REGIONAL WATER RESOURCES PLAN FOR THE EDWARDS AQUIFER

CITY OF SAN ANTONIO CITY COUNCIL
AND THE
EDWARDS UNDERGROUND WATER DISTRICT
BOARD OF DIRECTORS

SEPTEMBER, 1988

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EXECUTIVE SUMMARY

BACKGROUND

This plan deals with water resources in the region consisting of Uvalde, Medina, Bexar, Comal and Hays Counties. It presents a policy framework for water resources planning between 1990-2040 and lays out the next steps for implementation. It is the product of a unique joint planning effort by the City of San Antonio and the Edwards Underground Water District.

The precise beginning of any planning process is difficult to identify because many past decisions may have led up to initiation of the current plan. Sometime in the 1970s it became evident that a water resources plan for San Antonio must be developed within a larger regional context. It also became evident that this would require a regional consensus which did not then exist on the policies and actions that would be needed to implement the plan.

Regional Water Resources Study, 1983-1986

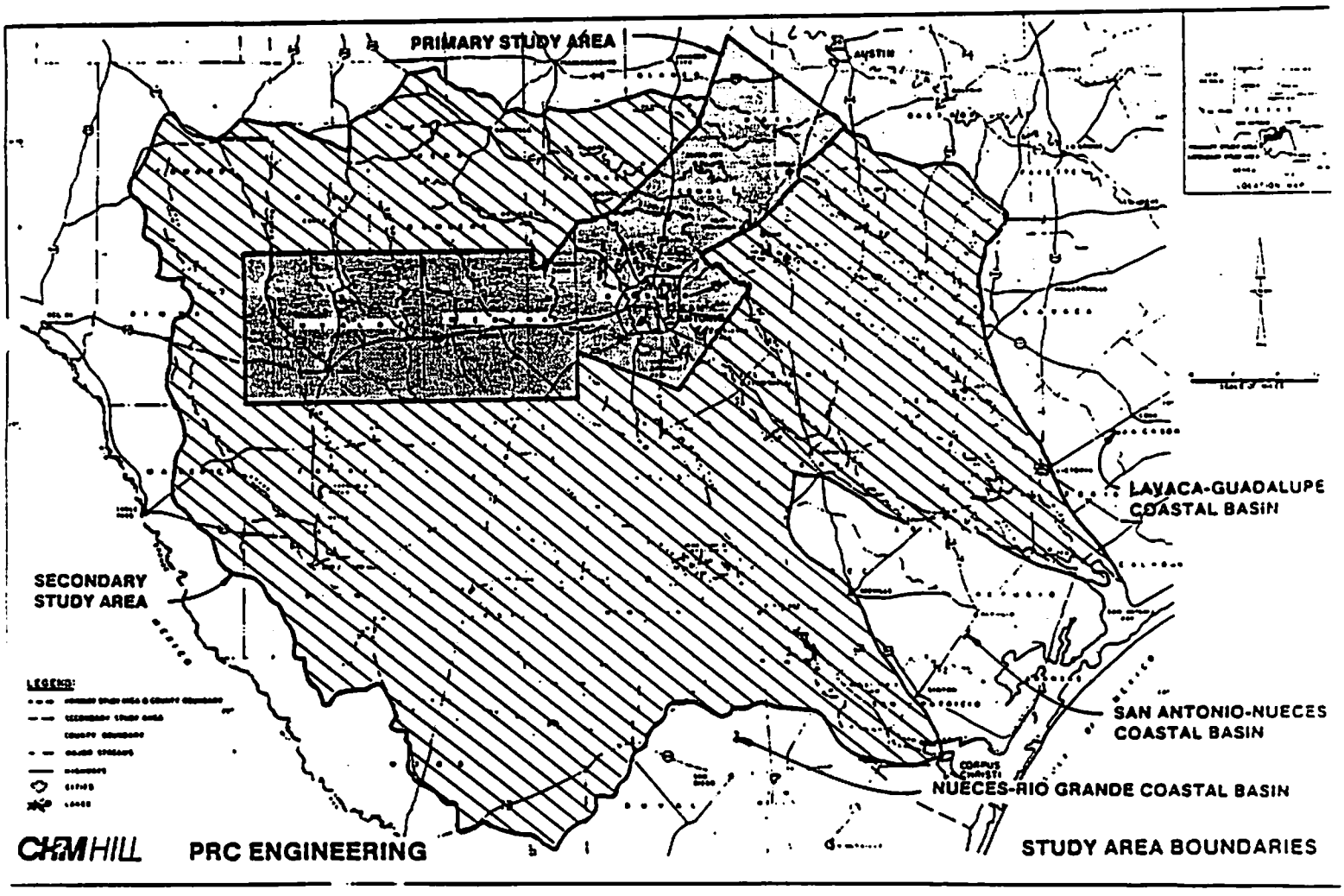
The realization of the need for a regional consensus led to an agreement between the City of San Antonio and the Edwards Underground Water District in November 1983 to develop this plan. The Memorandum of Understanding between these two agencies initiated a joint study of long range water needs and supply alternatives. Every effort was made to insure that the full range of issues was explored and that all interests were repre-

sented in the process. The resulting San Antonio Regional Water Resources Study (Figure E-1) was published in April 1986.

The Regional Water Resources Study identified the components that would constitute a regional water resources plan. It assembled data on future water demands and possible alternative sources, and analyzed the impacts of each alternative. It also suggested alternative implementation strategies.

One of the implementation recommendations was the formation of an Implementation Advisory Task Force. The objectives of the IATF were to learn about the issues, to educate others in the region, and to develop a consensus on policy recommendations to be considered by the District and the City. The IATF met throughout the summer and fall of 1986 and submitted its policy recommendations to the Joint Sponsors in December 1986.

Figure E-1
Study Areas of the San Antonio Regional Water Resources Study



Joint Committee, Spring 1987

At this point, two considerations were uppermost in the minds of the City Council and the Edwards District Board of Directors: (1) to provide adequate regional representation in the development of the plan; and (2) to create a workable decision-making process to ensure consensus on policy. These goals were accomplished by the appointment of a Joint Committee on Water Resources, representing both policymaking bodies. The Committee initially consisted of five members of City Council and five members of the Edwards Board of Directors, co-chaired by the Chairman of the Board and the Mayor of the City.

The Joint Committee met each week through the spring of 1987 to consider policy issues systematically. Discussions continued at these meetings until consensus was reached. Not all of the policy recommendations submitted by the IATF were adopted exactly as submitted, nor were all issues resolved. However, three extremely important elements of a Regional Water Resources Plan resulted from this effort.

First, a Joint Resolution was developed and adopted by the City Council and the Edwards Board of Directors in March 1987. This Resolution described the principles and policies accepted up to that point. The key policy held that the aquifer should not be overdrafted during periods of average rainfall, in order to ensure natural flows at Comal and San Marcos Springs.

The Joint Resolution was intended to inform the Legislature on the region's efforts and progress in developing a regional

plan, and to obtain approval of the program as state policy. It was submitted to the Legislature in the 1987 session, but it was not passed due to the press of time and the emphasis on efforts to pass related legislation on drought management.

