MONTGOMERY WATSON

March 31, 1993

Mr. Tony T. Gregg, P.E.
Conservation Program Manager
City of Austin
Environmental and Conservation Services Department
206 East 9th Street, Suite 17-102
Austin, TX 78701

SUBJECT: City of Austin Water Conservation Plan

Dear Tony:

Montgomery Watson is pleased to submit our Water Conservation Plan. Working closely with you and your staff, we have developed a plan to enable the City of Austin to be more water efficient. In developing this comprehensive plan, we evaluated over twenty different water conservation measures. The objective of the plan is to reduce peak water use ten percent by the year 2000.

To accomplish this goal, we recommend that Austin implement the following eleven programs:

1. Landscape Retrofit
2. Irrigation Efficiency Audits and Retrofit
3. New Xeriscape Incentive
4. Large Landscape Irrigation Audits
5. Residential Home Water Audit and Retrofit
6. Commercial/Industrial Audits and Rebate
7. Manufacturing Audits and Rebate
8. City Building Retrofit (interior)
9. 1.6 gpf Toilet Replacement
10. School Education
11. Commercial Landscape Ordinance

Montgomery Watson conducted the initial analyses. As part of our contract, we provided instruction and software so that the City of Austin could conduct subsequent analyses to update the initial data. The data in this report represents the updated analyses performed by the City staff. All of the measures have a benefit-cost ratio greater than one. One of the measures was not evaluated quantitatively because its water savings could not be estimated:

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School Education. While the water savings are not quantifiable, Montgomery Watson believes this measure to be an important element of the total program because it helps instill a water conservation ethic into the population.

The estimated budget to implement this program is about $2.45 million per year which includes a full-time staff of 16 persons plus 5 temporary auditors.

In order to achieve the water savings of ten percent by the year 2000, it is necessary to start all programs right away.

Benefits from implementing this plan include:

- Delaying the construction of the 40-mgd upgrade to the Ullrich Water Treatment Plant
- Deferral of the time when the City will have to start purchasing water from the Lower Colorado River Authority
- Deferral of construction of Water Treatment Plant No. 4
- Save energy and system operation costs
- Reduce water bills for program participants
- Leave more water in streams, the Colorado River, and the Highland Lakes

We look forward to seeing this program implemented. Should you need further assistance please call.

Sincerely,

William O. Maddaus

William O. Maddaus
Project Manager

T. David Chinn, P.E.
Principal Engineer

WOM:TDC:dhl
Enclosure

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SECTION 1

INTRODUCTION AND SUMMARY

BACKGROUND AND PURPOSE

The City of Austin (COA) has had an ongoing water conservation program, with the main thrust dating back to 1985. Montgomery Watson (MW) was retained in 1991 to conduct a study to expand upon the City's program by 1) updating demographic and water use data, 2) evaluating new or expanded water conservation measures, and 3) preparing an updated water conservation plan. MW, together with COA staff, gathered and tabulated the initial data and developed measures. MW provided the initial analysis and prepared a draft report dated June 1992. Following a training period and delivery of input files and benefit-cost software, subsequent analyses were performed by the COA. The data within this document reflects the most recent data collected by the COA and analyses performed on that data by the COA.

SCOPE OF WORK

The scope of work for this project covered: 1) development of data to assess conservation options, 2) the screening of water conservation measures, 3) evaluating the benefits and costs of conservation measures, 4) the development of a conservation plan, and 5) the preparation of a report. The scope of work did not include evaluation of reuse projects that could feasibly be implemented. The Water and Wastewater Utility has recently completed a separate study, "Master Planning for Recycled Water," which contains an analysis of reuse opportunities. In addition, the scope did not include evaluation of a conservation rate structure. The Water and Wastewater Utility has recently completed a Cost of Service Study, including examination of several conservation rate structure options. Implementation of such a rate structure would certainly provide water customers with an additional incentive to participate in the measures described in this report and would likely increase participation over the estimates used in this report.

Development of Data to Assess Conservation

This task required the collection of data from City records and recent reports in order to develop demographics, land use, and water use.

Screening of Conservation Measures

In this task, MW and the City staff applied their collective experience in water conservation to screen a large list of potential conservation measures into a smaller list of 11 appropriate measures for integration into the City's conservation program.

Evaluating the Benefits and Costs of Conservation Measures

The selected conservation measures were described by MW. The description included implementation strategies, market penetration, costs to the customer and utility, and unit water savings. MW used WaterPlan Version 2.0 to perform the initial evaluation of the benefits and costs of the individual conservation measures. Subsequent evaluations were conducted by COA staff using the same version of WaterPlan 2.0 with the latest demographic and water use numbers from 1993.

Develop a Conservation Plan

Based on the results of the benefit-cost analysis, MW developed and described a comprehensive water conservation program. The program description included costs, water savings, and timing for implementation of the program.

SUMMARY OF CONCLUSIONS

The project team, which included City staff, reviewed past demographic and water use records, as well as planning studies for future growth. Based on these studies, the estimated demography and water use were described.

The demographic data was used to evaluate a number of water conservation measures. The benefits-cost ratios of these measures are listed on the following table.

BENEFIT-COST RATIOS

	Measure	Benefit/Cost Ratio (Total Resource Test)	City Benefit/Cost Ratio
1.	Landscape Retrofit	0.28	2.68
2.	Irrigation Efficiency Audits and Retrofit	4.58	6.40
3.	New Xeriscape Incentive	1.52	1.98
4.	Large Landscape Irrigation Audits and Retrofit	6.12	7.87
5.	Residential Home Water Audits and Retrofit	13.65	13.65
6.	Commercial/ Industrial Audits and Rebate	3.58	4.57
7.	Manufacturing Audits and Rebate	4.94	29.64
8.	City Building Retrofit, Int.	2.29	2.29
9.	1.6 gpf Toilet Replacement	2.14	3.56
10.	School Education	NA	NA
11.	Commercial Landscape Ordinance	40.50	40.50

RECOMMENDED PROGRAM

Based on the above data, MW recommends that the City implement the following water conservation measures as part of its comprehensive water conservation program.

Landscape Retrofit Program

This program will draw on the experience of the City's current Xeriscape public education program. Xeriscape landscaping includes a water efficient turf such as:

- Buffalo Grass
- Prairie Buffalo

The staff of the City's Environmental and Conservation Services Department (ECSD) will establish the best landscape turf and plantings to use and how to install the turf and plantings. Generally, the user should ensure that soil conditions are favorable for growth, fertilizers should be applied to assure proper nutrients are available, and the appropriate watering schedule for the age and type of turf/plantings and weather conditions must be adhered to.

The City will offer a $.05/square feet rebate for replacing existing St. Augustine grass located in an area that receives at least eight hours of direct sunlight with Prairie Buffalo or No. 609 grass sod, with a per dwelling unit limit of $150.

Irrigation Efficiency Audits and Retrofit

Existing single family and multifamily building owners with high summer water use (the top 50 percent of water users) would be offered an irrigation system audit. Auditors would test the system, reporting any maintenance problems. Separate irrigation schedules for spring, summer, and fall will be developed for the owner. The owner will be encouraged to reset their irrigation controller or otherwise follow the schedules. The owner will receive $30 in retrofit parts or rebates.

New Xeriscape Incentive

This program is aimed at reducing the amount of high-water consuming landscape area. Alternatives include low-water use turf and low-water using plants and shrubs, as well as patios, decks, and walkways. Offer developers and/or builders a rebate for every new house that they sell, that has incorporated landscapes which use Xeriscape principles. Offer rebates for using water-conserving grass species in new residential construction. Home builders/developers could have model houses showing traditional and Xeriscape landscapes. Potential buyers will be informed of the benefits obtained from using Xeriscape principles. The rebate will be calculated at the site of $0.03 per square foot landscaped, up to a maximum of $150.

Large Landscape Irrigation Audits and Retrofit

An irrigation audit is conducted by a water utility representative or Contractor. Only sites larger than one acre (which represents a demand of up to 10 mgd in the summer) are considered applicable for this program. Auditors perform an on-site audit of the irrigation system and produce customized irrigation schedules for each site.

Program implementation would entail:

- Site selection and determination of site specific data
- Determination of priority of sites, based on irrigated acreage and past water use.
- Direct mail of audit program letter and commercial irrigation guides.
- Audits performed by an agency representative which produce a customized schedule for the building owner or landscape manager.
- Continued support of the program by providing weather information for updated schedules, seminars on topical issues, and a follow-up campaign.

The objective is to provide landscape managers with information to enable them to perform timely equipment maintenance and to apply accurate irrigation amounts throughout the year based on explicit customized reports. During the audit process, brochures describing the causes and cures of maintenance and management problems in large turf irrigation systems should be included with the agency's irrigation guide.

Residential Home Water Audits and Retrofit

Free indoor/outdoor water audits are offered to existing residential customers. The City will contact 25 percent of the users who use the highest percent of the water (per dwelling unit) and suggest that they obtain an audit. At the home, auditors will:

- Check water flows of faucets, showers, and toilets.
- Perform leak detection test on all toilets.
- Install toilet dam, if applicable, to reduce toilet flush volume.
- Install faucet aerators and low-water use showerheads
- Check domestic meter for determination if domestic leaks exist.
- Evaluate the benefits of installing a 1.6 gpf toilet and whether customer is eligible for rebate. Provide necessary forms to obtain rebate.
- Conduct audit of irrigation system and develop irrigation schedule.
- Advise the customer on the benefits of low water use landscaping.

Commercial/Industrial Audits and Rebate

This measure is applicable to commercial/industrial water use in Austin.

For existing and new sites, an interior and landscape audit is conducted by utility representatives working closely with the customer's technical staff. Auditors perform an on-site audit of the fixture condition and use pattern and quantity. They will perform leak tests and evaluate the irrigation system. A customized report is produced that describes fixture inspections, leak tests, process and cooling water usage, and landscaping for each site. The report includes a spreadsheet that compares the existing facility operations with conservation standards and potentials. A pay

back analysis will be provided and a description of incentives available. The participant's actions and water use is tracked over time. Standards are based on previous experience.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff or a consultant, will identify state-of-the-art improvements in process and cooling water use and landscape design and irrigation systems. This review will also be available to existing customers.

Manufacturing Audits and Rebate

The largest manufacturers in Austin would be offered assistance with process, cooling, and landscape water use reduction.

Existing customers would be offered an interior and landscape audit by water agency provided specialists. Auditors would work with on-site engineers to audit process, cooling and irrigation systems and produce a customized report that describes fixture inspections, process modifications, leak tests, landscaping and irrigation for each site. The report provides a pay back analysis and a description of incentives available. The participant's actions and water use is tracked over time.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff, will identify state-of-the-art improvements in process and cooling water use and landscaping and irrigation systems. A review will also be available for existing customers. To stimulate interest, the rebate can be calculated on a dollar per gallons saved per day basis, up to a cap of up to $3,000 per customer.

City Building Retrofit (Interior)

This water conservation program would put up a matching share of about 50 percent of the cost for retrofitting toilets with ultra low-flush models.

1.6 GPF Toilet Replacement

This program, initially restricted to residential dwellings, will have an overall goal to replace approximately 40 percent of existing residential toilets with ultra-low-flush toilets by the year 2000. There are approximately 379,000 residential toilets in Austin, assuming 1.7 toilets per residential unit. The residential goal of this program amounts to 3-4 percent of 379,000 toilets per year or a goal of replacing 11,000 to 15,000 toilets per year. Financial rebates in the form of water bill credits to those who purchase the toilets will be offered to increase acceptance.

School Education

School education serves to educate our future water users in the efficient use of their resources. Education will help children know where water comes from, how it is used, and ways to conserve.

Commercial Landscape Ordinance

The existing Commercial Landscape Ordinance would be amended to reflect a Xeriscape approach to current requirements. The ordinance would be written to require efficient irrigation systems (e.g. auto rain shut-off devices), give credit for xerophytic plants, etc.

The City staff will provide information on the best landscape turf and plantings to use and how to install the turf and plantings.

Water Savings from all Programs

This program is anticipated to reduce peak day demands and average day demands in the year 2000 by 10 percent.

Scheduling the Program

Because of the need to achieve significant water savings by the year 2000, it is recommended that the entire water conservation program will commence in late 1992 and be fully operational within eight years.

Budget Needed

The estimated annual budget required to implement all the above listed measures simultaneously would be about $2.45 million in the first year which includes a staff of 16 full time equivalents and 5 temporary auditors.

Program Benefits

The recommended program will:

- Enable delaying construction of the 40 million gallons per day (mgd) upgrade to the Ullrich Water Treatment Plant by six years.
- Delay construction of Water Treatment Plant No. 4.
- Delay purchasing water from the Lower Colorado River Authority.
- Save energy and system operation costs.
- Reduce ultimate peak water demands by over 10 percent.
- Reduce water bills for program participants.
- Enhance environmental benefits by leaving more water in streams, the Colorado River, and the Highland Lakes.

SECTION 2

DEMOGRAPHY AND WATER USE

Demographic and water use data was collected in 1991 from the City of Austin for the year 1990, which was considered a normal water use year. These data and information from previously completed planning studies on future growth were used to determine base water use and demographic data. These data are used in the benefit-cost evaluations of Section 4.

ANALYSIS METHODOLOGY

Previously conducted planning studies and recent information from the City of Austin Department of Planning and Development were used to determine present and future water use and demographics for the City of Austin service area.

