities and budget. Planning also allows installation of landscaping in phases which minimizes initial expenses.

- Limiting Turf Areas

Turf areas are the most long term water-consumptive component of a landscape. Depending on soil conditions, climate and grass type, turf areas normally require large amounts of water to supplement natural rainfall during the summer months. It is essential in a low-water demand landscape plan to reduce the size of the irrigated turf areas. Substitutes for irrigated turf areas include native grasses, ground covers, low-water demand plants or mulches, decks, patios, walkways and rock gardens.

- Soil Improvement

Prior to the installation of vegetation or an irrigation system, the existing soil must be analyzed to determine the necessary improvements. County extension agents can provide assistance in taking soil samples and determining the soil improvements required to ensure water holding capacity, absorption properties and nutrients for plant growth.

- Larger Mulch Areas

Mulches cover and cool the soil, reduce weed growth, minimize evaporation and slow erosion. Organic mulches are typically bark chips, wood grindings, composted leaves or pole peelings. Inorganic mulches include rock and various gravel products.

- Low-Water Use Plants

The use of native and other adapted low-water use plants is essential in any low-water demand landscaping strategy. Such plants normally do not require supplemental irrigation except during the initial establishment period or during severe drought conditions. Native plants are normally more resistant to disease and insects and more likely to survive temperature extremes.

- Efficient Irrigation

Water efficiency in irrigation requires knowing when to water, how much to water and how to water. Knowing when to water is essential to both healthy plant growth and water conservation. Most professionals agree that people tend to over-water, rather than under-water their landscapes. A general rule of thumb is to irrigate when plants first begin to show signs of drought stress. The most optimal time for landscape irrigation is during early morning hours and late evening when temperatures are the lowest and winds are normally calm.

How much to water is dependent upon the type, age and size of plant, soil characteristics, the season and weather. Most plants, including turf grasses, can survive with an application of water every five to seven days. A general rule-of-thumb is to apply 1.0 to 1.5 inches of water per application. To avoid over-watering or under-watering plants with similar water requirements should be grouped together.

The question of how to water relates mostly to the type of systems used to apply water to a landscape. These include three commonly used: end-of-hose sprinklers, drip irrigation systems and permanently installed automatic systems. End-of-hose sprinklers are commonly used in residential settings and efficiency varies with product design. Sprinklers that spray large droplets close to the ground are more efficient than those which spray a fine mist or stream high into the air. End-of-hose sprinklers require constant monitoring and control to ensure uniform water distribution.

Drip irrigation systems apply water at a low constant rate directly to or beneath soil surface. High water efficiency is attained by reducing evaporating losses and wasteful runoff. Drip irrigation systems are most suitable for the irrigation of trees, shrubs, bedding plants and vegetable gardens.

Permanently installed automatic systems have become increasingly common in both residential and commercial settings. Higher water use efficiency can be achieved with automatic sprinkler systems by automatically regulating the amount and timing of water application and can be tailored to water requirements of different plants and turf.

- Landscape Maintenance

Low-water demand landscaping generally requires less maintenance than the more traditional landscape. Proper maintenance is required and preserves the intended beauty of the landscape. Poor and improper maintenance practices can undermine much of the effectiveness of a well planned and installed Xeriscape.

Periodic <u>fertilizing</u> is essential to a healthy landscape. Because fertilizer requirements vary with plant type, season and soil type, professional advice should be sought.

Turf areas should be <u>mowed</u> frequently, cutting only the top one-third of the grass at a time. The clippings should be allowed to remain as mulch and soil conditioner.

Periodic <u>aeration</u> of turf areas is recommended. Aeration reduces compaction allowing water and fertilizer to penetrate the soil to the root zones.

Undesirable <u>weeds</u> should be removed as soon as they become visible. In addition to being unsightly, weeds use water intended for desired plants.

Trees and shrubs should be <u>pruned</u> periodically. Pruning reduces the amount of leaf surface on a plant which reduces plant transpiration.