Second, the Joint Committee reached consensus on the immediate need for a plan to manage a regional drought emergency. Therefore the Joint Resolution contained a policy statement that the Edwards District would seek legislative authority to develop and implement a Drought Management Plan. An amendment to the Edwards District enabling statute was developed, submitted and approved by the Legislature as House Bill 1942. Since then, the Edwards District has been developing the Drought Management Plan in a separate process from this long range planning program.

Third, the Joint Committee found that its format and procedures facilitated the development of consensus. They fostered the mutual trust and respect necessary to the negotiation and consensus building process. The Committee therefore agreed to continue addressing policy issues in this forum until all issues were negotiated and agreed upon, including both water quality and quantity measures.

City Council Committee on the Aquifer, Summer 1987

Development of the plan was continued throughout the summer of 1987 by a committee of the City Council examining water quality protection issues. The groundwork for this activity was

established by the Joint Committee in its policy statement number one:

> One of the ultimate goals of the Edwards aquifer region is to maintain the aquifer's current high water quality. With technical assistance from the Edwards Underground Water District, cities in the region will adopt ordinances in 1987 for water quality protection to prevent degradation by contamination of sensitive areas of the aquifer. The ordinances will cover matters including but not limited to: using, producing, transporting or storing hazardous materials by commercial activities; assuring the integrity of sewer lines; protecting caves and sinkholes.

A zoning request for a new shopping mall on the aquifer recharge zone precipitated a controversy over the adequacy of regulations to protect the aquifer's water quality. The result was a public hearing and the formation of the City Council Committee on the Aquifer.

This committee designated four "intervenor" groups to ensure that all views were considered in the course of its work. These represented environmentalist and community-based organizations, and the chambers of commerce and development industries. The committee heard from experts on each issue, along with questions and comments from the intervenors, at weekly meetings through the summer.

In September 1987, the Council Committee completed its report, <u>The Edwards Aquifer: Perspectives for Local and Regional Action.</u> The central policy statement was an unambiguous commitment: All policy should be based on a principle of no degradation in groundwater quality. Acceptance of this principle led the

Committee to examine potential sources of contamination along with procedures for dealing with them.

One possible major source of contamination was waste discharges or leaks from sewer lines and septic tanks. The Committee recommended improved specifications for sewer line construction and new controls on septic tanks.

Another concern was the storage and transportation of hazardous materials. A major recommendation was to encourage the Texas Water Commission to amend the Edwards Aquifer Rules to regulate more stringently the storage of hazardous materials. Another was to work for legislation authorizing cities to establish transportation routes through their jurisdictions for hazardous materials shipments.

The Committee recommended a new methodology for review of the Water Pollution Abatement Plans which are required by the Texas Water Commission as a condition for development. The City was urged to amend its zoning ordinance to withhold approval of a zoning change until TWC had previously approved the WPAP.

Still another recommendation was the development of an enhanced mapping process to identify sensitive recharge features such as caves, sinkholes and faults. This information would be useful to both the regulators and those being regulated.

The report was adopted by a unanimous Council and endorsed by the Edwards Board of Directors. Implementation is being carried out according to a specific timetable. These actions

have laid to rest the concern that water quality issues had to be considered first, before the quantity issues could be resolved.

CURRENT PLAN DEVELOPMENT PROCESS

Joint Committee, Fall 1987

The Joint Committee reconvened and modified its structure in October, 1987. The representation of the Edwards District was expanded to include one member of the Board from each of the District's five counties, along with the Board Chairman as Committee Co-chair. The City Council refreshed the selection of its five appointees, with the Mayor remaining as the other Co-chair. The Committee was then expanded to include one representative of each of the three river authorities in the region--the San Antonio, Guadalupe-Blanco, and Nueces -- in order to increase the representation of downstream user interests. The intervenor process established by the City Council Committee was also instituted to enhance the level of citizen participation.

Since then the Joint Committee has gone through two distinct steps in the current phase of plan development. The first was a re-examination of the assumptions, results and conclusions of the Regional Water Resources Study. In this stage the Committee came to understand the complex interrelationships among recharge to the aquifer, pumping demands, flows downstream in the Guadalupe and San Antonio River Basins, conservation and resulting demand reductions, wastewater reuse and its effect on water availability, the development of surface water supplies, and the necessity

of a reasonable cost recovery mechanism. This resulted in a reaffirmation of the principles adopted in the spring 1987 Joint Resolution.

Development of the Planning Model, 1988

The second step has involved a series of policy decisions. The Committee realized that policy on one plan component could not be made in isolation from other issues. The Committee also came to understand that a large number of alternatives were available for selection as policy.

A tool in the form of a "planning model" was developed (Table E-1.) A planning model in this sense presents numbers in an accounting framework for analysis of alternatives. The numbers in the model represent possible policy choices and they highlight the implications of choosing different values. Thus the Committee could quickly see the effect of using different numbers for groundwater withdrawals, conservation goals, wastewater reuse and surface water development, under both average and assumed drought conditions. The Committee steadily refined and adjusted its targets so that the impacts were as positive as possible for all categories of users in the region.

Table E-1
Planning Model

Water Demands and Sources to Meet Demands
Based on Average Rainfall Conditions
(Acre-feet per year)

Plan Component	Year 2000	2010	2020	2040
(1) Average Recharge	608,000	608,000	608,000	608,000
(2) Projected Demand	506,000	564,000	650,000	870,000
(3) (a) Groundwater Withdrawal	450,000	450,000	450,000	450,000
(b) Allowance for Springflows	158,000	158,000	158,000	158,000
(4) Conservation (10% of Demand)	50,600	56,400	65,000	87,000
(5) Reuse (Net Available after River Release and Evaporation)	37,000	59,000	83,000	131,000
(6) Subtotal: Groundwater Withdrawal + Conservation + Reuse - Demand (3a+4+5-2)	31,600	1,400	-52,000	-202,000
(7) Surface Water				
(a) Canyon	14,000	14,000	14,000	14,000
(b) Applewhite	50,000	50,000	50,000	50,000
(c) Cibolo		30,000	30,000	30,000
(d) Cuero I		141,000	141,000	141,000
(e) Cuero II			24,000	24,000
(f) Surface Subtotal	64,000	235,000	259,000	259,000
(8) Net Balance: Groundwater Withdrawal + Conservation + Reuse + Surface Water - Demand (3a+4+5+7f-2)	95,600	236,400	207,000	57,000

In refining the Planning Model, the Joint Committee arrived at policy recommendations on the following plan components:

1. Quantity of aquifer recharge to be assumed;
2. Projected future regional water demand;
3. Withdrawals of aquifer groundwater;
4. Conservation programs;
5. Wastewater reuse and downstream flows;
6. Surface water projects; and
7. Financing approaches.

The following section discusses each element of the Planning Model and the Committee's rationale for the recommended policy.

1. AQUIFER RECHARGE

Policy

The long term annual average recharge for the period of record, 608,000 acre-feet per year, is used throughout the planning period to represent average conditions.

Artificial recharge may help to sustain aquifer water levels in the long run, but it is not likely to become a major factor in the region's water budget.

Discussion

This policy, taken in conjunction with the groundwater withdrawal policy, reflects the overarching principle of no long term overdraft of the aquifer. For the purposes of this plan, overdraft is defined as a discharge of groundwater from the aquifer by pumping and springflows at an average rate which is greater than the long term average annual recharge.