The Department of Planning and Development provided information on occupied residential dwelling units, as well as residential populations. Much of this data came from the Census Report 3 - "Housing Stock Change 1970-80-90" dated October, 1991. Population growth rates were based on the "Population and Austin Transportation Study (ATS) Forecasts at the 1990 Census Tract Level." Dwelling unit growth rates were based on growth projections from the Water and Wastewater Utility's "Operating Budget Package Approved Budget 1991-1992."

Water use data came from a computer sort by building use codes. The figures were supplemented by data from the "Comprehensive Water Use Profile" provided by the Environmental and Conservation Services Department. Some of the ECSD data is based on water audits conducted in the last five years.

For the residential sector, interior water use (determined as 15 percent less than winter water use in the lowest two months billing period), per customer category, was divided by the total number of people to determine per capita interior water use data. Exterior water use (total water use minus interior water use), per customer category, was divided by the total number of dwellings to determine unit exterior water use data.

For the non-residential sector, interior water use, per customer category, was divided by the total area covered by this category to determine unit interior water use data. Exterior water use, per customer category, was also divided by the total area to determine unit exterior water use data.

These data were compared to industry standards to determine if the data provided was consistent to similar communities. In some cases the data was not, and this occurred where the split of customer categories for determining water use did not correspond with the split of customer categories for determining dwellings or area. These errors were corrected and the unit water use numbers recomputed.

DEMOGRAPHY

Demographic data included the number of people, dwellings in the residential customer categories, and acreage of the non-residential categories. Both existing and future numbers are provided. The breakdown between present and future is made because the water conservation will be applied differently for each category. For example, restrictions on type of plumbing fixtures for new construction is a measure applied to only new dwellings and not existing dwellings.

Defining the Categories

Two residential categories were used: 1) single family and 2) multifamily. Three non-residential categories were used: 1) commercial, 2) public, and 3) industrial. One more category included unaccounted-for water. The breakdown was based on available data from the City of Austin, as well as the logical breakdown for targeting water conservation efforts.

Single Family

The single family category comprises single family dwellings, duplex units, triplex, and four-plex units. These were grouped together because the interior and exterior water use patterns are similar and water conservation efforts can be similar for each category. Planning level estimates show there to be about 151,000 dwellings in 1990, which represents about 405,000 single family residents. Current projections for the Austin MSA predict a population growth rate on the order of 1.75 to just over 2 percent. To match water and wastewater projections, an annual growth rate of 2.03 percent was applied to the housing units based on the Water and Wastewater Utility's projections of customer growth, resulting in approximately 204,130 single family housing units in the year 2005. Household size was assumed to remain constant at 2.68 persons per single family dwelling unit. This data is presented in Table 2-1.

TABLE 2-1

CITY OF AUSTIN SERVICE AREA
CUSTOMER GROWTH

Category	1990	1995	2000	2005
Single Family (dwelling units)	151,000	166,960	184,600	204,130
Multifamily (dwelling units)	77,000	85,140	94,140	104,100
Commercial (acres)	95,780	96,450	97,120	97,810
Public (acres)	20,700	24,770	29,630	35,450
Industrial (acres)	10,240	11,470	12,860	14,400

Multifamily

The multifamily category comprises accounts with five or more units. It also includes mobile homes. Again, both interior and exterior water use patterns are relatively similar in these categories. Planning level estimates show there to be about 77,000 dwellings in 1990, which represents about 140,000 multifamily residents. As with the single family category, multi family housing units were projected to increase at an annual rate of 2.03 percent, resulting in approximately 104,100 units in the year 2005. Household size was held constant at 1.81 persons per dwelling.

Commercial

The commercial category included the following electric utility codes: 7 (vacant land), 12 (ground-level commercial), 13 (high-rise commercial), 26 (railroad), 30 (transportation), 36 (agricultural land), 37 (school property), and 39 (hospital property). While it is understood that some of these do not exactly fit the typical commercial water user, they better fit the commercial user than other categories, and their contribution to the overall demand is minimal. Data from the Engineering Science report Unit Service Demand, Water and Wastewater Utility Interim Plan was used to predict present non-residential land use. Future land use was expected to remain almost constant at a 0.14 percent annual growth based on the Operating Budget Package. There were about 96,000 acres of commercial land in 1990 and an anticipated 98,000 in the year 2005. There were approximately 12.6 acres per service connection in 1990.

Public

The public category comprises electric utility codes: 27 (highway), 29 (water surface), 34 (parkland), 35 (recreational land), and 40 (government property). Land use was expected to grow at 3.93 percent per year based on the Operating Budget Package. There were about 21,000 acres of public land in 1990 and an anticipated 40,000 in the year 2005. There were approximately 58 acres per service connection in 1990.

Industrial

The industrial category includes electric utility codes: 14 (industrial) and 38 (airport). There were about 10,000 acres of industrial land in 1995 and an anticipated 14,000 in the year 2005. There were approximately 71.6 acres per service connection in 1990.

Margin of Error and Impacts on Study

These demographic data were presented and agreed to by the Water and Wastewater Utility Systems Analysis Division. All the data provided, however, is planning level data. This implies that there are uncertainties in predicting future events based on past data. Normally, the future projections closest to present conditions are most accurate with the accuracy diminishing over time. Therefore, it is important to monitor actual demography and update the projections accordingly. Also, a margin of error of plus or minus 10 - 15 percent should be applied to the population growth rate given so that the City is prepared to accommodate actual conditions that vary from the predicted. For example, if the population growth rate between 1990 and the year 2005 were off by 15 percent, that would represent a difference of 20,000 people.

The impacts that these variances will have on this study will be the impacts of multiplying unit water conservation potential by populations and dwellings that are too low or too high. Thus, savings potential will be more or less than predicted. As will be discussed later, there is also an inherent error involved in predicting unit water conservation potential. The two variances can either cancel out one another or accentuate the variance. This is why vigilance in monitoring actual events must be maintained, and predictions updated every year. To assist in this process, the City has been given a spreadsheet of all demographic, water use, and unit conservation data. As more information becomes available, the data can be updated.

WATER USE

Water use includes the total and unit water use (both interior and exterior) for each customer category.

Existing water use data was used to predict demands from the existing customer base and to predict demands of future customers. The year 1990 was used when data was available from City billing records (See Exhibit B). Where this data was not available, information from previously conducted water audits was used.

Single Family

Single family water use was estimated to be about 18,000 million gallons per year in 1990 and 23,000 in the year 2005. The interior per capita use is about 77 gallons per day and the exterior per dwelling use is about 118 gallons per day. Future estimates were based on taking normal water use year (1990) unit water use values and multiplying them by future population and dwelling statistics. The factors will be modified once the demand management is factored into the demand equation. These demands are shown on Table 2-2. These values are averages. They will be higher during peak demand periods and higher for certain customers that have a tendency to use more water.

The location of these demands varies depending on location in the City of Austin. The most significant single family demands comes from sectors 2,6,7,9,10 and 11 in the northwest part of the City shown on Figure 2-1[1].

TABLE 2-2

WATER USE, MGY

Category	1990	1995	2000	2005
Single Family	17,890	19,330	20,900	22,600
Multifamily	5,000	5,440	5,930	6,450
Commercial	7,500	7,560	7,610	7,660
Public	3,410	4,070	4,870	5,830
Industrial	2,600	2,860	3,200	3,590
Unaccounted	1,980	2,140	2,310	2,490
TOTAL	38,330	41,400	44,810	48,620

[1] CH2M Hill "Technical Memorandum No. 2 - Water Supply and Demand Assessment Identification of Potential Areas for Water Reuse" Draft Figure 4

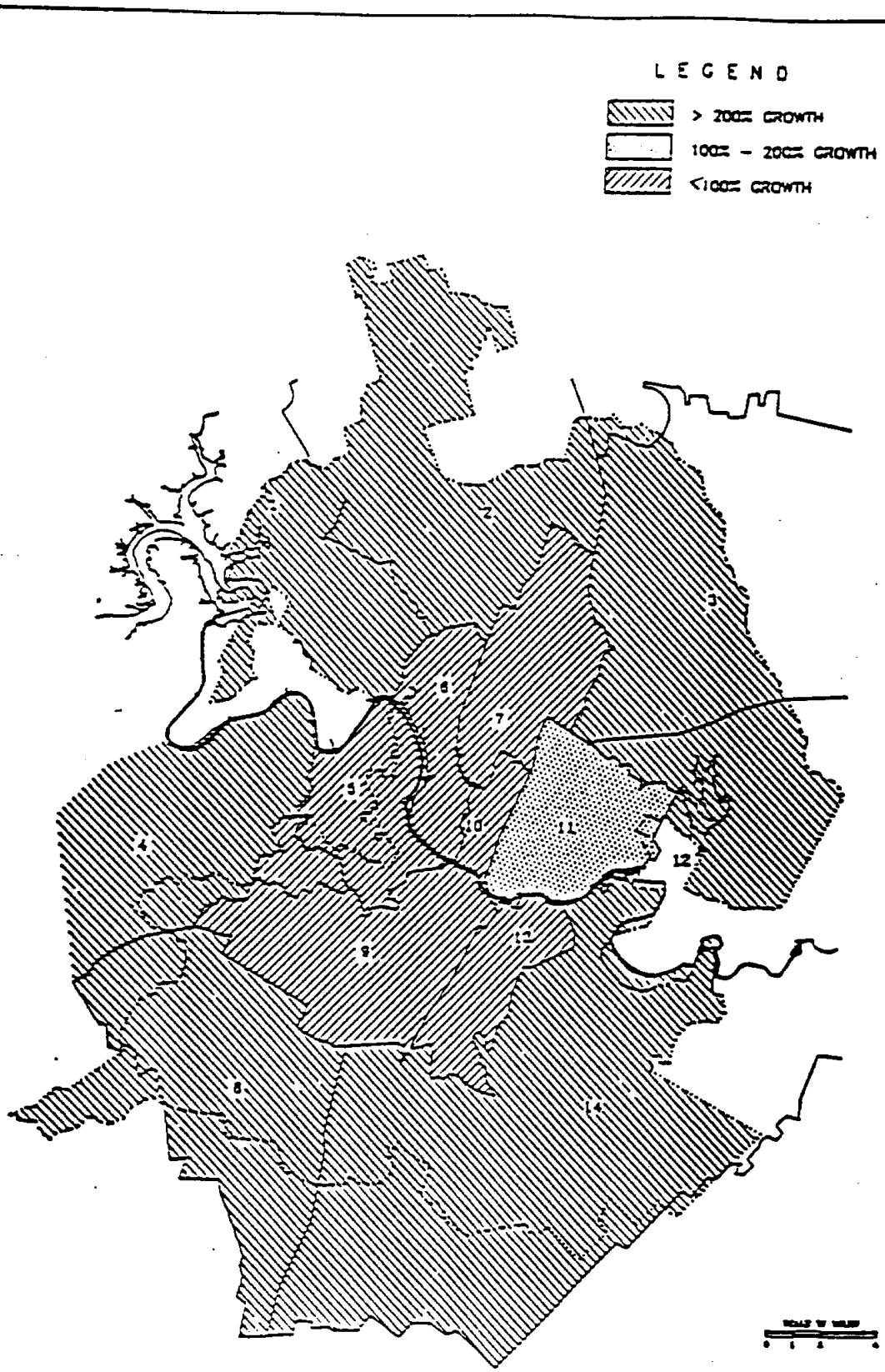

Figure 2-1
Residential Growth
in Water Usage

Multifamily

Multifamily water use was estimated to be about 5,000 million gallons per year in 1990 and 6,400 in the year 2005. The interior per capita use is about 91 gallons per day and the exterior per dwelling use is about 13 gallons per day.

Commercial

Commercial water use was estimated to be about 7,500 million gallons per year in 1990 and 7,700 in the year 2005. The interior per acre use is about 170 gallons per day and the exterior per acre use is about 45 gallons per day.

Public

Public water use was estimated to be about 3,400 million gallons per year in 1990 and 1,300 in the year 2005. The interior per acre use would be about 140 gallons per day and the exterior per acre use would be 320 gallons per day.

Industrial

Industrial water use was estimated to be about 2,550 million gallons per year in 1990 and 3,600 in the year 2005. The interior per acre use would be about 560 gallons per day and the exterior per acre use would be 120 gallons per day.

Peak Demands

Peak factors are estimated for aggregate system demands (which is the total amount of water billed). Average exterior demands in 1990 are multiplied by a factor of 2.93 to obtain the maximum-day exterior water use. Average interior demands are assumed to have a peaking factor close to 1.0. The peaking factor methodology was provided by the City of Austin Water and Wastewater Utility Systems Analysis Division with assistance from the Environmental and Conservation Services Department. Table 2-3 provides combined (interior/exterior) peaking factors based on dividing peak day demands by the annual average demand, and exterior peaking factors based on dividing peak day exterior demands by annual average exterior water use. The demands used in determining peaking factors for different customer categories were obtained by the ECSD for the period between 1989 and 1990. These are based on the data provided by the ECSD in the given time period, and not a prediction of future peaking factors. The "Long Range Modeling and Operating Strategies - Austin plan Demand Projections" September 1991 shows the peaks to vary with the smallest peaking factors in the central pressure zone and the largest peaks in the "NWB" and "SWB" pressure zones.

TABLE 2-3

WATER USE PEAKING FACTORS

Category	Time	Peak/Average Factor
Single Family	Combined	1.71
	Exterior	2.96
Multifamily	Combined	1.32
	Exterior	2.37
Commercial	Combined	1.83
	Exterior	3.22
Public	Combined	1.74
	Exterior	2.98
Industrial	Combined	1.33
	Exterior	2.36
TOTAL	Combined	1.66
	Exterior	2.93

Note: These peak/average factors are estimates by ECSD staff based on billing data.