Implementation

To achieve widespread use of the fundamentals of XERISCAPE, the following actions are required:

- Use all available educational resources as recommended in the Public Information and Education section of this document. Emphasis must be placed on the education of government officials as they have the authority to enact ordinances necessary to ensure use of Xeriscape fundamentals. Public awareness and knowledge of the long term benefits and cost effectiveness of the Xeriscape concept is essential to obtaining desired water conservation.

- Well-designed and properly maintained demonstration landscapes located in highly visible areas within Hays County.

- Incentives to include reduction in subdivision fees and building permit fees for builders or developers installing or requiring landscaping using the Xeriscape fundamentals.

The acceptance of the Xeriscape concept by the majority of Hays County residents is essential for the long term success of the Conservation Plan.

LEAK DETECTION AND WATER AUDITS

SYSTEM LOSS CONTROL

a. Leak Prevention, Detection and Repair

The surest way to minimize leaks is use high quality materials to construct the system, assure that they are properly installed, and then to maintain all components in good operating condition. Therefore, good water system construction standards and a program of water main replacement in areas where leaks are recurrent should result in a low level of leaks from water systems.

Many water systems are not following these practices, however, due partly to the cost of raw water currently being so low that low system integrity is generally affordable relative to the costs of higher construction standards and pipe replacement programs. Also, there is not universal agreement on what construction standards should be considered adequate.

A solution to this problem is to make it more costly to allow a low system integrity than to take the measures to raise it to an "acceptable" level. For this to happen, some authority must establish standards for system integrity, along with meaningful sanctions against the system operator for falling below that standard.

Specific actions can be taken to prevent leaks and to locate those that do occur so they can be repaired quickly. Corrosion can be prevented in tanks and metal pipes through proper coatings and cathodic protection. Valves can be inspected and operated periodically. Visual inspection and leak detection equipment can be employed to actively seek out system leaks. Records of leak frequency can be used as a guide to determining the cost effectiveness of line replacement. Through these activities, even a decrepit system could eventually be brought up to a high standard of integrity.

b. System Pressure Control

In general, pressure control is best executed at service laterals, since pressure reduction in the distribution system might compromise fire fighting capabilities. Any areas of the system where pressures become excessive, usually taken to mean over 100 psi static pressure, are candidates for system pressure control. Reduction of system pressure would minimize the losses from any leaks which go undetected for long periods. The actual static pressure to be maintained would depend upon the characteristics of the area and system, especially the pressure drop caused by peak demands.

CUSTOMER LOSS CONTROL

a. Pressure Control at Point-of-Use

Many water uses which require a specific amount of water--such as filling a bathtub, toilet tank or a washing machine--are not affected by pressure. However, others are "time dependent"--like taking a shower or watering a lawn--and reducing line pressure can reduce the total quantity of water flow from an outlet. For the same reason, pressure reduction would also reduce the waste per unit time from any leaks or faulty fixtures left unattended by the customer.

It is generally preferable to control pressure at the customer's service line. Many plumbing codes already require pressure regulators where the static pressure exceeds 80 psi. Uniform enforcement of this requirement would be a minimum step in this direction. A static pressure of 40 psi is generally more than adequate for household purposes.

b. Water Audits

A water audit offers a vehicle for helping to eliminate waste on the customer side of the meter. "Waste" might be defined broadly as water used in excess of the amount required to perform the desired function. Thus, water audits could not only help the homeowner to identify and fix leaks, but also could be used to purvey information about the cost effectiveness of retrofitting water conserving fixtures and about improved landscape irrigation practices.

Implementation

The HCWDB recommends that each water supplier voluntarily implement a leak prevention, detection, and repair program. The HCWB also recommends that each water supplier consider system pressure control as a means of reducing the potential for leaks.

WASTEWATER REUSE AND RECYCLING AS A CONSERVATION MEASURE

The planned reuse of treated wastewater effluent is one of the two major means of reducing demand upon aquifers and reservoirs. It is noted that when treated effluent is discharged into a receiving stream, that water often ends up being used again by downstream communities. There is no specific intent to reuse wastewater under this management strategy, so the extent of reuse is unknown, as is the cost effectiveness of any reuse which does occur. In contrast, the term "reuse" here refers to a deliberate strategy of directly using wastewater effluent--treated to a degree appropriate for the intended reuse--to satisfy various non-potable demands.