Annual recharge is a value calculated using specific measurements and formulas. Actual recharge has varied from a low of 43,000 acre-feet in 1956 to a high of 2,003,600 acre-feet in 1987 (Table E-2.) This variation reflects the region's history of alternating between periods of abundant rainfall and periods of painful drought.

TABLE E-2
EDWARDS AQUIFER DATA SUMMARY, 1934-1982

Year	Annual Rainfall (inches) Uvalde	San Antonio	San Marcos	Recharge*	Discharges* Wells	Springs	Total	Change in Storage Since 1933*	Year-End J-17 Well Level AMSL
1934	16.42	27.65	35.67	179.6	101.9	336.0	437.9	-258.3	669
1935	41.15	42.93	41.09	1258.2	103.7	415.9	519.6	480.3	680
1936	24.18	34.11	33.48	909.6	112.7	485.5	598.2	791.7	682
1937	17.88	26.07	28.05	400.7	120.2	451.0	571.2	621.2	678
1938	13.62	23.26	28.17	432.7	120.1	437.7	557.8	496.1	674
1939	25.30	18.83	18.59	399.0	118.9	313.9	432.8	462.2	668
1940	27.46	30.79	43.57	308.8	120.1	296.5	416.6	354.5	671
1941	31.52	26.34	48.41	850.7	136.8	464.4	601.2	604.0	677
1942	19.12	38.46	44.65	557.8	144.6	450.1	594.7	567.1	680
1943	19.77	20.51	25.45	273.1	149.1	390.2	539.3	300.9	669
1944	33.00	33.19	47.42	560.9	147.3	420.1	567.4	294.4	670
1945	22.37	30.46	-	527.8	153.3	461.5	614.8	207.4	673
1946	24.91	45.17	52.24	556.1	155.0	428.9	583.9	179.6	680
1947	22.67	17.32	27.53	422.6	167.0	426.5	593.5	8.7	668
1948	18.31	23.64	-	178.3	168.7	281.9	450.6	-263.6	657
1949	34.42	40.81	36.22	508.1	179.4	300.4	479.8	-235.3	664
1950	18.27	19.86	21.10	200.2	193.8	272.9	466.7	-501.8	656
1951	16.06	24.44	30.88	139.9	209.7	215.9	425.6	-787.5	646
1952	18.24	26.24	39.91	275.5	215.4	209.5	424.9	-936.9	645
1953	18.34	17.56	33.39	167.6	229.8	238.5	468.3	-1237.6	646
1954	15.87	13.70	13.42	162.1	246.2	178.1	424.3	-1499.8	637
1955	20.34	18.18	26.44	192.0	261.0	127.8	388.8	-1696.6	626
1956	9.29	14.31	18.37	43.7	321.1	69.8	390.9	-2043.8	626
1957	39.30	48.83	46.51	1142.6	237.3	219.2	456.5	-1357.7	653
1958	39.03	39.69	39.08	1711.2	219.3	398.2	617.5	-264.0	678
1959	31.51	24.50	43.47	690.4	234.5	384.5	619.0	-192.6	675
1960	23.98	29.76	45.48	824.8	227.1	428.3	655.4	-23.2	679
1961	26.26	26.47	30.02	717.1	228.2	455.3	683.5	10.4	676
1962	14.12	23.90	28.47	239.4	267.9	321.1	589.0	-339.2	666
1963	16.70	18.65	19.90	170.7	276.4	239.6	516.0	-684.5	653
1964	22.30	31.88	30.27	413.2	260.2	213.8	474.0	-745.3	653
1965	26.21	36.72	45.00	623.5	256.1	322.8	578.9	-700.7	669
1966	20.87	21.42	27.12	615.2	255.9	315.3	571.2	-656.7	657
1967	20.10	29.09	26.41	466.5	341.3	216.1	557.4	-747.6	660
1968	25.20	30.39	37.13	884.7	251.7	408.3	660.0	-522.9	670
1969	33.33	31.41	36.59	610.5	307.5	351.2	658.7	-571.1	670
1970	13.59	22.74	32.30	661.6	329.4	397.7	727.1	-636.6	663
1971	31.01	31.80	31.10	925.3	406.8	272.7	679.5	-390.8	674
1972	15.49	31.48	31.90	756.4	371.3	375.8	747.1	-381.5	673
1973	30.85	52.28	47.91	1486.5	310.4	527.6	838.0	267.0	690
1974	30.94	37.00	42.42	658.5	377.4	483.8	861.2	64.3	682
1975	24.92	25.67	48.64	973.0	327.8	540.4	868.2	169.1	676
1976	45.62	39.13	47.46	894.1	349.5	503.9	853.4	209.8	693
1977	19.91	29.64	27.69	952.0	380.6	580.3	960.9	200.9	684
1978	18.65	35.99	33.08	502.5	431.8	375.5	807.3	-103.9	679
1979	32.35	36.64	38.74	1117.8	391.5	523.0	914.5	99.4	680
1980	23.05	24.23	29.56	406.4	491.1	328.3	819.4	-313.6	669
1981	28.24	36.37	49.62	1448.4	387.1	407.3	794.4	340.4	679
1982		22.96		417.7	453.1	333.3	786.4	-28.3	667
1983		26.06		420.1	418.5	301.6	720.1	-12.3	653
1984		25.95		197.9	529.8	172.5	702.3	-832.7	648
1985		40.31		1003.3	522.5	334.0	856.5	-685.9	673
1986		38.		1153.7	429.1	405.3	634.5	-366.7	685
1987		39.		2003.6	-	-			685

*Thousands of acre-feet per year.

If groundwater discharges exceed average recharge for a number of years, we know that two things will happen as consequences:

(1) Water elevations throughout the region will decline.

(2) Pumping costs will increase.

Two other things also may happen:

(3) In some areas, particularly along the northern edge of the recharge zone, wells may cease producing water entirely.

(4) Poor quality water may move into the portion of the aquifer that now yields good quality water.

The Joint Committee recognized the wide variation in annual recharge. Therefore the Committee developed its general policy recommendations in the context of average conditions, and then superimposed the consequences of drought levels of recharge on the Planning Model to adjust its policy recommendations.

The difference in the Planning Model between average recharge and the total pumping withdrawal from the aquifer is reserved for natural springflows at Comal and San Marcos Springs. It is estimated that a discharge on the order of 150,000 acre-feet per year is the minimum needed to maintain the springs' unique environments in a healthy state. It is also necessary to consider the water rights of the downstream surface water users in the Guadalupe River Basin.

Policy for periods of relatively abundant rainfall is discussed in the section below on Groundwater Withdrawal.

Response to a regional drought emergency will be governed by the Edwards District's separate Drought Management Plan. Significant reductions in water use will be required during drought periods.

2. PROJECTED FUTURE WATER DEMAND

Policy

The water demand projections developed in the Regional Water Resources Study are used for the purposes of this plan.

Discussion

The Regional Water Resources Study provided population and water demand projections for the region through 2040. These projections are:

Table E-3
Projected Regional Population and Water Demand, 1990-2040

	1990	2000	2010	2020	2040
Population	1,360,000	1,640,000	1,950,000	2,330,000	3,290,000
Water Demand (acre-feet/year)	450,000	506,000	564,000	650,000	870,000

Changing these projections slightly would not alter the policy outcomes significantly. A conscious policy to limit regional growth is not likely in the foreseeable future. Therefore the projected water demand assumes that population growth will occur, that it is acceptable, and that it should be planned for.