High Water Users

The City has accurate estimates of average water use by various classes of customers. For certain programs, however, only the highest users in certain categories are targeted. Because calculating the consumption by the highest users is extremely difficult, a rough estimate has been made for each customer class. These estimates are illustrated in the table below.

TABLE 2-4

HIGH WATER USERS

Category	Average User Avg. Day Gallons/Acct	High User Avg. Day Gallons/Acct	High to Average Ratio
Single Family	324	1,014	3.13
Multifamily	162	315	1.94
Commercial	2,708	7,327	2.71
Public	26,135	75,079	2.87
Industrial	48,830	170,980	3.5

Evaluation of Demand

The above demands were evaluated for the purpose of describing where conservation efforts should be concentrated.

Location. The areas of the City that experience the largest existing demand are in the northwest portion of the Austin service area [2], which is mostly residential demand.

Customer Category. The customer category that contributes most significantly to demand is the single family category which represents about 47 percent of the total demand. The commercial sector represents about 20 percent of the demand and the multifamily sector constitutes about 15 percent. The remaining 18 percent is for public, industrial, and unaccounted-for uses.

Interior vs. Exterior. About 75 percent of all water use is for interior uses. This varies with user category. For example, an estimated 30 percent of public water use is for interior use, while an estimated 93 percent of multifamily use is for interior uses.

Existing vs. New. By the year 2006, 17 percent of the water use is expected to be for new customers and 83 percent for existing customers. This is influenced by residential growth. New growth is expected to occur in the northwest portion of the service area between elevation 720 ft and 1015 ft[2]. This nearly approximates recent trends for growth designated in the (1970) census tracts of Travis County: 11, 17.01, 17.02, 18.01, 18.02, 19.2, 22, 23.01, and 24 [3].

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[2] "Site Selection and Preliminary Design Report Water Treatment Plant No. 4" Lake Travis Consultants, April 1985

[3] "Census Report 1 August 1991 Population Change 1970-80-90" Department of Planning and Development, City of Austin

SECTION 3

CONSERVATION MEASURES DEVELOPMENT

This section explains and describes the water conservation measures that Montgomery Watson (MW) evaluated for the City of Austin. Also included is an explanation as to how the measures were designed and targeted for maximum effectiveness.

PRELIMINARY EVALUATION

In order to select and describe water conservation programs that are appropriate for the situation in the City of Austin, it is important to evaluate factors such as demands, existing conservation programs, etc. The development of water conservation measures began with the review of a large list of potential water conservation measures. These measures then were screened and those measures that "passed" the screening were evaluated in the benefit-cost evaluation.

City of Austin Evaluation of Preliminary Water Conservation List

Initial selection of a preliminary water conservation measure list was made by the City of Austin. The list was published at the initial project kickoff meeting held October 23, 1991, and then revised at a subsequent presentation to wholesale customers on February 4, 1992. The list included a brief description of the measures which will not be duplicated here.

Included on the list were the following 21 measures

- Landscape Retrofit Program
- Irrigation Efficiency Audits Program
- New Home Xeriscape Incentive Program
- Large Landscape Irrigation Audits Program
- On-Site Gray Water Reuse
- Residential Home Water Audits
- Commercial/Industrial Audits and Rebate Program
- Manufacturing Audits and Rebate Program
- Rainwater Harvesting
- Interior City Building Retrofit
- 1.6 gpf Toilet Replacement Program
- Goal Billing
- Approach Main Discounts for New Construction
- School Education
- Irrigation from Stormwater Basins
- Weather Station Controlled Subdivisions
- Shared Savings for MF, Office, Industry.
- Commercial Landscape Ordinance
- Water Awareness Ordinance
- Submetering Ordinance
- Toilet Flapper Valve Replacement

Initial Measure Selection

This list of 21 measures was evaluated using a set of qualitative criteria to represent non-monetary factors. The criteria are defined in Appendix A. The applied methodology was an adaptation of the method described in the American Water Works Association publication "Water Conservation". The results of the analysis are shown in Figure A-1. Measures are listed in the column on the left

and possible impacts are listed across the top of the table. In the table a "+" is assigned for a positive impact, a "-" for a negative impact, and a blank space indicates little or no impact.

Mandatory measures have the largest negative equity impacts because they could lead to significant opposition by customers due to additional expenses or impact on lifestyle. The qualitative analysis is a useful screening tool that can eliminate measures that are either technically not feasible, have severe environmental impacts, or would be very difficult to implement because of customer opposition.

Through this process, 15 measures were chosen for immediate study and possible implementation in the first phase of the City's expanded water conservation program.

Six measures have the potential for significant savings, but information on them is limited and additional studies to determine long-term benefits are recommended. These measures could be implemented in Phase II following additional studies including pilot studies. The six measures were:

- On-Site Gray Water Use
- Rain Water Harvesting
- Goal Billing
- Approach Main Discounts
- Irrigation From Stormwater
- Weather Station Controlled Subdivisions

A brief explanation of why they were dropped from further consideration in the evaluation process is described below.

On-Site Gray Water Use. This measure, if accepted and implemented, could yield significant average and peak water savings. The measure applies to all types of residential dwellings where sufficient irrigation exists to make gray water reuse feasible. The measure entails separate plumbing systems for gray water subsurface landscape irrigation in an approved manner. Surface systems are also available with filtration and chlorination. Annual inspections, however, are required. There are no surface systems of this type approved by the County Health Department for use in Austin. To better understand this measure for the Austin area, a pilot study that evaluates the installation method for underground pipes, including pipe lengths and grid lengths, would be needed. Costs, savings, and maintenance of this measure should be evaluated.

Rain Water Harvesting. This measure, if accepted and implemented, could yield significant average and peak water savings. The measure entails collection of rainwater in home catchment devices and use of this water for landscape irrigation. This measure has been used on a couple of sites in central Texas. To better understand this measure for the Austin area, a pilot study that evaluates the costs, savings, and required maintenance associated with this measure could be conducted.

Goal Billing. This measure will help reduce both average and peak water use, although it will have a greater impact on discretionary peak uses such as outdoor irrigation. Goal billing is currently being pioneered in Scottsdale, Arizona. Customers are given a water budget for the year based on their household size and lot size. If they exceed their water budget, they are assessed a surcharge; if they use less than their budget, they receive a discount. This measure will require a good information and public relations campaign, since it involves rates. This measure was evaluated as part of the Water and Wastewater Cost of Service Study, issued in September 1992.

Approach Main Discounts for New Construction. This measure will help assure that new construction is built with efficiency in mind. The measure entails offering discounts to developers for water efficient landscape designs or dual distribution systems. At this point in time, there are a number of variables associated with this program that need to be evaluated such as how much of a discount to offer, how to inspect the developments, etc. There are a number of similar programs just getting started in the United States. These programs will be tracked and studied to enable the City of Austin to base its program on the trials and tribulations of others.

Irrigation from Stormwater Sedimentation/Infiltration Basins. This measure, if accepted and implemented, could yield significant average and peak water savings. The measure entails using stormwater as an alternative irrigation source. Stormwater stored in existing storage basins would be pumped to existing or new landscape irrigation systems. The water may need to be filtered and would need to be stored until it could be used for irrigation. To better understand this measure for the Austin area, a pilot study that evaluates the costs, savings, and maintenance of this measure should be conducted. As this is being done at existing shopping centers, their operations could be evaluated.

Weather Station Controlled Subdivision. This measure has the potential to make dramatic reduction in peak day water use. The measure involves connecting all common area and residential controllers to a computer network, driven by an automated weather station. Although the technology exists to do this, it has never been done before. Furthermore it is unclear how individual yards would be handled and whether the homeowner could override the central system. Possibly front yards could be irrigated this way if landscaping were similar. Further research is needed before this measure can be evaluated.

MW Review of The City of Austin's Existing Water Conservation Program

The existing water conservation programs target primarily the residential customers. This is advantageous since the majority of demand comes from this sector. The existing program is summarized in Table 3-1.

MW and City of Austin Review of Water Demands

Tables 2-1 and 2-2 in Section 2 shows the demography and water use for the City between the years 1990 and 2005.

The single family category has by far the highest base (indoor) use, using about 30 percent of all water. The next highest users are multiple family, public/commercial, and unaccounted-for water (UAW).

The single family category also has the highest contribution to peak demands with 17 percent of all water used for exterior single family demand. The next highest is public/commercial demand.

TABLE 3-1

POTENTIAL AREAS IMPACTED BY EXISTING CONSERVATION PROGRAM

		Single Family	Multiple Family	Public/ Cmml	Industrial	Utility
Exterior						
	Xeriscape Demo	X	X	X		
	PSAs	X	X			
	School Education	X	X			
	Industry Education				X	
	Xeriscape Education	X	X	X		X
Interior						
	Home Audit	X	X			
	Retrofit (depot)	X	X			
	Retrofit (door-to-door)	X				
	Commercial/Public Retrofit			X		X
	Commercial Audit			X		
	Industrial Audit				X	
	Plumbing Code	X	X	X		

Demand Distribution

The location of demands was specified in Section 2. This determination was accomplished to determine what locations require specific water conservation efforts.

Growth

Although the City of Austin experienced rapid and then slow growth in the 1980's, all sectors are now experiencing a relatively modest growth rate of approximately 2.0 percent annually. Therefore, no special effort should be made to encourage water conservation programs designed for future customers over conservation programs targeted for present customers.

City of Austin's Review of Facilities Impacted by Demands

Demand reductions should be focused on the geographical areas associated with the following facilities:

- Transmission facilities to pump Ullrich Water Treatment Plant water north of the Colorado
- Ullrich Water Treatment Plant expansions
- Water Treatment Plant No. 4 on Lake Travis

Summary of Where to Place Conservation Effort

The City Council has adopted a water saving goal of reducing peak day water use by 10 percent and a 5 percent reduction in average day per capita water use by the year 2000. The largest exterior (peak) water use is exterior single family (17 percent) followed by exterior commercial use (5 percent). These areas are prime targets to reduce peak day use. The largest interior water use category is again, single family. When combined with multifamily, residential interior use is 42 percent of the total use. Commercial interior use at 18 percent is also significant. Conservation measures focusing on these categories and others are presented below.

LANDSCAPE RETROFIT PROGRAM

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- Existing Residential, Commercial/Public, Industrial

Description

This program will draw on the experience of the City's current Xeriscape public education program. Xeriscape landscaping reduces the amount of water that needs to be applied to turf grass and other plant life such as shrubs and trees. This type of landscaping is typically more drought tolerant than standard landscaping. Low water use landscaping includes a water efficient turf such as:

- 609 Buffalo Grass
- Prairie Buffalo Grass

The staff of the City's Environmental and Conservation Services Department (ECSD) will establish the best landscape turf and plantings to use and how to install the turf and plantings. Generally, the user should ensure that soil conditions are favorable for growth, fertilizers should be applied to assure proper nutrients are available, and the appropriate watering schedule for the age and type of turf/plantings and weather conditions must be adhered to.

Implementation Method

- Education Program

  Further encourage more education of green industry and builders. The City of Austin (COA) is developing a "Green Builder Program" including:

  - City to review plans and certify, if plans meet COA Xeriscape requirements. The City of Austin will develop a point system to determine if a landscape is a Xeriscape.

- Incentive Program

  Encourage and educate customers in the principles and practices of Xeriscape through:

  - Offer a $.05/square feet rebate for replacing existing St. Augustine grass located in an area that receives at least eight hours of direct sunlight with Prairie Buffalo or No. 609 grass sod, with a per dwelling unit limit of $150.

Water Use and Savings

The water savings from using Xeriscape techniques has been shown to be about 20 to 50 percent of what is used for highly maintained St. Augustine lawns[1,2,3,7,8]. For the purpose of this report, a savings of 30 percent is assumed for areas receiving direct sunlight and not heavily shaded that could substitute Xeriscape for St. Augustine lawns. The 30 percent savings is applied against the exterior water use for only. On an individual basis, the savings should be based on gallons-per-acre per-inch of evapotranspiration (ET) applied, where ET applied is the minimum amount of water required to grow a particular turf in a given climate[6].

The market penetration for this measure will initially be rather low and will increase over time. It is conservatively estimated that one percent of the existing landscapes will be redone and Xeriscaped over the next 8 years.

Direct Cost and Lifetime

The minimal customer cost of this program is estimated based on an additional cost of $0.30/square foot over the rebate amount of $0.05/square foot for Prairie Buffalo grass. Retrofitting with landscape beds would be considerably more expensive. Additional costs include installation requiring 25 man-hours of labor. For use in this report, a value of $15/hour is used [5] for the Austin area. Annual maintenance was considered to be no different than conventional landscaping. The lifetime of a landscape depends upon the wishes of the homeowner, but is assumed to last at least 20 years[4].

A one-time cost of $15,000 is used to set up the program. This program will require the following COA staff per 1,000 participants: One quarter-time landscape architect, a full time Conservation Associate, and a quarter-time administrative clerk. Hourly salaries including overhead for these positions in 1992 are, respectively, $15, $15 and $12. A sum of approximately $5,000 per year should be set aside for a site check, marketing materials, development and distribution.