This general strategy of wastewater management is termed "beneficial reuse." In practice, satisfaction of irrigation demand will often be the reuse to which wastewater effluent is applied. It is important to distinguish between "beneficial reuse" and the conventional wastewater disposal practice of "land application." The latter is quite often what may be termed a "contrived" reuse--that is, an area of land is irrigated for the sole purpose of disposing of wastewater. This land would not be irrigated in the absence of this need, and economic benefits from irrigation are usually not a factor. Under a "land application" management strategy, wastewater literally lives up to its name.

In contrast, under a "beneficial reuse" strategy, effluent is used to supply irrigation demands which would exist regardless of the need to dispose of wastewater. Treated wastewater is used to displace an equivalent amount of demand upon the potable water supply system. Therefore, this effluent has a value, as opposed to effluent under a "land application" strategy, which is generally viewed as a liability. In Hays County, a large part of that value would be forestalling the need to bring new sources of supply on line.

"Reuse" is the general term applied to any process in which a wastewater stream is employed for any beneficial purpose. A common example is treated effluent being used for golf course irrigation. "Recycling" is a subclass of reuse in which the same water is used over and over to satisfy the same demand. An example would be the recycling of toilet flush water in an office building. For convenience, the general term "reuse" is used here to cover both reuse and recycling. The context of usage will indicate those situations were "recycling" is the appropriate action.

Reuse activities can be executed at varying levels of aggregation of wastewater flow. The lowest level at which reuse is expected to be viable is at the "building" scale. Obviously, the greatest level of aggregation is reusing conventional, centralized wastewater treatment plant effluent. This is denoted the "utility" scale. Between these extremes, two other levels are identified--the "neighborhood/campus" scale and the "development" scale. Reuse opportunities at each scale and their expected costs and benefits are discussed separately herein.

I. BUILDING SCALE

a. Prototypes and Examples

Part or all of the wastewater flow from a single building may be intercepted, treated and reused at the site of generation. A prototype for this scale of reuse is the old rural practice of using clothes wash water to irrigate lawns and gardens. Though the direct dumping of untreated wash water is now outlawed, the basic idea may still be executed. Appropriately treated residential greywater can displace an equivalent amount of demand upon the potable water system for landscape irrigation. If these individual lot systems are controlled by the residents, it is probably in the best interests of public health that they be limited to low density developments.

Another example of this scale of reuse is the recycling of toilet flush water after treatment in office buildings. Since approximately 90% of the water demand in such buildings is for toilet flush water, most of the demand upon the potable water supply system can be displaced by this practice. It is also possible that the residual 10% of the flow could be reused, for irrigation around the building or to supply cooling towers for the building's space conditioning system.

b. Potential and Limitations

The water savings potential from implementation of reuse at this scale will depend on the portion of total water use demanded by development in which on-site reuse is a viable option. Therefore, future development patterns would dictate total savings county-wide. As noted above, 90% savings in demand is expected in each office building for which toilet flush water recycling is practiced. A cursory analysis of irrigation demands versus greywater flows indicates that, subject to several assumptions, on-lot reuse of treated greywater for landscape irrigation might save about 30% of total water demand annually, with about 25% savings being realized in the peak month. If toilet flush water were also supplied by treated greywater, saving should be 40% annually and 30% in the peak month.

Reuse is expected to be more cost effective at the building scale than at greater levels of wastewater aggregation in those situations in which on-site reuse is otherwise viable. For isolated homes or developments of low density, collection and redistribution system costs would most likely make collective reuse systems far more costly. Building scale toilet flush water recycling is generally considered appropriate for isolated office buildings, where again collective systems would be far more costly.

A great deal of existing development may be difficult to retrofit for reuse at this scale, effectively limiting potential savings to new development. The ability to retrofit new development in the future would be enhanced by assuring that proper provisions are built into all new structures. As present Hays County population is less than one-third of that projected for 2040, new development alone offers a very significant potential for savings in water demand.