3. GROUNDWATER WITHDRAWAL

Policy

The amount of water withdrawn from the aquifer by new users, and increases in withdrawals by existing users, will both be regulated. This process will recognize the historic rights of all users to pump the amounts they have used in previous years. Over time, as new sources of water are developed and as irrigation rights are transferred to other uses, the total amount pumped will be gradually reduced to a goal of preserving 150,000 acre-feet per year in natural springflows. This means a pumping goal of 450,000 acre-feet, or approximately 75% of the average annual recharge.

Owners of irrigated agricultural land will be entitled to pump the actual amount they need to grow crops on the number of acres that were irrigated at any time during the "historic period." They will have flexibility in applying this right to specific acres. Non-irrigation users will be entitled to the amount actually pumped during the historic period. Transition periods of six years for agricultural irrigators and three years for other users will allow new historic rights to be established.

Use of water in excess of the historic rights will be subject to a withdrawal fee to offset the cost of other water supplies. This fee will be higher for low priority uses such as seasonal lawn watering and lower for high priority uses such as cropland irrigation and industrial purposes.

During periods of relative abundance, additional water withdrawals may be permitted, depending on conditions in the aquifer. During periods of drought, withdrawals from the aquifer will be governed by the Regional Drought Management Plan.

The Edwards District will organize a market in water rights. The principal means to reduce groundwater withdrawals to the long run target will be an active policy of retiring water rights through voluntary purchases.

Implementation of the groundwater withdrawal policy will be closely tied to the development of alternative water supplies, including conservation, reuse, and surface water development.

Discussion

The Regional Water Resources Study identified four basic sources of water which could be included in the regional water plan: the aquifer, conservation, wastewater reuse, and surface water projects. The most fundamental policy issue is how much water will be withdrawn from the aquifer.

The recommended policy for groundwater use is rooted in the decision that the aquifer must not be overdrafted on a sustained basis and that springflow and other environmental needs will be recognized. In implementing this principle, the groundwater withdrawal policy attempts to protect all of the varied user interests in the aquifer.

Once the decision is made that groundwater withdrawals must be limited, the amount of the limit becomes the next policy

issue. If this amount is set very high, less protection is afforded to environmental water needs and downstream users. If it is set very low, more water must be developed from other sources. The amount used as a planning/target value also influences legal and financial policies.

The Joint Committee considered possible target values ranging from 425,000 acre-feet per year (the amount recommended in the 1984 Texas Water Plan) to 525,000 acre-feet (the approximate maximum historic experience.) After analyzing the impacts of various combinations in the Planning Model, the Committee chose a target withdrawal limit of 450,000 acre-feet/year for average recharge conditions. This value represents a balance between the reality of current pumping conditions and the need to provide protection to springflows, instream water needs, and bay and estuary freshwater inflows. The value is not an initial "allocation" amount but a target value to be reached over an indefinite time.

In effect, all existing water rights are "grandfathered" at historic pumping amounts. New growth is then made to bear the cost of the additional supplies it will require.

The development of a market in water rights is an important safety valve in the plan. Sale or lease of groundwater rights would allow water to shift easily and efficiently from one use to another in response to market incentives. As irrigation rights are converted to non-irrigation uses, they would be limited to two acre-feet per previously irrigated acre. This conversion

ratio is an essential mechanism to gradually reduce the existing rights toward the long run target.

The entire regulatory mechanism will automatically terminate by law if satisfactory progress is not made in developing additional water supplies to serve the region's growth.

4. CONSERVATION

Policy

Conservation is to be treated as a source of water, with a goal of reducing total regional water demand by 10% by the year 2000. This will be achieved by a combination of measures including:

- Public and school education programs to develop wise water use practices;
- Restructuring water rates to encourage conservation through increasing block rates, seasonal peak rates and excess use penalties;
- Institution of leak detection programs by the water purveyors;
- Building code amendments to require installation of water conserving fixtures and appliances in all new construction;
- Ordinances requiring retrofit of existing structures with water conserving devices upon sale or structural remodeling;

- **Ordinances and education programs to reduce the use of water in urban landscape irrigation;**
- **Retrofitting of public facilities with water conserving fixtures and more efficient landscape irrigation.**

Significant effort will be made to increase this goal in the future.

Discussion

In a major departure from "traditional" water planning, demand management -- conservation -- is treated as a source of water. The Committee recognized that a gallon of water saved is equal to a gallon of new water supply.

With this principle established, the next policy question was to determine how much could be saved and by what means. The Committee considered an array of possible programs which would produce estimated savings ranging from 2% to 13.5% (Table E-4.) After evaluating the costs of each option, the Committee agreed that a goal of 10% was ambitious but achievable. This is shown in the table as Revised Alternative 2C.

Table E-4

ELEMENTS OF ALTERNATIVE WATER CONSERVATION PROGRAMS

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
	Education		Education, Resale Ordinances, Govt Audits			Education, Resale Ordinance Active Govt Replacement	
SUPPORTIVE PROGRAMS							
Public information/education	X	X	X	X	X	X	X
School education	X	X	X	X	X	X	X
Pricing:							
Increasing rate blocks		X	X	X	X	X	X
Seasonal rate blocks			X	X	X	X	X
Penalty charges				X	X	X	X
Leak detection		X	X	X	X	X	X
DEVICES FOR NEW CONSTRUCTION							
Low flush toilets	X	X	X	X	X	X	X
Low flow shower heads	X	X	X	X	X	X	X
Pipe insulation		X	X	X	X	X	X
Pressure regulation			X	X	X	X	X
Faucet aerator				X	X	X	X
Water efficient appliances							
Dishwashers	X	X	X	X	X	X	X
Washing machine					X	X	X
*Gray water systems					X		X
RETROFIT DEVICES FOR EXISTING HOUSING							
Displacement bottles	X	X					
Shower flow restrictors		X	X	X	X	X	X
Toilet dams			X	X	X	X	X
Pressure regulation				X	X	X	X
Faucet aerators					X	X	X
Pipe insulation					X	X	X
Replacement toilets					X		X
URBAN LANDSCAPE IRRIGATION							
Reduced watering	X	X	X	X	X	X	X
Irrigation scheduling		X	X	X	X	X	X
Low water use landscape			X	X	X	X	X
Low volume sprinkers				X	X	X	X
Moisture sensing valve-controller					X	X	X

NOTE: Pricing alternatives may encourage voluntary retrofit device installation, low water use landscaping and installation of water conserving devices in new construction.

* Gray water systems or internal residential recycle systems may not be compatible with system wide reuse plan

Table E-4 (cont.)