IRRIGATION EFFICIENCY AUDITS AND RETROFIT

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- All Sectors

Description

Existing single family, multifamily and commercial building owners with high summer water use (the top 50 percent water users) would be offered an irrigation system audit to determine water use efficiency of the existing sprinkler system. Sections of the system which irrigate shrubs and trees are also tested to check their ability to function properly. Irrigation maintenance, placement, and scheduling by such methods as a lawn watering schedule offers easy techniques to permit application of accurate irrigation amounts throughout the year. Additional flyers describing the causes and cures of maintenance problems in residential irrigation systems may be distributed at the same time.

One of the key areas of this audit is establishing the correct watering rate. Using various techniques, an auditor measures the precipitation rate of the sprinkler system and uses locally-provided information to determine minutes of watering time for the three main irrigation periods of the year (spring, summer, fall). This technique is useful for both permanent in-ground systems with automatic controllers, as well as for homeowners using hose-end sprinkler heads.

Include a computer generated determination of efficiency to see if the sprinkler heads need to be changed or adjusted. The auditor can change or adjust heads on-site.

Implementation Method

- Audit Program
  - Target existing high water use customers. Mail lawn watering schedules (to encourage self-audits) and offer a free audit to owners of existing homes who have summer water use in the top 50 percent of all accounts.

Water Use and Savings

The water savings from an irrigation audit of this type is estimated to be 15 percent of exterior household use. This estimate is based on a number of studies[9-14]. The highest savings quoted was 25 percent[15]. There are no water savings data for mailings of lawn watering guides or other similar literature, so no savings are assumed. Experience has shown that 20 percent of the homes contacted (top 50 percent) will agree to having an audit performed.

Direct Cost and Lifetime

No costs are assigned to the customer for this measure.

Irrigation maintenance and testing equipment will cost approximately $50 per kit. The kit would consist of washers, pliers, screwdrivers, pressure gauge, catchment cups and stands, etc. The cost of the field audit for retrofit parts or rebates will be about $30 per home audited and $90 per commercial site. The value of these devices will be advertized as a program incentive. Five auditors can be hired and trained each year at an hourly cost of eight dollars. Total cost for labor would be $7,000 per auditor for a five month employment, since demand for these audits is typically greatest during the summer. About 320 appointments per auditor can be made during the months from May to September.

All homes targeted for an audit will receive water saving literature, including a lawn watering schedule. The COA currently sends out schedules each June at a cost of $0.03/schedule. If a redesign of the schedule is required, the cost may increase slightly. Promotional costs will add up to about $10,000 for the single family sector, $8,500 for the multi-family sector, and $8,500 for each non residential sector per year.

A water savings lifetime of 10 years is assumed for this program. The COA will mail each participant a yearly follow-up letter at the start of the watering season, as a reminder. After five years, the City will offer a repeat audit to participants, to ensure the program's efficacy over the complete lifetime.

NEW XERISCAPE INCENTIVE

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- Residential, Commercial, Public

Description

This program is aimed at reducing the amount of high-water consuming landscape area. Alternatives include low-water use turf and low-water using plants and shrubs, as well as patios, decks, and walkways. Offer developers and/or builders a rebate for every new house that they sell, that has incorporated landscapes which use Xeriscape principles. Offer rebates for using water-conserving grass species in new residential construction. Home builders/developers could have model houses showing traditional and Xeriscape landscapes. Potential buyers will be informed of the benefits obtained from using Xeriscape principles.

Low water use landscaping includes a water efficient turf such as:

- 609 Buffalo Grass
- Prairie Buffalo Grass

Implementation Method

Under this program, a rebate is paid to those who use water-efficient landscaping in lieu of traditional landscaping around new homes. Set up, administer, and advertise rebates for the installation of low-water use landscaping in place of heavy-water using turf. The City will review plans and certify if plans meet the City of Austin (COA) Xeriscape requirements. The COA will develop a point system to determine if a landscape is a Xeriscape.

The City of Austin recently surveyed new home landscapes and found that only 11 percent had incorporated Xeriscape principles. Of the homes surveyed that did exhibit some degree of Xeriscape, none were appraised at less than $150,000.

Water Use and Savings

As mentioned earlier, the water savings from replacing high water using turf with low-water use landscaping (Xeriscape) has been shown to be about 20 to 50 percent of what is used for highly maintained St. Augustine lawns. For the purpose of this report, a savings of 30 percent is assumed for those areas that are using St. Augustine lawns and are not heavily shaded. The 30 percent savings is applied against the exterior water use for only those areas that will Xeriscape.

Direct Cost and Lifetime

The net customer cost of this measure is the difference between the cost of a traditional landscape and a Xeriscape landscape. From this cost, the rebate amount of $0.03 per square foot, up to $150 for single family customers and others at $0.03 per square foot times the turf area replaced will be subtracted. There will be no additional customer costs for labor, since he or she would have to landscape the same area regardless. Annual maintenance was considered to be the same as conventional landscapes. The lifetime of a landscape depends upon the wishes of the homeowner, but is considered to be at least 20 years.

Costs to the City include the amount of the rebate, plus the administration costs. A total of $11,000 is used to set up the program and $4,000 per year will be allocated for promotional costs. The rebate cost is assumed to be $0.03 per square foot of area landscaped, up to a maximum rebate of $150. Quarter-time assistance from a landscape architect, as well as a full time conservation associate and a quarter-time administrative clerk, will be required to run the program, assuming 1,000 participants. Additional staff will be needed if participation exceeds 1,000 homes in one year.

LARGE LANDSCAPE IRRIGATION AUDITS AND RETROFIT

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- Existing and New Multifamily Residential, Commercial/Public, Industrial

Description

An irrigation audit is conducted by water utility representatives or consultants. Only sites larger than one acre (which represents a demand of up to 10 mgd in the summer) are considered applicable for this program. Auditors perform an on-site audit of the irrigation system and produce customized irrigation schedules for each site, based on procedures, software, and training handbooks developed by such agencies as the Texas A&M University and California Department of Water Resources for the Landscape Water Management Program[6].

Program implementation would entail:

- Site selection and determination of site specific data
- Determination of priority of sites, based on irrigated acreage and past water use.
- Direct mail of audit program letter and commercial irrigation guides.
- Audits performed by an agency representative which produce a customized schedule for the building owner or landscape manager.
- Continued support of the program by providing weather information for updated schedules, seminars on topical issues, and a follow-up campaign.

The objective is to provide landscape managers with information to enable them to perform timely equipment maintenance and to apply accurate irrigation amounts throughout the year based on explicit customized reports. During the audit process, brochures describing the causes and cures of maintenance and management problems in large turf irrigation systems should be included with the agency's irrigation guide.

Implementation Method

- Information Program
  - Promote on-site irrigation audit by utility representatives to assess landscape water conservation opportunities.
  - Provide follow-up to maintain savings.

Water Use and Savings

The long-term average water savings from using irrigation audits is estimated to be 15 percent of irrigation water use. This assumes that periodic follow-up is provided. This savings estimate is based on California Best Management Practices[10]. Applicable turf area in Austin was extracted from land use information compiled for the City's NPDES Stormwater permit (applies to all turf areas greater than one acre). Theoretically, there could be overlap with the other commercial/industrial audit programs which also involve irrigation audits, however, most large landscapes are associated with public areas and the commercial/industrial programs focus on interior water use.

Direct Cost and Lifetime

Audit equipment costs are negligible as the COA already has this equipment. The kit consists of a pressure gage, catchment cups and stands, etc. For each 1,000 participants a part-time (1/8)

landscape architect will be use on this program. It is also suggested that four auditors be trained and deployed for auditing each year. The cost of training, sponsored by the City, will be a one time cost of $6,300. Cost of a delivered landscape water audit will vary depending on the size of the turf and complexity of the irrigation system[6]. Audit costs will be lower for large and uniform sites such as playing fields and higher for disaggregated and complex sites such as a low-rise condominium. However, in the latter case, standard Irrigation Efficiency Audits may initially be low and system improvements may yield savings large enough to offset the higher cost of performing the audit. An audit cost for materials of approximately $690 per site is assumed[10]. Each auditor should be able to conduct about 40 audits of large turf areas each summer.

Ongoing costs for this program are annual follow-up calls or visits by the auditor, which are recommended. The estimated cost of follow-up contacts is $100 per site per year. An annual cost of $2,000 for the public sector, $4,000 for the commercial sector, $2,000 for the industrial sector, and $2,000 for the multi-family sector is needed for promotions and marketing. A water savings lifetime of 20 years is assumed for this measure. Rebates are not recommended for this program because water bill savings and the free audit should be ample incentive to encourage participation.

RESIDENTIAL HOME WATER AUDITS AND RETROFIT

Objective

- Conservation and Peak Reduction

Applicable Sectors

- Existing Residential

Description

Free indoor/outdoor water audits are offered to existing residential customers. The City will contact 25 percent of the users who use the highest percent of the water (per dwelling unit) and suggest that they obtain an audit. The audit will include:

- Check water flows of faucets, showers, and toilets.
- Perform leak detection test on all toilets. In recent studies in the Austin area 14 percent of the toilets were found to be leaking. Of these leaks, 76 percent were from the flapper valve and 24 percent were from the overflow pipe.
- Install toilet dam, if applicable, to reduce toilet flush volume.
- Install faucet aerators and low-water use showerheads
- Check domestic meter for determination if domestic leaks exist.
- Evaluate the benefits of installing a 1.6 gpf toilet and whether customer is eligible for rebate. Provide necessary forms to obtain rebate.
- Conduct audit of irrigation system and develop irrigation schedule.
- Advise the customer on the benefits of low water use landscaping.

Implementation Method

- Information Program
  - Evaluate utility bills and find 25 percent of the customers with the highest percent of water use (on a per dwelling unit basis). Mail these customers a letter with an offer of a free water audit. Schedule an audit for those customers that respond to the letter. Provide telephone follow- up for customers who do not respond to the letter and offer free audits.

Water Use and Savings

The water savings from using audits is estimated based on California Best Management Practices[10].

- Retrofit of homes saves 8 gcd including a low flow showerhead and leak repair. No long-term savings for the toilet dam are assumed. Not all homes will achieve savings since about 50 percent of existing homes have already received the retrofit through various earlier kit distribution programs.
- Water savings from retrofit of 1.6 gpf toilets is provided for in the toilet replacement program.
- The outdoor water audit will save an average of 10 percent of exterior water use for the audited homes.

Experience has shown that 20 percent of the homes contacted (top 25 percent) will agree to having an audit.

Direct Cost and Lifetime

The customer will incur no expenses (the purchase of a ULF toilet is covered under another program).

A lump sum will not be required to get the program started, as the COA already has begun audits. Approximately $10,000 per year should be set aside for marketing materials, development, and distribution. This is low, since the City already has some of its own promotional material developed such as the "Home Leak Detection Kit." The audits will cost about $40 per audit if done in-house. This includes labor and materials. In either case, the program will involve a part-time (1/8) landscape architect per 1,000 participants and about four to six auditors. The existing staff of auditors will be used. Each auditor can audit about four homes per day.

A lifetime savings of 10 years is assumed for this audit program. After five years, the message will not be as strong and new information should be provided to the customers in order to maintain savings and the audit repeated.

COMMERCIAL/INDUSTRIAL AUDITS AND RETROFIT

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- Existing and New Commercial/Industrial

Description

This measure is applicable to: 1) the top 500 water using accounts (20 percent of the commercial/industrial water use) in Austin, exclusive of large manufacturers, which is covered by another measure.and 2) restaurants, large apartment complexes, bars/nightclubs, office buildings, hotels/motels, laundries, small office buildings, and other accounts with significant water use. A water use of at least 1,000 gpd is considered significant.

An interior and landscape audit would be conducted by COA staff. They perform an on-site interior/exterior audit of the irrigation system and produce a customized report that describes fixture inspections, leak tests, cooling tower operation and irrigation inspections for each site. The report includes a spreadsheet that compares the existing facility operations with conservation standards and potentials. The participant's actions and water use is tracked over time. Standards are based on previous experience. A rebate based on amount of water saved could be made available. A maximum rebate of $100 per audit is suggested. Toilet rebates are addressed in a separate toilet rebate program.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff or a consultant, will identify state-of-the-art improvements in process and cooling water use and landscape design and irrigation systems. This review will also be available to existing customers.

Implementation Method

- Information Program
  - Promote on-site audit or plan review by utility representatives to assess water conservation opportunities. The types of customers included in this program would be the University of Texas, state buildings, the largest hotels, etc.
  - Promote successful case-studies already in place to motivate other similar industries.
- Incentive Program
  - To stimulate interest, a rebate will be provided to the customer, based on the amount of water saved. The rebate amount needs to be calculated based on 1,000 gallons per day savings.

Water Use and Savings

The water savings from audits is estimated based on California Best Management Practices[10]. A 15 percent overall water savings is assumed for audited sites. It is assumed that the top 500 commercial/industrial water users would be covered by this program.

Direct Cost and Lifetime

The cost to customers being audited will range from $0 to almost any amount, depending on the level of complexity of the audited site. A study performed in San Jose, California[18] of 15 large commercial/industrial customers showed that implemented water conservation practices cost about $100,000 per customer.

Based on the estimated cost of low flow toilets, ozone generators and conversion of water cooled to air cooled machines, a rough cost estimate of $674 per customer is used. Rebates averaging $300 would be offered.

For the purposes of this report, a City cost of $1,400 per existing site ($600 for exterior and $800 for interior) and $500 for a site plan check is assumed. These values reflect the costs the existing City staff has in carrying out these audits as well as a one-quarter time staff person to administer the program per 1,000 participants. It is estimated that 60 audits per year can be performed by one auditor. Appropriate follow-up will be provided by City staff to ensure that the audit savings are permanent. Annual training and marketing costs will be $20,000.