First cost inertia is perhaps the greatest obstacle to reuse at the building scale. Effective on-site reuse of greywater for landscape irrigation or recycling of toilet flush water would require a substantial investment in treatment facilities. Also, dual piping--for greywater/blackwater separation or a separate supply line to toilets--would increase first costs, the degree varying from negligible to considerable, depending upon the situation. Regardless of the general benefit of helping to forestall costly water supply projects, the microeconomics of the project are often favorable, however. In many cases, paybacks from savings in water costs are fairly attractive. But in general, the people building a project are far more sensitive to first cost than to operating cost. Therefore, some mechanism of financing these types of projects would help to proliferate them.

II. NEIGHBORHOOD/CAMPUS SCALE

a. Prototypes and Examples

This scale is appropriate to a neighborhood with higher residential density where a block of homes could have their greywater treated at a collective facility, then routed back to the lots on which it was generated to serve irrigation demands and to supply toilet flush water. These facilities would probably be installed by and under the control of some wastewater service authority.

Another example would be reuse within a commercial/industrial campus. Renovated wastewater could be used for cooling tower supply, irrigation, toilet flush water, or other non-potable demands. Cooling tower blowdown could also be utilized to serve other non-potable demands. Process water might also be amenable to reuse or to direct recycling.

b. Potential and Limitations

The total savings potentially available county-wide from broad implementation of reuse at this scale would be highly dependent upon the portion of total water demand routed to development in which reuse at this scale would be viable. A cursory analysis similar to that conducted for a single home indicates that neighborhood greywater reuse might result in a 46% savings in water demand, the greater savings being due to the ability to cost effectively include long-term storage in a collective system. In addition, an 84% decrease in wastewater flow--other than to the greywater treatment facilities--could be realized.

Savings from reuse within a commercial/industrial campus would depend upon the water use characteristics of the activities being carried on there. A toilet flush water recycle system for an office building complex would exhibit savings similar to that for a single building. Cooling towers are a significant point of demand for air conditioned buildings. Cooling tower blowdown is a lightly polluted stream with potential for reuse. A study recently completed for Southwest Texas State University indicates that cooling tower demands constitute about a quarter of total water demands on campus, and that cooling tower blowdown might supply almost all irrigation needs. A cascading reuse system, with renovated greywater supplying cooling towers and cooling tower blowdown supplying irrigation demands and toilet flush water, might cut total water demand in half.

This scale of reuse might prove to be the most cost effective. Collective systems at a neighborhood or campus scale are likely to exhibit the maximum economy, considering the collection and redistribution systems as well as the treatment facilities.

Barriers to reuse at this scale again include the difficulty of retrofitting existing development and various regulatory/code problems. Public acceptance of neighborhood greywater reuse systems may be more of a barrier than with on-lot systems, since a assurance of proper operation is beyond the control of the residents receiving the renovated water. Objections may be blunted by choosing to use treatment systems appropriate to use at this scale, in terms of the operating reliability and maintenance liabilities--that is, using treatment schemes which are inherently more "fail-safe."

Neighborhood greywater systems would presumably be sponsored by a water and wastewater authority rather than directly by the residents, so first cost inertia might not be as great. The water savings potential and long-term cost advantages are likely to be more important than quick payback to such entities. Campus scale reuse systems which are sponsored by the business entities involved are likely to be subject to considerable first cost inertia, since such investments would be governed by typical business microeconomics, stressing fast payback on capital investments. The expectation of increased water rates would, of course, help to spur such investments. Still, the people who build the structures--both residential and commercial/industrial--must be given some incentive or provided with some financial assistance to justify incurring the increased first cost required to build in the provisions for reuse, such as dual piping.