Water Conservation Opportunity	ALTERNATIVE PROGRAMS 1A	1B	2A	2B	REVISED 2C	3A	3B
PUBLIC FACILITY RETROFIT							
Toilet dams	X	X	X	X	X	X	X
Faucet aerators		X	X	X	X	X	X
Automatic faucets			X	X	X	X	X
Shower flow restrictors				X			
Low flow showers					X	X	X
Public facility landscape maint					X		
MANUFACTURING							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of cooling process water		X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
Efficient landscape irrigation			X	X	X	X	X
Low water using fixtures				X	X	X	X
Process modifications					X	X	X
AGRICULTURE							
Irrigation system evaluations	X	X	X	X	X	X	X
Irrigation scheduling	X	X	X	X	X	X	X
Laser leveling		X	X	X	X	X	X
Furrow diking			X	X	X	X	X
Low energy precision application				X	X	X	X
Surge flow irrigation					X	X	X
Drip & low volume irrigation						X	X
Brush management							X
ENERGY GENERATION							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of treated wastewater		X	X	X	X	X	X
In system treatment			X	X	X	X	X

* Energy Generation and Manufacturing reuse systems may not be compatible with system wide reuse plans.

The goal of reducing total regional water demand by 10% translates into the following decreases from the demands projected by the Regional Water Resources Study:

Table E-5
Regional Water Conservation Goals, 2000-2040
(Acre-feet per year)

Year	2000	2010	2020	2040
Amount Conserved	50,600	56,400	65,000	87,000

The amounts which would be saved and the costs of each element in the recommended program are shown in Table E-6. Additional conservation reductions in the agricultural, industrial and steam electric generating sectors are also expected as the result of stream discharge requirements and economic pressures.

Table E-6

COSTS AND SAVINGS OF RECOMMENDED CONSERVATION PROGRAMS

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
SUPPORTIVE PROGRAMS (all residents yr 2000)								
Public Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
School Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	$0	$0	Policy Change
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	$0	$0	Policy Change
Penalty	.5 gpcd		1,636,373	10%	91	$0	$0	Policy Change
Leak Detection Programs		$3000/mile		100%	600	$150,000	$250	Maint Policy
NEW CONSTRUCTION (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3,106	$0	$0	Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2,081	$0	$0	Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621	$0	$0	Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621	$99,400	$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	50%	465	$17,700	$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155	$7,300	$470	Ordinance
WE Washing Mach	5.0 gpcd	$70.00	277,270	75%	1,164	$66,000	$570	Ordinance
Gray Water Sys.	———	———	277,270	voluntary			———	Incentive
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	75%	5,591	$10,903,000	$19,500	Ordinance
LW Irrig	13.0 gpcd	$1500/home	277,270	75%	3,028	$8,236,000	$27,200	Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	75%	1,164	$6,600,000	$56,700	Ordinance
RETROFIT DEVICES (housing units built before 1990)								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	50%	5,100	$6,000	$12	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	50%	3,430	$48,000	$140	Retrofit Ord.
Pressure Regul.	3.0 gpcd	$70.00	1,359,103	50%	2,280	$87,000	$380	Retrofit Ord.
Faucet Aerators	.5 gpcd	$2.00	1,359,103	50%	380	$18,000	$470	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	15%	115	$9,000	$820	Retrofit Ord.
Repl Toilets	10. gpcd	$300	1,359,103	25%	3,806	$339,000	$890	Retrofit Ord.
Landscape Irrigation (housing units constructed before 1990)								
Watering Prg	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
Irrig Sched	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
PUBLIC FACILITY RETROFIT (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%	700	$9,800	$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%	50	$2,000	$380	Govt Replace
Auto Faucet		$25.00		100%	50	$5,000	$900	Govt Replace
LF Showers	1.5 gpm	$15.00		100%	325	$2,000	$60	Govt Replace
Public Facility Landscapes (all public facilities)								
Irrig Sched	20% reduction in seasonal UAF water			100%	2,500	$25,000	$10	Maint Policy

5. WASTEWATER REUSE AND DOWNSTREAM FLOWS

Policy

The City of San Antonio should develop a program to reuse wastewater as a substitute for other supplies. New "water factories" should meet at least 20,000 acre-feet per year of the regional water demand in non-potable uses by the year 2000. The effluents of the existing regional advanced secondary treatment plants should be further treated to a quality allowing discharge into area cooling lakes. The amounts not sold for non-potable uses and not needed in the lakes should be treated to drinking water standards and added to the city's water supply.

This program must be managed to maintain a minimum flow in the San Antonio River of 55,000 acre-feet per year as measured at the Falls City gauge. It must also be managed to allow 46,000 acre-feet per year in evaporation at the City Public Service cooling lakes.

Local economic development agencies should encourage new water using industries to locate near the projected "water factories" in order to provide a market for the reused water.

Other wastewater producers in the region should also explore the potential to promote reuse within their service areas.

Discussion

The City of San Antonio proposes to treat its wastewater to a level sufficient to allow for indirect reuse in nonpotable purposes of 20,000 acre-feet per year by the year 2000.

The first project would involve construction of a new "water factory" near San Antonio International Airport to treat the wastewater generated in the upper Salado Creek watershed. This facility is expected to produce 4000 acre-feet per year in 1995, rising to 40,000 acre-feet by 2040. The effluent from this plant would substitute for pumping from the aquifer to create the flow of the San Antonio River through downtown and to irrigate downstream golf courses.

A related project would transfer the effluent from the existing Salado Creek Wastewater Treatment Plant to a new Water Renovation Center next to Braunig Lake. Here the nutrients would be removed and further treatment provided to allow reuse in area lakes. An estimated 24,000 acre-feet would thus be available to improve the water quality of Braunig Lake. A water treatment plant adjacent to the Water Renovation Center could then treat the improved lake water to drinking water standards. Allowing for 7000 acre-feet in evaporation consumption, this would provide an additional 17,000 acre-feet per year for reuse.

Additional water factories would be built in the upper Leon Creek and Medina River watersheds. Their effluents would be targeted for industrial reuse opportunities along Leon Creek, Apache Creek, the San Antonio River, and the Medina River below Applewhite Reservoir. The effluents from the existing Leon Creek and Dos Rios plants would also be transferred to the Water Renovation Center for release to the cooling lakes. Ultimately

the water treatment plant could be expanded to treat 63,000 acre-feet of lake water to drinking water standards.

Table E-7 summarizes the wastewater volumes generated and available for reuse from each project. Figure E-2 shows the entire program schematically.

Data developed by the San Antonio River Authority suggest that a minimum flow of 55,000 acre-feet per year is needed in the San Antonio River to satisfy surface water rights and prevent environmental damage downstream from the city. Since there may be no natural flow in the river during a drought, the city may have to release this amount from its wastewater treatment system.