MANUFACTURING AUDITS AND REBATE

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- Existing and New Industrial Manufacturers

Description

The largest manufacturers in Austin would be offered assistance with process, cooling, and landscape water use reduction.

Existing customers would be offered an interior and landscape audit by water agency provided specialists. Auditors would work with on-site engineers to audit process, cooling and irrigation systems and produce a customized report that describes fixture inspections, process modifications, leak tests, landscaping and irrigation for each site. The participant's actions and water use is tracked over time.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff, will identify state-of-the-art improvements in process and cooling water use and landscaping and irrigation systems. A review will also be available for existing customers. To stimulate interest, a rebate of up to $3,000 will be made available per customer. The amount can be adjusted upwards and/or expressed on a dollar per gallons per day saved basis if needed to stimulate interest.

Implementation Method

- Information Program

- Promote on-site audit by water agency representatives to assess water conservation opportunities.
- Promote successful case-studies already in place to motivate other similar industries.

Water Use and Savings

The water savings from audits are estimated based on California Best Management Practices[1]. It is assumed that this measure only applies to 100 sites within Austin (drawn from the list of the top 500 water users). It is assumed that the audit savings will average 15 percent.

Direct Cost and Lifetime

Cost to the customer being audited will range from $0 to almost any amount depending on the level of complexity. A study performed in San Jose, California[16] of 15 commercial/industrial customers showed that implemented water conservation practices cost about $100,000 per customer is used. Based on conservation projects in Austin a rough cost estimate of $50,000 per customer is used.

For this report, a City cost of $6,000 is assumed for an existing site and $2,000 for a plan review for a new site. Rebates of up to $3,000 will be provided. In addition, the City already has a one-sixteenth time staff person to administer the program and provide appropriate follow-up. Six audits will be conducted per year. Annual training and marketing costs are estimated to be $2,000.

INTERIOR CITY BUILDING RETROFIT

Objective

- Conservation

Applicable Sectors

- Existing Municipal Buildings

Description

Considering that there are about 11,000 City employees flushing toilets between two and three times per day, substantial savings can be realized by decreasing the volume per flush. This water conservation program would put up a matching share of about 50 percent of the cost for retrofitting toilets with ultra low-flow models. Ultra-low-flush (ULF) toilets use special designs to reduce water used for toilet flushing to about 1.6 gallons per flush, down from an average of 4.25 gallons per flush in a non ULF toilet. Two main types of tank-type, ultra-low-flush toilets are currently available[1]. The first type retains the gravity flush concept, operating very efficiently because of improvements in design. Toilets with this design typically use 1.6 gpf. A second category eliminates the gravity flush concept. One model of this type features a pressurized flush tank, in which water is forced into the bowl using pressure from the water system. In addition, there are now several models of 1.6 flush valve toilets and 1.0 gpf urinals.

Implementation Methods

- Information Program

- Promote interior audits.

Water Use and Savings

As part of a study by Mr. Tom Konen with the Stevens Institute of Technology[17], data on frequency of flushes and water use in toilets was collected from office buildings in New Jersey. These groups were monitored for one week. Based on the data collected, an average flush rate of 1.6 flushes for toilets per male employee per day and 3.7 flushes per female per day was estimated. The data was then normalized for a seven day week by multiplying by 5/7. Combining this information with gallons per flush results yielded the following water use per employee:

Type	Gallons per Flush	Water Use Per Employee/Day
Non-ULF Toilet	4.25	8.05
Ultra Low-Flush	1.6	3.03

The default value for water use by ultra low-flush toilets is 3.03 gallons per employee per day (ged), based on a toilet that uses 1.6 gallons per flush. Savings values were increased by a constant of 1.095 to account for walk-in traffic in the buildings. This multiplier was determined based on a study done in San Jose, California[18].

Based upon information from the California Best Management Practices, the interior audit and subsequent retrofits should save an average of 5 ged[18].

Direct Cost and Lifetime

An estimate of the capital cost, installation cost, and lifetime was obtained by contacting manufacturers, consultants, and/or vendors of this measure. The retail cost of ultra-low-flush toilets is $100 for tank-type toilets and $160 for flush valve and commode[19]. The installation cost per toilet is $20 (30 minutes x $40/hour). A life expectancy of 20 years is expected for the toilets[19]. The customer cost would be reduced with a $120 contribution from the water conservation program.

Costs for the program would include a part-time auditor, $120 rebates and a $2,000 administration cost per year.

1.6 GPF TOILET REPLACEMENT

Objective

- Conservation

Applicable Sectors

- Existing Residential

Description

Ultra-low-flush toilets use special designs to reduce water used for toilet flushing to about 1.6 gallons per flush, down from an average of 4.25 gpf for non-ULF toilets. Two main types of ultra-low-flush toilets are currently available[16]. The first type retains the gravity flush concept,

operating very efficiently because of improvements in design. A second category eliminates the gravity flush concept. One model of this type features a pressurized flush tank, in which water is forced into the bowl using pressure from the water system.

This program, initially restricted to residential dwellings, will have an overall goal to replace approximately 60 percent of existing residential toilets with ultra-low-flow toilets by the year 2000. This rate amounts to about 6 percent per year. Between 4,500 and 5,000 1.6 gpf toilets have already been purchased in the Austin area. Currently, all new construction and remodeling requiring a plumbing permit must install 1.6 gpf toilets. The natural replacement rate due to voluntary remodeling is estimated to be 2-3 percent per year. Therefore, to achieve this goal, the City's promotion program needs to generate an additional 4 percent replacement per year. There are approximately 379,000 residential toilets in Austin, assuming 1.7 toilets per residential unit. The residential goal of this program amounts to 4 percent of 379,000 toilets per year or a goal of replacing approximately 15,700 toilets per year.

Implementation Method

- Toilet Rebate Program
  - Provide rebate to building owners who replace toilet with 1.6 gpf model. No rebates will be provided for new construction or with building permit.
  - Rebates of completed or ongoing programs range from $50-100. For the level of replacement that Austin desires, the recommended rebate amount is $75 in order to stimulate acceptance.
  - Verification of installation can be handled by City staff or contractors.

Water Use and Savings

Toilet replacement programs in the Cities of Los Angeles and Santa Monica recently have been evaluated by Metropolitan Water District of Southern California. The range in water savings was 30 to 45 gallons per day per retrofitted toilet.[20] The resulting per capita water savings was 15 gcd.

Market penetration for each of the plans is estimated as follows:

- Natural replacement rate of toilets (in addition to promotion program) = 2-3%/year
- Toilet Rebate = 4-5 percent/year

The total replacement rate is the plan rate plus the natural rate.

Direct Cost and Lifetime

An estimate of the capital cost, installation cost, operations and maintenance (O&M) cost, and lifetime was obtained by contacting manufacturers, consultants, and/or vendors of this measure. The retail cost of ultra-low-flush toilets is $100[21]. The installation cost is $40 (1 hour x $40/hour). A life expectancy of 30 years is expected for the toilets[22]. A cost of $194,000 per year is used for marketing. Incentive of $75/unit would total $1,180,000 per year.

Costs to the City would be as follows.

Program Type	Cost on a Per Toilet Basis					Staff Requirements	
	Payment/ Toilet	Insp.	Outreach	Admin.	Total Cost	Implementation	Administration
Rebate	$75	$7	$12	$4	$98	1 full-time	1 full-time 1 part-time

SCHOOL EDUCATION

Objective

- Conservation

Applicable Sectors

- Existing and New Retail Water Customers

Description

School education serves to educate our future water users in the efficient use of their resources. Education will help children know where water comes from, how it is used, and ways to conserve.

Implementation Method

This program is an expansion of the present program, targeted at children in the first through fourth grade at the 64 public and over 20 private schools in the Austin Independent School District and other school districts in the Austin Water Service Area. The City has a school education program featuring "Dowser Dan". The expansion is a school assembly program patterned after similar programs in the cities of Phoenix and Seattle. The objective is to train future generations to be water wise and receptive to other City conservation programs when the children reach adulthood and become homeowners and water customers.

Water Use and Savings

There is no published data to estimate water savings from these types of programs. They are viewed as necessary to tie all other programs together and are usually done as an overall part of a public education program.

Direct Cost and Lifetime

The current cost of the City's school education program is $25,000 in its first year. This includes the contract cost of the school assembly program and printing newsletters.

SHARED SAVINGS FOR MANUFACTURERS, OFFICES, APARTMENTS AND INDUSTRIAL

Objective

- Conservation and peak reduction

Applicable Sectors

- Existing Multifamily, Commercial, Public, Industrial

Description

Provide framework and possible training for contractors to offer shared savings programs to multifamily developments, office buildings, schools, and industrial buildings. Contractors would identify potential sites, such as a high school, contact the owner (school district), arrange for a preliminary audit, possibly do a pilot study, develop a proposal for a complete retrofit and arrange for third party financing. Private investors would lend the money to building owners, following a favorable preliminary audit and feasibility study. Contractors, building owners, and investors would share the savings based upon a prearranged formula. The loan would be repaid by the water and wastewater bill savings generated by the installation of water saving equipment.

Implementation Method

- City would promote the concept to the business community and to large water customers (possibly in conjunction with another City audit program).
- Contractors would make the primary contacts, perform the preliminary audits, do pilot studies, arrange financing, and install the recommended water saving equipment.

Water Use and Savings

This program has worked in the Washington, DC area with apartment buildings[23] and in the Los Angeles area with school districts.[24] Savings in the range of 20-30 percent are attractive to third party financing and have been shown to be achievable. The contractor will take a percentage of the savings for a specified number of years. The number of buildings that are applicable for this measure needs to be researched for Austin.

Direct Cost and Lifetime

The cost to the customer is zero. The one exception to this is if the City asks the contractor to train its own staff. The cost to the City will be a small amount of money used for promotion which existing staff can handle.

COMMERCIAL LANDSCAPE ORDINANCE

Objective

- Conservation
- Peak Reduction

Applicable Sectors

- New Multifamily/Commercial/Industrial

Description

The existing Commercial Landscape Ordinance would be amended to reflect a Xeriscape approach to current requirements. The ordinance would be written to require efficient irrigation systems (e.g. auto rain shut-off devices), give credit for xeric plants, etc. Xeriscape landscaping reduces the amount of water that needs to be applied to turf grass and other plantings such as shrubs and trees. This type of landscaping is typically more drought tolerant than standard landscaping. Low-water use landscaping includes a water efficient turf such as:

- 609 Buffalo Grass
- Prairie Buffalo Grass

The City staff will provide information on the best landscape turf and plantings to use and how to install the turf and plantings. Generally, the user should ensure that soil conditions are favorable for growth, and the appropriate watering schedule for the age and type of turf/plantings and weather conditions must be adhered to.

Implementation Method

- Landscape Ordinance
  - Set limits on amount and type of landscaping to use.
  - Develop an ordinance similar to Article III Landscaping ordinance and specify similar procedures, such as requiring information in accordance with the Administrative Manual and the Environmental Criteria Manual and inspections by the Environmental and Conservation Services Department prior to the issuance of the Certificate of Occupancy.

Water Use and Savings

The water savings from using Xeriscape techniques has been shown to be about 20 to 50 percent of what is used for highly maintained St. Augustine lawns. For the purpose of this report, a savings of 30 percent is assumed for those areas that are using St. Augustine lawns and are not heavily shaded. The 30 percent savings is applied against the exterior water use for only those areas that will Xeriscape.

There is very little experience on how much of the theoretical potential savings can be achieved with an ordinance. This type of program is similar to one used as a best management practice in California. The assumed savings for that program is 30 percent reduction in the outdoor use for new development. It will apply to all new landscaped areas, i.e., it will affect 100 percent of the new exterior water use in these sectors with the exception of the Central Business District, which is exempt under the current landscape ordinance.

Direct Cost and Lifetime

Since this measure applies to new customers, no additional costs are assumed for using Xeriscape as opposed to traditional landscaping for the customer. Annual maintenance was also considered to be the same as for conventional landscaping. The lifetime of a landscape varies, but is assumed to be at least 20 years.

The cost to the City to implement the ordinance, including plan checking and field inspection, since this is a modification of an existing program, is equivalent to a landscape architect (one-eighth

time) per each 1,000 participants. A lump sum of $10,000 is required to set up the measure and administer it in the first year.

WATER AWARENESS ORDINANCE

Objective

- Conservation

Applicable Sectors

- Existing and New Retail Water Customers

Description

This program is targeted at residential, commercial, and industrial customers which irrigate; restaurants and institutions which have water-cooled icemakers; medical offices that have water-cooled x-ray machines; and commercial and industrial customers that have cooling towers.

An ordinance would be adopted by the City which would make it illegal to do the following;

- Irrigate between the hours of 10 AM to 7 PM from May 1 to October 1 of each year, except for newly installed landscapes.
- Irrigate more frequently than once every five days between May 1 and October 1.
- Allow water to flow into the street from irrigation, broken sprinkler heads, or leaking water lines or faucets.
- Fail to repair leaks within three days.

New facilities would be prohibited from the following:

- Discharging more than 5 gallons per ton per hour of condensor waste water.
- Operating a car wash that does not recirculate water, except for self-service car wash operations.
- Having water-cooled icemakers, unless the water is recirculated.
- Having water-cooled x-ray machines, unless water is recirculated.