III. DEVELOPMENT SCALE

a. Prototype and Examples

In a mixed use development there may be many opportunities for non-potable reuse. If such a development were served by a conventional, centralized wastewater system, then dual piping might be installed throughout to route treated effluent to a variety of demands, such as irrigation, toilet flush supply, cooling tower supply, or commercial/industrial process water supply. In a new development, the building scale and neighborhood/campus scale facilities could be incorporated into the development's wastewater management plan. In any case, the ability to "connect" between water usage sectors at the development scale offers the possibility of maximizing reuse opportunities. An example of such a synergism is the use of wastewater from a housing development to irrigate a golf course, which serves as a major amenity of the development.

b. Potential and Limitations

This ability to maximize reuse indicates that total savings development-wide would exceed that available at the neighborhood scale. A greater variety of reuse opportunities would be available, perhaps allowing a better spatial and temporal match of supply and demand. Long-term storage may be more cost effective in a development-wide reuse system as well. It may be possible to integrate long-term storage into "water amenities." Since the neighborhood/campus scale of reuse exhibited a residential sector savings potential of 46% and a commercial office sector savings potential of 90%, it is likely that in excess of 50% of potable water demand could be displaced in a residential/office/retail development if all opportunities for reuse were implemented.

Relative cost effectiveness of reuse at the development scale would be somewhat site specific. If, for example, treatment were executed at a high level of wastewater flow aggregation but reuse opportunities were widely distributed, cost per gallon of water made available for reuse might be higher than if reuse were executed at a neighborhood scale. As a general rule, however, however, the ability to more cost effectively incorporate long-term storage and to connect among different sectors of water demand would tend to make development scale reuse the most cost effective level.

Again, it may be difficult to retrofit much of the existing development for reuse at this scale, since the actual reuse activities are simply multiples of the lower levels of reuse. Nevertheless, with over two-thirds of the County population projected for 2040 yet to be accommodated, new development still offers vast potential for reuse. Planning entire developments to incorporate reuse would maximize the opportunities for savings in potable water demand, so it is imperative that new projects be guided in this direction at the earliest possible stage.

Reuse projects instituted at this scale would definitely be under the sponsorship of a utility provider. Regulatory/code problems may still be a barrier at this scale, but perhaps less so than at lower scales, where reuse activities might be privately executed. Likewise, public acceptance of reuse activities which are "institutionalized" as an integral facet of development design would probably be more readily given. Concerns may arise as to whether treatment facilities can be made continuously reliable, which may be minimized by choosing to use relatively "fail-safe" treatment schemes.

First cost inertia would be a significant obstacle to gaining support of the developer of a project. Some form of incentives or some mechanism of financial assistance would probably be necessary to spur planning for reuse at the development scale. The public entities created to purvey the utility service to the users of the development are likely to have access to financing sources with greater latitude to make capital improvements now in the expectation that future savings would make them a wise investment. Allowing the developer to transfer some of the first cost burden of reuse facilities to these entities may be a viable form of assistance.

IV. UTILITY SCALE

a. Prototypes and Examples

This is the scale encountered when wastewater flows aggregate at a conventional, centralized treatment plant before being treated to a level allowing reuse. Reuse opportunities at this scale include routing of effluent to a single point of large demand, such as agricultural operations or industrial processes, routing effluent to several points of lesser but still sizable demands, like parkland irrigation, or installation of extensive dual pipe systems to route effluent to many points of small demand, such as lawn watering or toilet flush supply. A prototype of this scale of reuse is provided by the Irvine Ranch Water District in California, which has used centralized treatment plant effluent for irrigation since the mid-60's.

b. Potential and Limitations

A utility scale reuse system could theoretically result in the reuse of the entire flow into the treatment plant. Therefore, the potential for water savings by this strategy would be governed by the percent of total water use resulting in return flow to the wastewater system. Again, total savings countywide would depend upon the amount of total development served by treatment plants where this scale of reuse was found to be viable.

Unless there is available a large point of demand near the treatment plant, this scale of reuse is likely to be somewhat more expensive than reuse at lower levels of wastewater flow aggregation. Both an extensive wastewater collection system and an extensive water redistribution system would have to be paid for, in addition to the treatment facilities.