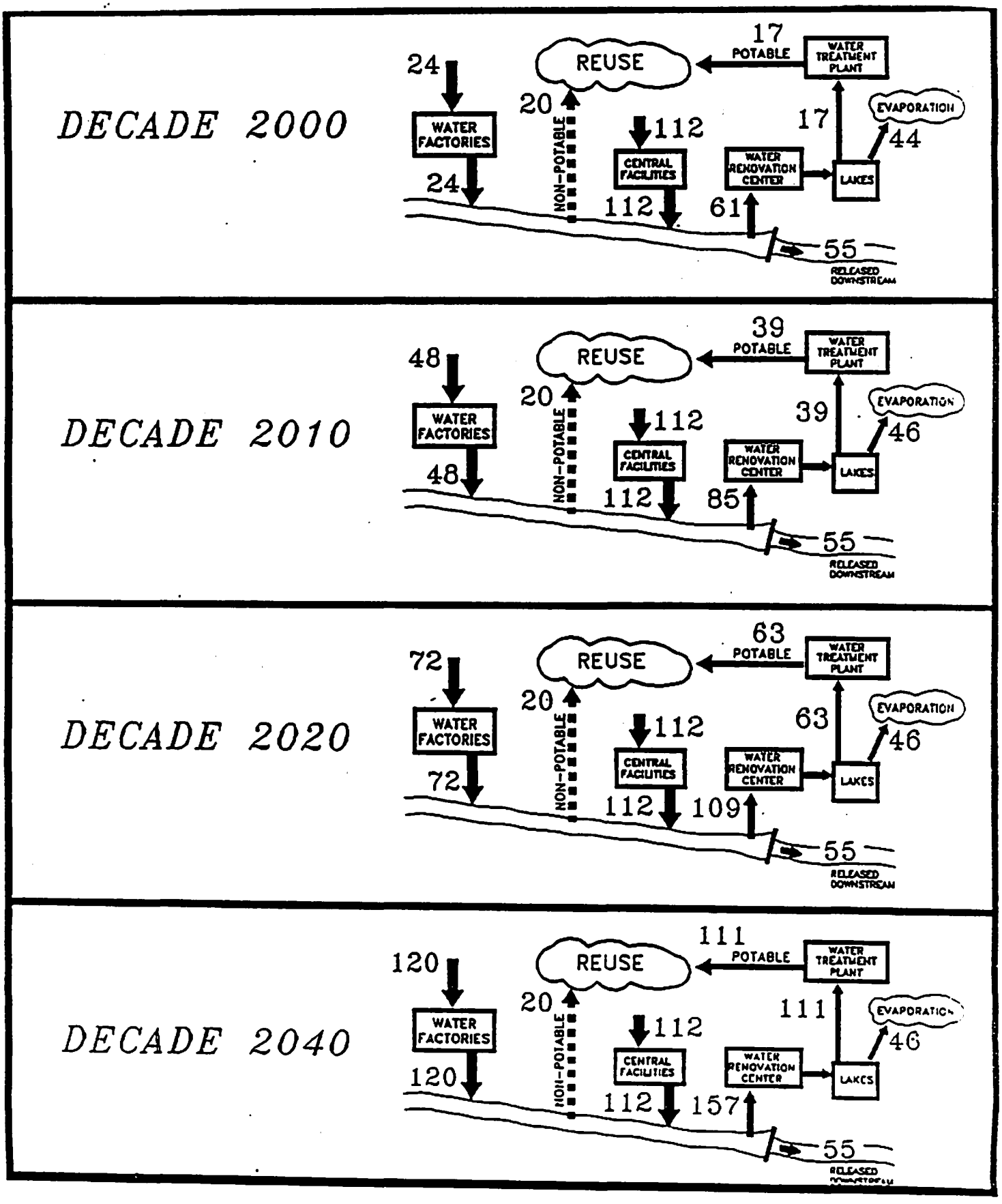
Under current City Public Service plans, the cooling lakes will also consume 46,000 acre-feet per year in evaporation. This water is now diverted from the San Antonio River. A plan needs to be developed to manage lake releases in order to reduce the dissolved solids in Braunig Lake.

Marketing the output of these new facilities is also an important consideration. The initial target for indirect reuse of 20,000 acre-feet by the year 2000 is a bare minimum. Under the city's projections of wastewater availability, the city's treatment plants may be capable of producing 131,000 acre-feet by 2040. This would save the expense of the additional treatment needed to take this water all the way to drinking water standards.

Table E-7
Wastewater Volumes Generated and Available for Reuse, 1995-2040
(Acre-feet per year)

	1995	2000	2010	2020	2030	2040
WASTEWATER GENERATED						
Water Factories						
Northeast	4,000	8,000	16,000	24,000	32,000	40,000
Northwest	4,000	8,000	16,000	24,000	32,000	40,000
Far West	4,000	8,000	16,000	24,000	32,000	40,000
Subtotal	12,000	24,000	48,000	72,000	96,000	120,000
Existing Treatment Plants						
Salado Creek	24,000	24,000	24,000	24,000	24,000	24,000
Leon Creek	24,000	24,000	24,000	24,000	24,000	24,000
Dos Rios	64,000	64,000	64,000	64,000	64,000	64,000
Subtotal	112,000	112,000	112,000	112,000	112,000	112,000
Gross Total Generated	124,000	136,000	160,000	184,000	208,000	232,000
OTHER USES						
Braunig Lake Evaporation	7,000	7,000	7,000	7,000	7,000	7,000
Calaveras Lake Evaporation	37,000	37,000	39,000	39,000	39,000	39,000
Downstream River Releases	55,000	55,000	55,000	55,000	55,000	55,000
Total Committed to Other Uses	99,000	99,000	101,000	101,000	101,000	101,000
NET TOTAL AVAILABLE FOR REUSE	25,000	37,000	59,000	83,000	107,000	131,000

Figure E-2
Schematic Summary of Proposed San Antonio
Wastewater Reuse Management Strategy, 2000 - 2040



6. SURFACE WATER PROJECTS

Policy

The Applewhite Reservoir project should be developed with all due speed. It should be reconfigured to defer indefinitely the Leon Creek Diversion. An improved wildlife mitigation plan should also be developed.

Permitting should be initiated for the Cibolo, Cuero I and Cuero II projects in order to protect the region from a severe drought after the year 2000.

Discussion

Under average rainfall conditions, additional sources of water will clearly be needed by 2010. Without surface water, the Planning Model (Table E-1, page 10) shows a deficit beyond 2010 even after the effects of significant conservation and reuse programs. A drought of any serious magnitude would hasten the onset of a crisis (Table E-8.)

Table E-8
Planning Model Projections for Year 2000
Under Alternative Drought Conditions

	Average Condition	Mild Drought	Historic Drought
1. Recharge	608,000	350,000	180,000
2. Projected Demand	506,000	500,940	519,156
3. Allocation	450,000	405,000	350,000
4. Conservation	50,600		
5. Drought Reduction		22,770	68,310
6. Reuse	37,000	34,000	32,500
Total (3+4+5+6-2)	31,600	-39,170	-68,346

Possible surface water projects have been identified for many years. These are shown in Figure E-3 and compared in Table E-9.

By their nature, these projects have a long lead time. Planning, permitting, design, construction and filling can easily take 10 or 20 years. Therefore they must be initiated as soon as possible.

Applewhite is the only project which can be completed before the year 2000. Design and permitting are virtually complete, but there are concerns over the effects of the Leon Creek Diversion and the wildlife mitigation plan. Therefore the Joint Committee recommended that this project be completed with changes in design configuration and planned mitigation.

The Cibolo and Cuero Projects should be initiated for planning design and permitting purposes in order to reduce the impacts of a severe drought beyond the year 2000.