Implementation and Enforcement Method

This program would be regulatory and would require the cooperation of several City departments, including the building and planning departments. Enforcement begins with a friendly, non-threatening contact to inform and progresses to more severe stages. In stage 1, an inspector is dispatched to investigate a violation and discusses methods to solve the violation, if it exists, with the customer. If the problem persists, stage 2 involves issuing a violation warning and a picture is taken of the violation. If the problem remains uncorrected, stage 3 involves issuing a violation order and this is filed with the City prosecutor's office for review and possible prosecution. The last stage, if required, is prosecution.

Water Use and Savings

There is no data on the water savings of this type of an ordinance. Some cities have implemented waste of water ordinances during droughts, but not during normal water years.

Direct Cost and Lifetime

The cost to set up this type of ordinance is estimated to be $10,000. A one eighth-time administrator is required to enforce and maintain the measure per 1,000 participants.

SUBMETERING ORDINANCE

Objective

- Conservation

Applicable Sectors

- New Multifamily and Commercial

Description

This program is targeted at customers installing over one-half acre of landscaping and large residential projects. Revise water service regulations to require individual meters on new apartment units and a separate irrigation meter on large irrigated areas.

Implementation Method

Renters will have an incentive to conserve water because they will be billed for what they use. The City would revise the capital recovery fee and tap fee ordinances.

Water Use and Savings

There is no comparable program to base estimated savings on. The effect upon renters would be similar to the impact of a water price increase. Savings are estimated to be on the order of 5 - 10 percent. The effect on irrigators would depend upon the type of price structure implemented and could be in the same range (5-10 percent).

Direct Cost and Lifetime

There would be considerable expense on the part of developers. Each dwelling unit might cost an additional $200. Irrigation meters would be an extra expense. City costs would involve changing the billing system, revising ordinances and appropriate public education for renters. A one eighth-time administrator will be required per 1,000 participants, as well as a lump sum amount of $10,000 to start the measure.

TOILET FLAPPER REPLACEMENT

Objective

- Conservation

Applicable Sectors

- Existing Residential

Description

Simple replacement of the flapper valve can reduce toilet leaks presently estimated to be 24 gallons per day per leaking toilet.[25] Recent studies in Austin have shown that about 10.5 percent of the toilets will have a leak in the flapper valve assembly[28]. When done on a large scale in apartment buildings with considerable toilet leakage, toilet flapper valve replacement can be an effective way to save water.

This program assumes that the City of Austin will purchase toilet flapper valves in large quantities and distribute them to multifamily building owners who are willing to install them (and single family homeowners who request them). The City will not agree to service toilets with the devices, if problems arise, but will refer the customer to the manufacturer. The City may be liable for any problems arising from flapper malfunctions.

The City also has the option of installing the flapper valves for the customer, but runs the risk of "owning" the toilet mechanism in the eyes of the customer, if anything goes wrong. Other cities, such as Phoenix, have had this experience where they had to respond to calls from customers who had problems with their toilets. This would become an added cost to the City.

The flapper valve industry has traditionally been price driven and not quality driven. The traditional flapper valve is manufactured with low quality and low price rubber and vinyl products. The result is rapid deterioration of the flapper valve once placed in the tank of water closets. Unfortunately, ozone treated or chlorinated water can cause deterioration of the material as soon as two months after installation. Most rubber flapper valves can distort thus allowing water to pass directly through the tank of the water closet at high rates. Vinyl flapper valves react to treated potable water by becoming hard and shrinking in size. As the hardening and shrinking process begins, these flapper valves lose their ability to provide a tight water seal.

Another consideration in the deterioration of flapper valves is the addition of chlorinated water additives in the tank of the water closets by homeowners and tenants in multifamily dwellings. Most flapper valve manufacturers who offer a warranty on the material and workmanship of their product advertise on their packaging that the warranty is voided if such additives are present in the tank.

There are at least two flappers on the market that offer a five-year warranty, even when used in water with chlorinated additives. The manufacturers credit their products' longevity to better composition, but no independent tests of these products have been performed.

Traditional flapper valves are limited as to the percentage of toilet tanks they may fit in a large retrofit program. This is due to a lack of standardization by the water closet manufacturing industry. With a traditional flapper valve, the highest percentage of toilets that could be expected to be retrofitted is about 80 percent. Some manufacturers, however, report a retrofit ability of about 98 percent. The American Water Works Association (AWWA) and the National Wildlife Federation[29] (NWF) are both working toward the development of standards for flapper valves on a national basis.

If material standards, from reputable national organizations, are not available at the time of program implementation, it would be inadvisable for the City to proceed with this program, since the City does not have testing facilities to determine which flappers will actually last five or nine years.

Implementation Method

- Information Program
  - Promote the installation of toilet flapper mechanisms to owners of existing homes and multifamily buildings. Mandate, through amending the plumbing code, the quality of the material creating the water seal in new water closets sold in the City. Only proven materials should be promoted. The City could do a random inspection to verify installation.

Water Use and Savings

Studies performed by PPPI on flapper valves removed from the tanks of water closets in Austin indicate a leakage rate of approximately 24 gal/day/leaking toilet. Assuming 1.4 persons per toilet, then the potential savings are 2.2 gcd. Traditional conservation product giveaway programs have a market penetration (installation rate) of approximately 15 percent, which is assumed for this measure. Savings should be reliable for about 5-6 years, since that is the length of the best warranty.

Direct Cost and Lifetime

An estimate of the capital cost, installation cost, and lifetime was obtained by contacting manufacturers, consultants, and/or vendors of this measure. The retail cost of toilet flush flappers ranges from $2.0 to $5.5[26] Wholesale costs are much lower and the City has received quotes as low as $1.7. The installation will be done by the building property manager at no cost to the City. A life expectancy of five to six years is expected for the flapper valves[27]. It is anticipated that 10 - 15 percent of purchased flappers will be installed by homeowners or property managers. The City will need a quarter-time administrator per 1,000 participants and an annual promotional budget of about $5,000.

REFERENCES

1. American Water Works Association. "Landscapes Show Impressive Savings" John O. Nelson, Journal, March 1987

2. East Bay Municipal Utility District. "Evaluation of EBMUD's Demonstration Garden Projects. Richard E. Bennett, Water Conservation Administrator. April 1987.

3. Bruce K Ferguson, "Water Conservation Methods in Urban Landscape Irrigation: An Exploratory Overview:, Water Resources Bulletin, Vol. 23, No.1, February 1987

4. Personal communication from Steve Smith, Aqua Engineering, December 1991

5. Current estimate for landscape installation labor in Austin, Texas provided by John Gleason, ASLA, City of Austin xeriscape program coordinator.

6. California Department of Water Resources, Office of Water Conservation. "Landscape Water Management Handbook, Version 3.1 September 1987

7. Meyer J.L., V.A. Gibeault. 1986 "Turfgrass Performance Under Reduced Irrigation" California Agriculture Vol 40. Nos. 7 & 8 pp. 19-20

8. Xeriscape "Water Conservation Through Creative Landscape- An Overview of Methods, Activities, and Programs for Reducing Water Consumption in Landscaped Areas" Metro Water Conservation Inc. Monograph Series No. 2 May 1987.

9. Personal letter from John O. Nelson, regarding Marin Country Club Pilot Study, October 4, 1988

10. "Assessment of Water Savings from Best Management Practices, Report prepared for Metropolitan Water District of Southern California, May, 1991.

11. Personal letter from Robert Walker, regarding "Summary of the Desert Water Agency Turf Irrigation Evaluations Conducted by the C.V.R.C.D.'s Mobile Lab 1987-1988", November 14, 1988

12. Personal letter from Ed Murdock, regarding Livermore Parks and Recreation Pilot Study, July 15, 1991

13. Conservation Technologies, Inc. "Residential Water Savings with Improved Irrigation Control - A Sense of Magnitude", Glenn Dobbs, August 1991

14. Lynn Hulme, Virginia Porter, "Large Turf Irrigation Audits - Marin Municipal Water District", Managing Limited Urban Water Supplies, Conference for California Water Agencies Proceedings, Oakland, CA November 1989

15. Sunset Magazine, "How Much Water Does Your Lawn Really Need", ER 520C, June 1987

16. Plumbing Engineer. "High Efficiency Water Closet Analysis" Burton Preston, P.E. June 1987.

17. Konen, T.P. "Water Use in Office Buildings", Plumbing Engineer July/Aug. 1986

18. Brown and Caldwell, "Evaluation of 1988-1989 Commercial Water Conservation Retrofit Program, City of San Jose" February 1990

19. Personal communication with Kohler representative, Brad Kuplic, Aug. 1991 and American Standard representative, C. Yee, Aug. 1991

20. Chestnut, Tom "The Conserving Effect of Ultra Low Flush Toilets" Presentation to Metropolitan Water District of Southern California, December 1991.

21. Correspondence with American Standard

22. Correspondence with Wendy Corpening

23. Brown and Caldwell, "Residential Water Conservation Projects, Summary Report", Prepared for the U.S. Department of Housing and Urban Development, June 1984.

24. Mr. David Horne, Co-Energy Group, personnel communication, March 6, 1992.

25. U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Building Technology Division. "Survey of Water Fixture Use", Brown and Caldwell Consulting Engineers, March 1984.

26. Quotes from Lavelle Industries, July 1992 and Precise Plumbing Products, March 1992

27. Based on correspondence with Tom Babcock, City of Phoenix

28. Based on recent City of Austin survey, March 1992

29. Plumbing & Mechanical, Volume 9, Number 1, March 1992, Jim Olszlynski, "Water Conservation Update: Plumbing In the Age Of Frugality", pages 31-37

SECTION 4

BENEFIT-COST EVALUATION

The benefit-cost evaluation was used to perform an economic comparison of various water conservation measures and to facilitate selection of the most cost-effective measures for implementation so they can be prioritized. This section presents the results of cost-benefit analyses performed on each of the water conservation measures discussed in Section 3. The cost-benefit analyses are based on the water savings and cost data for individual measures presented in Section 3. Additionally, a brief discussion of the economic impacts of water conservation is presented.

NET EFFECT OF CONSERVATION

The benefit-cost evaluation also yields data on net water savings. This is useful in helping the utility planners estimate future demands which may be impacted by water conservation. The distribution of water savings throughout the life of the measures is also presented. Savings are usually minimal in the first year of implementation, and will reach full maturity when the full market penetrations have been achieved. The effects of the water savings on the City are discussed below.

Revenue Reduction and Rate Increase

Implementation of conservation will result in less water use and thus, fewer revenues. Since revenues normally equal operating costs and other items such as retirement of debt for past projects or reserves for future projects, either rates will have to be raised or operating costs and reserves will have to be reduced. However, since the plan will be implemented over 10 years, the yearly decrease in revenues is expected to be insignificant in comparison to overall system revenues. Generally, through water conservation, operating costs will decrease and allocation of funds for future projects can be delayed or downsized, if the expected savings are large enough.

Implementation Costs and Rate Increase

Implementation and operation of a conservation program increases operating costs. As discussed above, either the operating costs will have to be decreased or rates will have to be raised to accommodate this increase. Since funding for the conservation program is currently less than 0.25 percent of water and wastewater revenues and would only increase slightly as this plan is implemented, any rate increases would be very small.

Water Conservation Savings and Rate Decrease

Water conservation programs will also cause operating costs for water distribution pumping and treatment chemicals to decrease, thus lowering operating expenses.

Control of Escalating O&M Costs and Retrofit of Old Facilities

Water rates have a historical tendency to increase, even if demands remain constant. They increase to accommodate increasing operating and maintenance expenses, as well as the retrofit of old facilities. Water conservation has a tendency to attenuate these increases and will sometimes counterbalance these cost increases entirely so that no net increase in operating cost is incurred.

Control of Annual Growth in Demand and Need for New Facilities

Water rates will also have a historical tendency to increase in order to accommodate growth and the need for financing of new facilities. Examples exist of cities that have grown while water conservation kept the demand relatively constant so that no net gain in consumption was realized. Thus, water conservation can also serve to postpone or reduce the need for capital projects.

Compare Water Conservation Expenditures to Other Uses for Money

Lastly, the net dollars either lost or gained through water conservation should be compared to other alternatives such as traditional water storage options, water transfers, etc. It is through this comparison that the planner can be assured that funds spent on water conservation are put to the best possible use.

PRELIMINARY MEASURE EVALUATION

A preliminary review and screening of applicable measures was presented in Section 3 and 11 measures were selected for further evaluation. Cost-benefit analyses were performed on measures where water savings and market penetration and cost data were available.

Use of WaterPlan Version 2.0 Computer Program

The benefit-cost evaluation was conducted using WaterPlan Version 2.0 software. MW assisted in the development of the database for this software and used the new version to generate benefits and costs of water conservation. The software allows the user to model individual water conservation measures, as well as complete water conservation programs consisting of multiple measures.

Input Data

Input data into the benefit-cost analysis software includes:

- Unit water use data (presented in Section 2)
- Demographic data (presented in Section 2)
- Unit water savings (presented in Section 3)
- Market penetration expectations (presented in Section 3)
- Cost of service (presented in this section)

A summary of the market penetration, unit water savings, and unit cost data is provided below.

Market Penetration

The market penetration is based on measure design, input from the City, and experience from similar measures implemented by other water utilities.

Existing Market. The market penetration for existing customers indicates the number of customers that will be participating in the measure after the program has been concluded. For example, if there are approximately 75,000 existing customers when the Irrigation Efficiency measure is started in 1992 and the ultimate penetration rate of the measure of 8 percent will be reached in the year 1996, then (assuming a linear increase) by the year 1993, a two percent penetration is achieved; by the year 1994, a 4 percent penetration has been achieved; by the year

1995, a 6 percent penetration has been achieved; and by the final year, 1996, the penetration of 8 percent has been achieved. This would correspond to 1,500 dwellings in 1993, 3,000 dwellings in 1994, and so on.