Since economics favors the targeting of large volume demands, it is probable that reuse at this scale could be more readily retrofitted into existing development. The problem of retrofitting the facilities--such as an office building using effluent for flush water supply--at the end use might still constitute a formidable barrier, however.

Unless reuse is targeted to specific demands with uniform potential for human contact and similar constraints, the entire volume of wastewater would have to be treated to the quality required by the most restrictive use. It is reasonable to assume that beneficial reuse regulations would allow lesser treatment for effluent used to irrigate access controlled areas, like agriculture operations, golf courses or roadway medians, than for effluent with higher potential for human contact, like lawn irrigation or toilet flush supply.

Public acceptance of utility scale reuse has not been found to be a problem in areas where it has been practiced. Some degree of education would probably be required, and the public would have to be convinced that the utility operator can assure continuously reliable operation of its treatment facilities. As almost every existing wastewater service provider in Hays County has some history of non-compliance, this may be a considerable obstacle to public acceptance. It is possible, however, that the proper choice of treatment facilities--favoring those which are more inherently "fail-safe"--might relieve such problems.

Recommendations

In view of the potential for reuse of treated wastewater effluent to greatly decrease per capita water demands without comprising the ability to accomplish the desired purposes of water use, the Hays County Water Development Board recommends that reuse be encouraged by all available means wherever it is found to be fiscally, environmentally and institutionally practical and prudent.

MEANS OF IMPLEMENTATION AND ENFORCEMENT

The Hays County Water Development Board will act as the administrator of the Water Conservation Program. The Board will oversee the execution and implementation of the program.

The HCWDB will be responsible for the submission of an annual report to the Texas Water Development Board on the Water Conservation Plan. This report will include the following elements:

1) Progress made in the implementation of the program.
2) Response to program by the public.
3) Quantitative effectiveness of the program.

The HCWDB will require, upon disbursement of any funds for water supply projects, that each water supply entity (city, public or private water supply corporation) being served by the water supply projects adopt this water conservation plan by ordinance or by-laws. Each entity will be responsible for enforcement of the Water Conservation Plan and each entity will also be responsible for furnishing all information requested by the HCWDB.

DROUGHT CONTINGENCY PLAN

HAYS COUNTY WATER DEVELOPMENT BOARD
DROUGHT CONTINGENCY PLAN

INTRODUCTION

The Hays County Water Development Board's Drought Contingency Plan will include the following:

- Trigger Conditions
- Drought Contingency Measures
- Information and Education
- Termination Notification
- Implementation Procedure

The Board's Drought Contingency Plan will be a recommendation for the water suppliers within Hays County to follow. During a drought condition, the Board will serve to coordinate the consumption of water resources within the county to insure fair and equitable use among consumers.

Groundwater is the primary source of water for Hays County, however surface water is expected to provide a large percentage of water in future years. Several agencies or governmental authorities have jurisdiction over these water supplies including the Edwards Underground Water District (EUWD), Barton Springs-Edwards Aquifer Conservation District, Lower Colorado River Authority, and the Guadalupe-Blanco River Authority.

Hays County is served by three major aquifer systems: the Edwards Aquifer (San Antonio Region), the Barton Springs-Edwards Aquifer, and the Trinity Group Aquifer. Therefore, the drought contingency plan is divided into parts according to the particular area served by each of the above mentioned aquifers. These areas are defined as:

- Edwards Underground Water District within Hays County
- Barton Springs-Edwards Aquifer Conservation District within Hays County
- Trinity Group Aquifer area defined as the area west of the EUWD boundary and west of the Barton Springs-Edwards Aquifer Conservation District boundary within Hays County.

The EUWD has a drought management plan which will apply to the Edwards Aquifer (San Antonio Region) in Hays County. The Barton Springs-Edwards Aquifer Conservation District has not developed a drought contingency plan to date, however a plan is expected in the near future. The Trinity Group Aquifer serves most of western Hays County. Due to the complex interactions with the Trinity Group Aquifer and the Edwards Aquifer (San Antonio Region), and the fact that a large portion of the spring discharge from the Trinity Group Aquifer recharges portions of the Edwards Aquifer, the two areas were combined so that both areas are subject to the same trigger conditions.