Figure E-3
Possible Surface Reservoir Locations,
San Antonio and Guadalupe River Basins

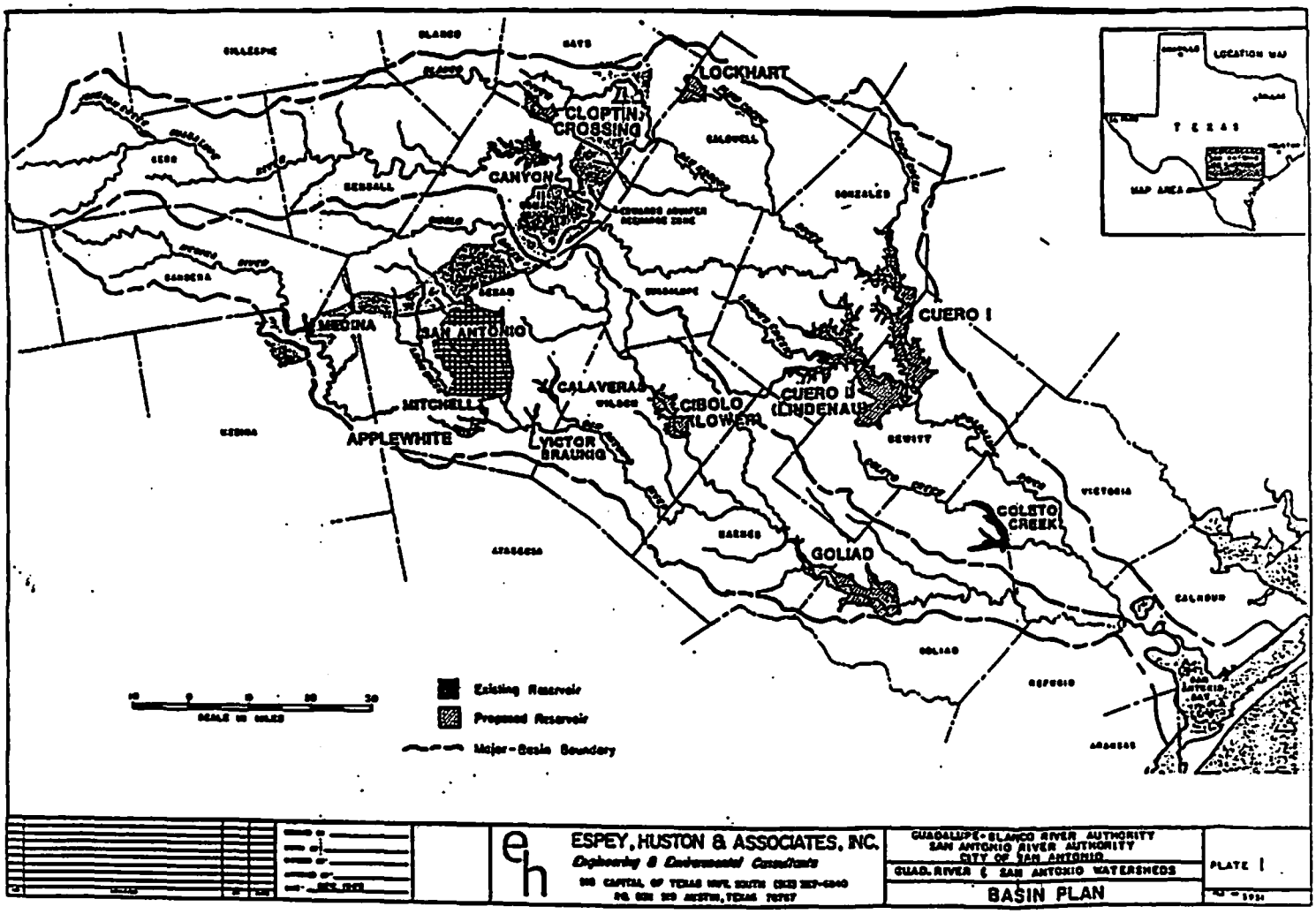


Table E-9

Comparative Summary of Potential Surface Water Projects

PROJECT	COSTS ($ Mil. 1988) Capital	O & M	DEVELOPMENT TIME (Years) Optimistic	Nominal	Pessimistic	PROJECT YIELD (KAF/YR) Average	Mild Drought	Severe Drought	Cost/ Ac-Ft
Applewhite	113.0	1.2	6	7	8	50	40	12	$2,260
Cibolo	258.0	2.5	13	20	27	30	30	30	$8,600
Cuero I	457.0	7.4	12	17	23	141	141	141	$3,241
Cuero II (Stand Alone)	398.0	8.2	8	12	17	80	80	80	$4,975
Cuero II (Incremental)	398.0	8.2	8	11	14	24	24	24	$16,583

7. FINANCE

Policy

The costs of these plan components should be met as follows:

- **The Edwards Underground Water District's ad valorem property tax should fund implementation of the groundwater withdrawal policy and the conservation program.**
- **Sewer use charges should fund the wastewater reuse program.**
- **Water purveyor rates areawide, water availability charges (hook-up fees), and groundwater withdrawal fees during times of relative abundance, all should fund surface water development.**

Discussion

From the beginning of the planning process, the cost of implementing these recommendations was known to be high. Using water directly out of the aquifer is inexpensive, so any change would be relatively costly. The issue of "who pays and how much?" has been at the heart of the difficulty in developing a regional water plan for many years.

An equitable groundwater withdrawal policy is essential to the solution of this problem. No one can be expected to pay for additional supplies willingly if others can escape this cost entirely. The essence of the groundwater withdrawal policy is to limit the use of aquifer water to the amount the aquifer can

provide. Thereafter the growth which requires additional supplies will pay the costs of those supplies.

The total public sector costs of the recommended programs are detailed in Table E-10. These costs include operating and maintenance expenses and annual debt service. The financing period for each project was based on a financing program developed by each responsible agency.

Table E-10

Plan Component Project Costs, 1990-2040
($ millions - 1988)

PROJECT	CAPITAL COST	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
GROUNDWATER WITHDRAWAL	3.0																	
Debt Service		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	3.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION	0.0																	
Debt Service																		
Operation & Maint.		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	0.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																		
WATER FACTORIES	140.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total	140.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	10.6	10.6	10.6	10.6	10.6	10.6	10.6
SALADO CREEK WWTP	28.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
LEON CREEK WWTP	28.0																	
Debt Service												2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP	11.0																	
Debt Service												1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	11.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	207.0	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	23.8	23.8	23.8	23.8	23.8	23.8	23.8
SURFACE WATER																		
CANYON	0.0																	
Debt Service																		
Operation & Maint.																		
Total	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	2.1	2.1	2.1	2.1	2.1	2.1	2.1
APPLEWHITE	113.0																	
Debt Service		1.0	3.2	5.9	7.8	9.1	9.3	9.3	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Operation & Maint.		0.0	0.0	0.0	0.5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	113.0	1.0	3.2	5.9	8.3	10.3	10.5	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
CIBOLO	258.0																	
Debt Service													23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Total	258.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I	457.0																	
Debt Service												31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	457.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II	398.0																	
Debt Service																		
Operation & Maint.																		
Total	398.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TREATMENT PLANTS	241.3																	
Debt Service		0.1	0.3	0.8	1.8	2.6	5.3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	9.5	9.5
Operation & Maint.						1.1	1.1	1.1	1.1	1.1	1.1	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Total	241.3	0.1	0.3	0.8	1.8	3.7	6.4	7.1	7.1	7.1	7.1	9.4	9.4	9.4	9.4	9.4	12.9	12.9
SURFACE SUBTOTAL	1,467.3	3.7	6.1	9.3	12.7	16.6	19.5	20.2	20.2	20.2	20.1	62.2	86.7	86.7	86.7	86.7	90.2	90.2
TOTAL REGIONAL COST	1,677.3	18.4	20.8	24.0	27.4	31.3	34.2	34.9	34.9	34.9	34.8	88.6	113.1	113.1	113.1	113.1	116.6	116.6

Table E-10 (cont.)