Table 4-1 illustrates the predicted ultimate market penetration when the measure's implementation is complete. The column titled "Applicable Market" in the table indicates those customers who possibly could be impacted by the measure. For example, since about 65 percent of the existing customers do not already have a Xeriscape-style lawn or have no lawn at all, they represent the applicable market for the Landscape Retrofit measure. The column titled "Target Market" in the table indicates those customers that the City would like to target. Referring again to the Landscape Retrofit measure, the City would like to target the five percent of the customers who relandscape their lawns. The column titled "Acceptance Rate" indicates the prediction of those customers who will initially consent to participate in the measure. It is anticipated that of the five percent of the customers who relandscape, 30 percent will agree to put in a Xeriscape-style lawn. The acceptance rate has also been reduced to account for only those customers who are not already participating in the measure based on previous water conservation programs implemented by the City.

New Markets

The market penetration for new customers indicates the number of new customers that will participate in the measure each year. For example, if there are approximately 1,300 new customers in 1992 and 1,400 new customers in 1993, then, if the annual penetration rate of the new Xeriscape measure is 22 percent, 286 of the new dwellings will be reached in 1992 and 308 of the new dwellings will be reached in 1993. Table 4-2 illustrates the predicted market penetration for each year of the program. Values in the "Total Market" column were used in the cost-benefit analyses to determine the total number of new customers participating in measures targeted at new markets.

Market penetrations are predictions based on previous experience and the methods used to implement the measure, and effort and costs allocated to the measure. The error in measure market penetration can be significant, but can be corrected as the implementation of the measure progresses. For example, if a certain market penetration is required to achieve the needed savings, then if the market penetration is more or less than predicted, adjustments to the implementation efforts should change. Perhaps more promotions or larger rebates are required to increase the market penetration. If the market penetration is too high and savings more than required, perhaps less promotion is needed. The process is iterative to reflect actual conditions and helps to assure that the market penetration and needed savings are achieved regardless of future variances between estimates and actual conditions.

TABLE 4-1

MARKET PENETRATION OF EXPANDED PROGRAM FOR EXISTING CUSTOMERS, PERCENT

Measure	Customer Categories	Applicable Market	Target Market	Acceptance Rate	Total Market
Landscape Retrofit	Res, Cmml, Pub, Ind	65	5	30	1
Irrigation Efficiency Audits and Retrofit	All Sectors	80	50	20	8
New Xeriscape Incentive	Res, Cmml	80	100	10	8
Large Landscape Irrigation Audits and Retrofit	MF, Cmml, Pub, Ind	10	75	80	6
Residential Home Water Audits/Retrofit	Res	100	25	20	5
Commercial/Industrial Audits and Retrofit	Cmml, Ind	100	20	30	6
Manufacturing Audits and Rebate	Ind	100	30	100	30
City Building Retrofit, Int.	Pub	100	100	75	75
1.6 gpf Toilet Replacement	Res	99	100	60	60
School Education	Retail Water Cust.	100	100	75	75
Shared Savings for MF & Office Apts	MF, Cmml, Pub, Ind	100	100	15	15
Commercial Landscape Ordinance	MF, Cmml, Ind	NA	NA	NA	NA
Water Awareness Ordinance	Retail Water Cust.	100	100	75	75
Metering Ordinance	MF, Cmml	NA	NA	NA	NA
Toilet Flapper Replacement	Res	100	100	15	15

TABLE 4-2

MARKET PENETRATION OF EXPANDED PROGRAM FOR NEW CUSTOMERS, PERCENT

Measure	Applicable Market	Target Market	Acceptance Rate	Total Market
Landscape Retrofit	NA	NA	NA	NA
Irrigation Efficiency Audits	NA	NA	NA	NA
New Xeriscape Incentive	89	100	30	27
Large Landscape Irrigation Audits	15	75	80	9
Residential Home Water Audits	NA	NA	NA	NA
Commercial/Industrial Audits and Rebate	100	3	30	1
Manufacturing Audits and Rebate	100	15	30	5
City Building Retrofit, Int.	NA	NA	NA	NA
1.6 gpf Toilet Replacement	NA	NA	NA	NA
School Education	100	100	75	75
Shared Savings for MF & Office Apts	NA	NA	NA	NA
Commercial Landscape Ordinance	100	100	100	100
Water Awareness Ordinance	100	100	75	75
Metering Ordinance	NA	NA	NA	NA
Toilet Flapper Replacement	NA	NA	NA	NA

Unit Water Savings

Tables 4-1 and 4-2 detail the percent of customers will participate in the measure. For those who participate, one must determine the resultant water savings. The unit water savings for various measures are described in Table 4-3. Unit savings are either expressed on a percentage basis or on a per-capita basis. Initial unit savings are generally less than preliminary estimates, due to device installation and long-term installation or "staying power" of less than 100 percent. These reductions are reflected in the column titled "Long-Term Savings."

Costs To The City

The City will incur costs based on how the measure is implemented. The costs are described in Table 4-4. Costs include annual components plus a one-time set up cost.

Benefits of Saving Water

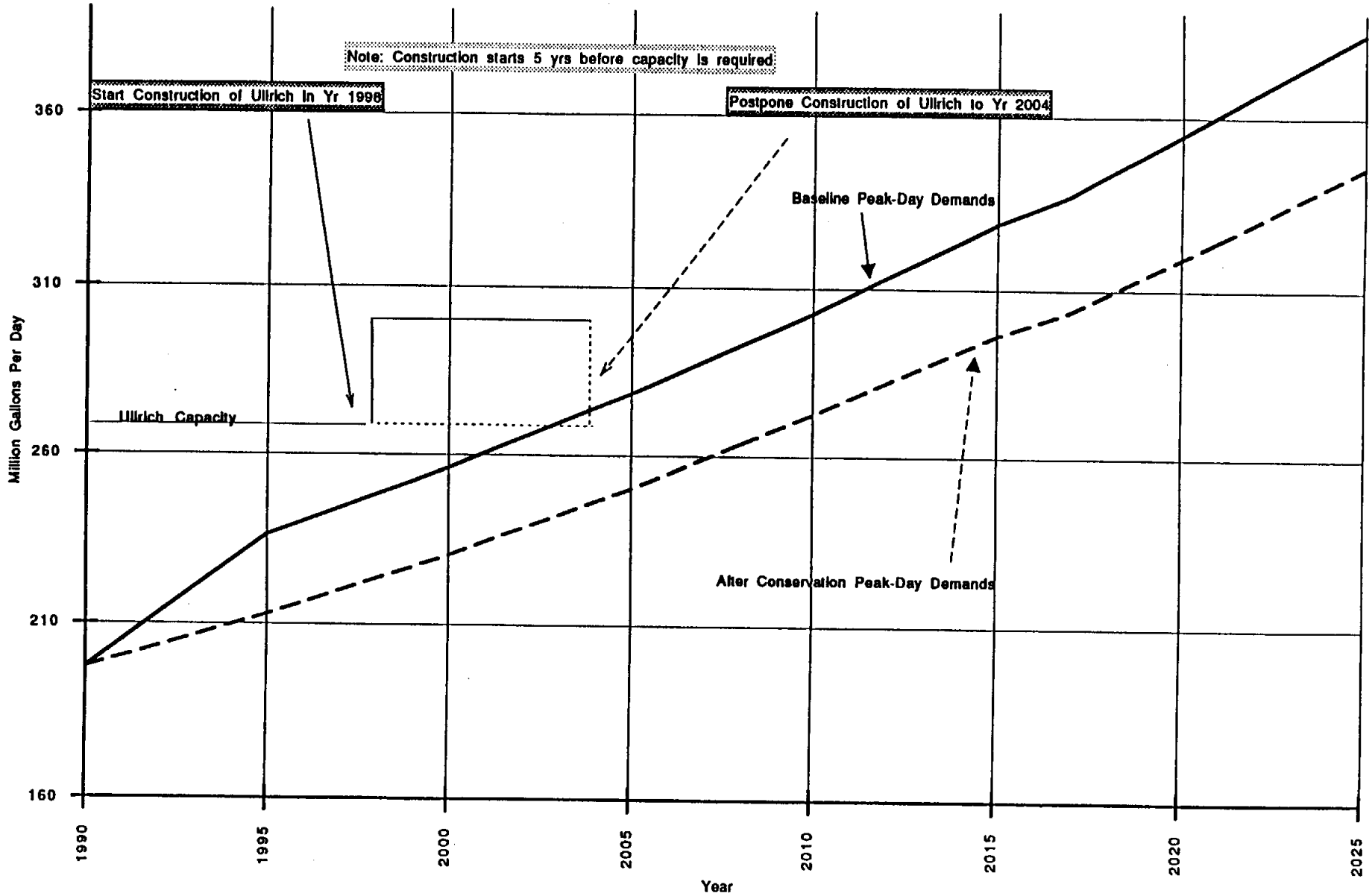
If less water is used, there will be three obvious impacts: 1) reduction in revenues, 2) reduction in some operation and maintenance expenses, and 3) potential cost savings due to downsizing or delaying of capital facilities.

Revenue Reduction. All savings that are achieved by the customers will result in a loss to the City. The goal is to make sure that the long-term revenue loss is less than the long-term gain from reduced operating expenses and deferral or downsizing of capital facilities. The expected revenue losses are discussed in this section under the customer benefits section.

Reduction in O&M Expenses. The City has both fixed and variable operating expenses. The fixed expenses for water treatment in today's dollars are about $42,000 per million gallons per day (mgd) and $83,000 per mgd for wastewater treatment. This is based on a weighted average of the costs experienced at the various water and wastewater treatment plants in the 1991-92 fiscal year.

Based on the same year's data, the variable costs for water treatment in today's dollars is about $0.12 per thousand gallons and $0.23 per thousand gallons for wastewater treatment. When calculating interior savings, benefits are witnessed for water and wastewater, so the variable costs would become $0.35 per thousand gallons.

Deferral or Downsizing of Capital Facilities. If the City could achieve a 10 percent reduction in peak demand, it was estimated that the 40 mgd upgrade of the Ullrich treatment plant and associated facilities could be delayed from an original construction year of 1998 to a delayed construction year of 2004. It is estimated that a volume of about 14,000 million gallons of water must be saved to enable the delay of construction for six years. This is equivalent to an $0.26 per thousand gallons savings from deferral of the capital facilities in 1992 dollars. This assumes a zero inflation rate and three percent real interest rate. To this savings, are added the O&M savings discussed above giving the total savings of $0.88/1000 gallons. This graph is used for illustrative purposes and is considered applicable to the year 2005 only. Appendix C shows the planning level calculations for these values. These savings are illustrated on Figure 4-1.



City of Austin Peak-Day Demand Estimates and Phasing of The Ullrich WTP
Figure 4-1

TABLE 4-3

UNIT WATER SAVINGS RATES

Measure	Long-Term Savings
Landscape Retrofit	30% Ext.[a]
Irrigation Efficiency Audits	15% Ext.
New Xeriscape Incentive	30% Ext.
Large Landscape Irrigation Audits	15% Ext.
Residential Home Water Audits	
Interior	8 gcd[b]
Exterior	10% Ext.
Commercial/ Industrial Audits and Rebate	15%
Manufacturing Audits and Rebate	15%
City Building Retrofit, Int.	5 ged
1.6 gpf Toilet Replacement	15 gcd
School Education	0[d]
Shared Savings for MF & Office Apts	25%
Commercial Landscape Ordinance	30% Ext.
Water Awareness Ordinance	0[d]
Metering Ordinance	10% Ext.
Toilet Flapper Replacement	2.2 gcd

[a] Ext. = Exterior savings
[b] gcd = gallons per capita per day savings
[c] Int. = Interior savings
[d] 0 = No reliable data is available on this measure to allow for proper analyses.
ged = gallons per employee per day

TABLE 4-4

COSTS TO THE CITY

Measure	Total Annual No. of Participants	Average City Cost of Incentives per unit, $	Yearly Cost of Incentives, $	Annual Fixed Costs, $	Annual Variable Cost, $	Total Annual City Cost, $	One Time Lump Sum Set-Up Cost, $
Landscape Retrofit	300	150	45,000	5,000	10,000	60,000	15,000
Irrigation Efficiency Audits and Retrofit	1,300	30	39,000	44,000	83,000	166,000	0
New Xeriscape Incentive	380	150	45,000	4,000	11,000	60,000	11,000
Large Landscape Irrigation Audits and Retrofit	70	0	0	10,000	47,000	57,000	6,000
Residential Home Water Audits and Retrofit	1,400	0	0	10,000	60,000	70,000	0
Commercial/Industrial Audits and Retrofit	200	400	80,000	20,000	292,000	392,000	0
Manufacturing Audits and Rebate	6	3,000	18,000	2,000	36,000	56,000	0
City Building Retrofit, Int.	35	120	16,000	2,000	5,000	23,000	0
1.6 gpf Toilet Replacement[1]	15,600	75	1,180,000	200,000[4]	170,000	1,550,000	5,000
School Education	18,000	0	0	50,000	30,000	80,000	0
Shared Savings for MF & Office Apts	--	0	0	0	0	0	0

TABLE 4-4

COSTS TO THE CITY (Continued)

Measure	Total Annual No. of Participants	Average City Cost of Incentives per unit, $	Yearly Cost of Incentives, $	Annual Fixed Costs, $	Annual Variable Cost, $	Total Annual City Cost,$	One Time Lump Sum Set-Up Cost, $
Commercial Landscape Ordinance	--	0	0	10,000	0	10,000	10,000
Water Awareness Ordinance	--	0	--	10,000	0	10,000	10,000
Metering Ordinance	--	0	--	10,000	0	10,000	10,000
Toilet Flapper Replacement	4,000	0	0	5,000	25,000	30,000	0

1 Costs will vary depending on one of four implementation methods used.
2 Maximum rebate per account.
3 Material costs only.
4 Varies based on funding method employed and discussed in Section 3.