TRIGGER CONDITIONS

1. <u>Mild Condition</u>

Barton Springs-Edwards Aquifer Conservation District area

(a) Elevation of water level in well #58-57-903 at Mountain City Ranch less than 580 ft MSL for a period of 90 consecutive days or,

(b) Barton Springs discharge is less than 30 cfs for 90 consecutive days.

EUWD and the Trinity Group Aquifer area

(a) Stage I (Mild Condition) is reached according to the EUWD Drought Management Plan.

2. <u>Moderate Condition</u>

Barton Springs-Edwards Aquifer Conservation District area

(a) Elevation of water level in well #58-57-903 at Mountain City Ranch is less than 575 ft for 60 consecutive days or,

(b) Barton Springs discharge is less than 20 cfs for a period of 60 consecutive days.

EUWD and the Trinity Group Aquifer area

(a) Stage II (Moderate Condition) is reached according to the EUWD Drought Management Plan.

3. <u>Severe Condition</u>

Barton Springs-Edwards Aquifer Conservation District area

(a) Elevation of water level in well #58-57-903 at Mountain City Ranch is less than 570 ft MSL for 30 consecutive days or,

(b) Barton Springs discharge is less than 15 cfs for a period of 30 consecutive days.

EUWD and the Trinity Group Aquifer area

a. Stage III (Severe Condition) is reached according to the EUWD Drought Management Plan.

DROUGHT CONTINGENCY MEASURES

The following actions shall be taken by the Hays County Water Development Board when trigger conditions are met for any of the areas mentioned previously. These measures will apply only to the particular area in which a trigger condition is reached

1. Mild Condition

(a) Inform the public through the news media that a trigger condition has been reached and that they should look for ways to voluntarily reduce water use. Specific steps which can be taken will be provided through the news media.

(b) Publicize a voluntary lawn watering schedule.

(c) During winter months, request water users to insulate pipes rather than running water to prevent freezing.

2. Moderate Condition

(a) Continue implementation of all sections in preceeding phase.

(b) Car washing, window washing, and pavement washing is prohibited, except when a bucket is used.

(c) The following mandatory lawn watering schedule will be implemented:

Consumers with even numbered street addresses may water on even days of the month. Consumers with odd numbered street addresses may water on odd days of the month. Watering shall occur only between the hours of 6-10 a.m. and 8-10 p.m.

(d) Public water uses, not essential to public health or safety, are prohibited.

3. Severe Condition

(a) Continue implementation of all relevant actions in preceeding phase.

(b) All outdoor water use not essential to public health or safety is prohibited.

INFORMATION AND EDUCATION

The purpose and desired effects of the Drought Contingency Plan will be communicated to the public through articles in local newspapers and supplemented by pamphlets and notices. When trigger conditons appear to be approaching, the public will be notified through publications of articles in local newspapers, with information on water conserving methods.

Newspapers will publish notifications that drought contingency measures are abated for a given condition, and will outline measures necessary for the reduced condition.

Throughout the duration of drought contingency measure implementation, regular articles will appear to explain and educate the public on the purpose, cause, and methods of conservation for that condition.

INITIATION PROCEDURE

Prior to formal notification of a drought condition, the Board will release a statement to all media sources warning that a potential drought condition is approaching. Once a trigger condition is reached, the Board will make formal notification that a particular drought condition is in effect.

TERMINATION NOTIFICATION

The Board will acknowledge through the news media that the emergency condition has passed. The Board will also recommend to each water supply utility to notify the customers that the emergency has passed and any temporary restrictions that are being relieved.

IMPLEMENTATION PROCEDURE

The Hays County Water Development Board cannot implement ordinances, codes, etc., however the HCWDB will require, upon disbursement of any funds for water supply projects, that each water supply entity (city, public or private water supply corporation) being served by the water supply projects adopt this drought contingency plan by ordinance or by-laws. Each entity will be responsible for enforcement of the plan and will also be responsible for furnishing all information requested by the HCWDB.

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