Plan Component Project Costs, 1990-2040
($ millions - 1988)

PROJECT	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GROUNDWATER WITHDRAWAL																			
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION																			
Debt Service																			
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																			
WATER FACTORIES																			
Debt Service	5.6	5.6	5.6	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	5.0	5.0	5.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	10.0	10.0	10.0	10.0	10.0	10.0
Total	10.6	10.6	10.6	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	18.4	18.4	18.4	18.4	18.4	18.4
SALADO CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8						
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP																			
Debt Service	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	23.8	23.8	23.8	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	28.8	28.8	28.8	28.8	28.8	28.8
SURFACE WATER																			
CANYON																			
Debt Service																			
Operation & Maint.																			
Total	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE																			
Debt Service	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	9.6	9.6
CIBOLO																			
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I																			
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II																			
Debt Service														26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.2	8.2	8.2	8.2	8.2	8.2
Total	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS																			
Debt Service	9.5	9.5	9.5	10.4	10.4	10.4	10.4	10.4	14.3	14.3	14.3	14.3	14.3	15.3	15.3	15.3	15.3	15.3	15.0
Operation & Maint.	3.4	3.4	3.4	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	10.1	10.1	10.1	10.1	10.1	10.1
Total	12.9	12.9	12.9	16.9	16.9	16.9	16.9	16.9	20.8	20.8	20.8	20.8	20.8	25.4	25.4	25.4	25.4	25.4	25.1
SURFACE SUBTOTAL	90.2	90.2	90.2	95.2	95.2	95.2	95.2	95.2	99.1	99.1	99.1	99.1	99.1	137.9	137.9	137.9	137.9	137.1	136.8
TOTAL REGIONAL COST	116.6	116.6	116.6	126.9	126.9	126.9	126.9	126.9	130.8	130.8	130.8	130.8	130.8	169.3	169.3	169.3	169.3	168.5	168.2

Table E-10 (cont.)

Plan Component Project Costs, 1990-2040
($ millions - 1988)

PROJECT	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
GROUNDWATER WITHDRAWAL															
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION															
Debt Service															
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE															
WATER FACTORIES															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	0.0
Operation & Maint.	10.0	10.0	10.0	10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	15.0
Total	18.4	18.4	18.4	18.4	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	15.0
SALADO CREEK WWTP															
Debt Service															
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP															
Debt Service	2.8	2.8	2.8	2.8											
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
DOS RIOS WWTP															
Debt Service	1.1	1.1	1.1	1.1											
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
REUSE SUBTOTAL	28.8	28.8	28.8	28.8	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	21.5
SURFACE WATER															
CANYON															
Debt Service															
Operation & Maint.															
Total	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
CIBOLO															
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I															
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II															
Debt Service	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Total	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS															
Debt Service	15.0	15.0	15.0	15.0	12.2	12.2	12.2	12.2	12.2	19.1	19.1	19.1	19.1	19.1	21.6
Operation & Maint.	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	19.1
Total	25.1	25.1	25.1	25.1	22.3	22.3	22.3	22.3	22.3	29.2	29.2	29.2	29.2	29.2	40.7
SURFACE SUBTOTAL	136.8	136.8	136.8	136.8	134.0	134.0	134.0	134.0	134.0	140.9	140.9	140.9	140.9	140.9	152.4
TOTAL REGIONAL COST	168.2	168.2	168.2	168.2	164.0	164.0	164.0	164.0	164.0	170.9	170.9	170.9	170.9	170.9	176.5

The Joint Committee considered a wide range of possible funding sources (Table E-11.) For each one it considered whether the burden would fall on existing users or only on new growth, whether new legislation would be needed to implement it, and whether it would contribute to the goal of conservation. The Committee also considered which plan component each revenue source could most logically finance, and whether it could meet the full costs of that component.

Table E-11
Comparative Analysis of Possible Revenue Sources

Revenue Source	Potential Revenue	Administering Entity	Method of Cost Recovery	Sector Affected	All Users or New Growth	Approval Required	Impact on Conservation	Applicable Program	Able to Meet Full Costs?
EUWD Property Tax	$.01 increase = $3,822,701	E.U.W.D.	Land Value	Entire Region	All	Referendum	None	Groundwater Mgmt Conservation	Yes Yes
Well Permit Fees	$1000/well/year	E.U.W.D.	Growth	Irrigators, Municipal & Industrial	Growth	State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Well Pumpage Fees	@$.01/1000 gal. (= $3.26/AF) 100,000 AF = $325,850	E.U.W.D.	Water Consumption	Irrigators, Municipal & Industrial	All	State Legislation	Positive	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Water Rates	$.01/100 cu ft = $970,000	Water Purveyors	Water Consumption	Municipal & Industrial	All	City Ordinances TWC Approval State Legislation	Positive	Conservation Surface Water	Yes Yes
Sewer Rates	$.01/100 cu ft = $660,666 (San Antonio)	City of San Antonio	Water Consumption	Municipal & Industrial	All (San Antonio)	City Ordinance	Positive	Reuse	Yes
Recreation Fees	Not determined	River Authorities and Cities	User Fee	Facility Users	All	None	None	Surface Water	No
Water Availability Hook-up Charge	$1000/dwelling unit equivalent	Water Purveyors	Growth	Municipal & Industrial	Growth	City Ordinances State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Sales Tax	Not determined	State	Economic Activity	Entire Region	All	State Legislation Referendum	None	Surface Water	No
State/Federal Aid	Not determined	Cities Water Purveyors River Authorities E.U.W.D	N/A	N/A	N/A	None	None	Reuse Surface Water	No No

IMPLEMENTATION

It is crucial that this plan be implemented as a regionwide program. The Edwards District should administer the groundwater withdrawal policy and manage the conservation programs because of their regionwide impacts. It should provide technical assistance to municipalities in developing conservation ordinances and facility retrofit programs. It should also assist water purveyors in developing leak detection programs and restructuring their rates to encourage conservation. To do this the District must have adequate funding, staffing, and capital equipment.

Other agencies should take part in the operation of the remaining plan components as they are implemented. The City of San Antonio should be responsible for the wastewater reuse program. The City Water Board, San Antonio River Authority and Guadalupe-Blanco River Authority should be the contracting agencies for the proposed reservoirs.

Action will be needed in the 1989 session of the Texas Legislature to authorize the groundwater withdrawal policy. This is the key to implementing the entire plan. Other legislative initiatives such as new fees are for consideration in the future.

Once the region achieves consensus for this legislation, implementation efforts must be made equally on the conservation, reuse and surface water components. If one of these is less successful than intended, then the other programs must make up the difference. An early start on the modified Applewhite

Reservoir project is also essential to establish momentum in creating supplemental water supplies.

Ultimately, everyone in the region has a major stake in the success of this plan. Each agency, and each individual consumer, must recognize that we all depend on the same Edwards Aquifer. It is a common resource with a finite capacity. If the region is to continue to grow and prosper, we must act upon this knowledge now.