The other capital facility that could be deferred would be the 100 mgd Water Treatment Plant No. 4 and associated facilities. It is assumed that the original construction year of 2017 could be delayed to the year 2025 through a water conservation of 10 percent. It is estimated that a volume of about 25,000 million gallons of water must be saved to enable the delay of construction for eight years. This is equivalent to a $1.30 per thousand gallons savings from deferral of the capital facilities and the inclusion of O&M savings in 1992 dollars. The total benefit for deferring both Ullrich and WTP No. 4 is $2.18 per 1000 gallons.

MEASURE BENEFIT-COSTS

WaterPlan software was used to calculate aggregate water savings, costs, net benefits, and benefit-cost ratios for selected water conservation measures in order to determine the cost-effectiveness of each measure. Initial analyses were performed by Montgomery Watson. The data base was then updated with current 1993 data and the analyses were rerun by the staff of the City of Austin. The calculations and data of this section reflect these updated numbers run by the City.

Water Savings

The projected total water savings associated with the affected market are shown on Table 4-5. Water savings are determined by multiplying the affected market for each measure by the associated per-capita, per-dwelling, or per-acre unit water savings described in Table 4-3. The snapshot of annual and peak savings is given for three specified years: 1995, 2000, and 2005.

Wastewater Savings

Water savings also have the benefit of reducing wastewater flows. Wastewater savings are found from all water savings inside the customer's buildings and are shown in Table 4-6.

Costs

The costs associated with implementing a conservation measure depend upon the measure's design. If the measure requires much labor, rebates, or professional assistance provided to the City, this will increase the City's direct costs while minimizing the customer's direct costs. Conversely, a mandatory measure based on regulations or ordinances will incur lesser costs to the City, but higher direct costs to the customer for implementation. Since all water conservation costs are invariably paid for by the customer (either directly or indirectly through rate increases), it is best to minimize total costs while maximizing total benefits. If the City shoulders most of the costs to implement conservation measures, high water users will pay more than low water users through higher City water bills. Conversely, if the cost burden to implement a measure is largely carried by individual customers, water conservation can cost more for those who already conserve and less for those who do not.

Savings

The total calculated savings come from water savings and wastewater treatment savings. The customers' water savings are the sum of interior and exterior water savings. The interior dollar savings equal the interior water savings associated with each conservation measure times the applicable incremental water and wastewater fees.

TABLE 4-5
WATER SAVINGS FOR EXISTING AND NEW CUSTOMERS, mgd

Measure	1995		2000		2005	
	Avg	Peak	Avg	Peak	Avg	Peak
Landscape Retrofit	.04	.14	.10	.36	.14	.48
Irrigation Efficiency Audit and Retrofit	.46	1.61	1.22	4.29	2.7	4.70
New Xeriscape Incentive	.04	.13	.10	.36	.17	.58
Large Landscape Irrigation Audit and Retrofit	.15	.52	.39	1.37	.63	2.23
Residential Home Audit and Retrofit	.12	.21	.32	1.9	.52	.90
Commercial/ Industrial Audits and Retrofit	.69	1.40	1.86	3.74	2.32	4.67
Manufacturing Audits and Rebate	.43	.63	1.15	1.68	1.29	1.89
City Building Retrofit, Int.	.01	.01	.03	.03	.03	.03
1.6 gpf Toilet Replacement	1.67	1.67	4.47	4.47	7.26	7.26
School Education[1]	NA	NA	NA	NA	NA	NA
Shared Savings for MF & Office Apts[1]	NA	NA	NA	NA	NA	NA
Commercial Landscape Ordinance	0.05	0.09	0.14	0.25	0.23	0.42
Water Awareness Ordinance[1]	NA	NA	NA	NA	NA	NA
Metering Ordinance[1]	NA	NA	NA	NA	NA	NA
Toilet Flapper Replacement	.07	.07	.12	.12	.12	.12
Plumbing Code	.72	.72	1.7	1.7	2.7	2.7

1 Data on water savings not available for this measure.

2 Savings remain at the year 2000 rate even though the measure is no longer actively administered. Indirectly, it will be promoted through the public education efforts, but since diligence may diminish, savings are assumed to remain constant.

TABLE 4-6

WASTEWATER SAVINGS FOR EXISTING AND NEW CUSTOMERS,mgd

Measure	1995	2000	2005
Landscape Retrofit	NA	NA	NA
Irrigation Efficiency Audits[1]	NA	NA	NA
New Home Xeriscape[1]	NA	NA	NA
Large Landscape Irrigation Audits[1]	NA	NA	NA
Residential Home Water Audits	0.08	0.22	0.36
Commercial/Industrial Audits and Rebate	.42	1.11	1.39
Manufacturing Audits and Rebate	.35	.94	1.1
City Building Retrofit, Int.	.012	.03	.03
1.6 gpf Toilet Replacement	1.67	4.47	7.2
School Education[2]	NA	NA	NA
Shared Savings for MF & Office Apts.[2]	NA	NA	NA
Commercial Landscape Ordinance[1]	NA	NA	NA
Water Awareness Ordinance[2]	NA	NA	NA
Metering Ordinance[2]	NA	NA	NA
Toilet Flapper Replacement	.069	.12	.12
Plumbing Code	.72	1.7	2.7

1 Measure generates outdoor water savings only.

2 Data on water savings not available for this measure.

When combining the savings, the savings to the customers are not included since they represent the revenue loss to the City. The net result would be zero. Therefore, only the savings to the City are included in the combined savings. The costs, however, are combined.

Benefit-Cost Ratios

The benefits and costs of each conservation measure can be used to rank the relative merits of the different water conservation measures. Those benefit-cost ratios which are near or above unity serve as economic justification for implementation of the respective water conservation measures. The benefit-cost ratios are shown in Table 4-7. The calculations for these numbers were performed using WaterPlan Software. Engineer's calculation for a sample evaluation are contained in Appendix D to help the user determine how calculations were made. Based on the cost and water savings, data presented in the following water conservation measures exhibited benefit-cost ratios greater than 1.0 from the City's perspective:

- Landscape Retrofit
- Irrigation Efficiency Audits
- New Xeriscape Incentive
- Large Landscape Irrigation Audits/Retrofit
- Residential Home Water Audits/Retrofit
- Commercial/Industrial Audits and Rebate
- Manufacturing Audits and Rebate
- City Building Retrofit (interior)
- 1.6 gpf Toilet Replacement
- Commercial Landscape Ordinance

The benefit-cost ratios above reflect the results of a test which incorporates the benefits and costs to the City. In cases where the City's benefit/cost ratios are much higher than the participant's benefit/cost ratios, the City could add or increase incentives (rebates) as needed to achieve desired market penetration.

TABLE 4-7
BENEFIT-COST RATIOS

Measure	Participant Benefit/Cost Ratio	City Benefit/Cost Ratio[1]	Total Resources Benefit/Cost Ratio
Landscape Retrofit	0.29	2.68	0.28
Irrigation Efficiency Audits	7.99	6.40	4.58
New Xeriscape Incentive	2.11	1.98	1.52
Large Landscape Irrigation Audits/ Retrofit	20.35	7.87	6.12
Residential Home Water Audits/ Retrofit	NA	13.65	13.65
Commercial/ Industrial Audits and Rebate	13.71	4.57	1.07
Manufacturing Audits and Rebate	9.17	29.64	4.94
City Building Retrofit, Int.	7.09	2.29	2.29
1.6 gpf Toilet Replacement	4.97	3.56	2.14
School Education	NA	NA	NA
Shared Savings for Multifamily & Office Apts.	NA	NA	NA
Commercial Landscape Ordinance	NA	40.5	40.5
Water Awareness Ordinance	NA	NA	NA
Metering Ordinance	NA	NA	NA
Toilet Flapper Replacement	2.13	3.83	0.89
Plumbing Code	NA	NA	NA

1 Represents the ratio of avoided supply costs to net program costs to utility only.

SECTION 5

RECOMMENDED WATER CONSERVATION PROGRAM

This section presents a plan for improving water use efficiency through water conservation and defines the implementation requirements. The plan is a combination of the most cost-effective and socially and environmentally acceptable measures evaluated in Section 4.

SELECTION OF MEASURES FOR IMPLEMENTATION

Based upon the evaluation of the measures in Section 4, an overall cost-effective water conservation program was selected with the following elements:

1. Landscape Retrofit
2. Irrigation Efficiency Audits and Retrofit
3. New Xeriscape Incentive
4. Large Landscape Irrigation Audits and Retrofit
5. Residential Home Water Audit and Retrofit
6. Commercial/Industrial Audits and Rebate
7. Manufacturing Audits and Rebate
8. City Building Retrofit (interior)
9. 1.6 gpf Toilet Replacement
10. School Education
11. Commercial Landscape Ordinance

All eleven measures have benefit-cost ratios greater than one from the utility perspective. Toilet flapper replacement was not selected because the materials have a limited lifespan. It should be noted that the Residential Home Water Audit program overlaps with other programs. One of the measures was not evaluated quantitatively because its water savings could not be estimated: School Education. Montgomery Watson believes this measure to be an important element of the total program because it helps instill a water conservation ethic into the population.

PROJECTED WATER SAVINGS

Shown in Table 5-1 are the million-gallon-per-day (mgd) projected water savings from the proposed program elements whose water savings were calculated. Savings derived from the School Education program was undetermined. The total calculated savings of 20 mgd peak day in 2000 represents a ten percent reduction over the estimated peak-day water demand of 205 mgd in the year 2000 (without water conservation). Peak-day water demand in the year 2000 will be about 185 mgd with the recommended program. By reducing peak demand this amount, the expansion of the Ullrich and Plant No. 4 water treatment plants can be delayed as was discussed in Section 4.

BENEFITS

Table 5-2 shows the projected benefit-cost ratios of the proposed program. As is shown on the table, the plan is cost-effective and all elements have benefit-cost ratios greater than one for the City.

TABLE 5-1

RECOMMENDED PROGRAM WATER SAVINGS, MGD

	Program Element	1995 Average	1995 Peak Day	2000 Average	2000 Peak Day
1.	Landscape Retrofit	.04	.14	.10	.36
2.	Irrigation Efficiency Audits/ Retrofit	.46	1.61	1.22	4.29
3.	New Xeriscape Incentive	.04	.13	.10	.36
4.	Large Landscape Irrigation Audits/Retrofit	.15	.52	.39	1.37
5.	Residential Home Water Audit and Retrofit	.12	.21	.32	1.9
6.	Commercial/Industrial Audits and Rebate	.69	1.40	1.86	3.74
7.	Manufacturing Audits and Rebate	.43	.63	1.15	1.68
8.	City Building Retrofit, Interior	.01	.01	.03	.03
9.	1.6 gpf Toilet Replacement Program	1.67	1.67	4.47	4.47
10.	School Education	NA	NA	NA	NA
11.	Commercial Landscape Ordinance	0.05	0.09	0.14	0.25
12.	Plumbing Code	.72	.72	1.7	1.7
	Total	4.38	7.13	11.48	20.15

TABLE 5-2

RECOMMENDED PROGRAM BENEFITS AND COSTS

	Measure	Participant Benefit/Cost Ratio	City Benefit/Cost Ratio[1]	Total Resource Benefit/Cost Ratio
1.	Landscape Retrofit	0.29	2.68	0.28
2.	Irrigation Efficiency Audits and Retrofit	7.99	6.40	4.58
3.	New Xeriscape Incentive	2.11	1.98	1.52
4.	Large Landscape Irrigation Audits and Retrofit	20.35	7.87	6.12
5.	Residential Home Water Audits and Retrofit	NA	13.65	13.65
6.	Commercial/ Industrial Audits and Rebate	13.71	4.57	1.07
7.	Manufacturing Audits and Rebate	9.17	29.64	4.94
8.	City Building Retrofit, Int.	7.09	2.29	2.29
9.	1.6 gpf Toilet Replacement	4.97	3.56	2.14
10.	School Education	NA	NA	NA
11.	Commercial Landscape Ordinance	NA	40.50	40.50

1 Represents the ratio of avoided supply costs to net program costs to utility only.

PROGRAM ELEMENTS

Based on the above data, MW recommends that the City implement the following water conservation measures as part of its comprehensive water conservation program.

Landscape Retrofit Program

This program will draw on the experience of the City's current Xeriscape public education program. Xeriscape landscaping includes a water efficient turf such as:

- Buffalo Grass
- Prairie Buffalo

The staff of the City's Environmental and Conservation Services Department (ECSD) will establish the best landscape turf and plantings to use and how to install the turf and plantings. Generally, the user should ensure that soil conditions are favorable for growth, fertilizers should be applied to assure proper nutrients are available, and the appropriate watering schedule for the age and type of turf/plantings and weather conditions must be adhered to.

The City will offer a $.05/square feet rebate for replacing existing St. Augustine grass located in an area that receives at least eight hours of direct sunlight with Prairie Buffalo or No. 609 grass sod, with a per dwelling unit limit of $150.

Irrigation Efficiency Audits and Retrofit

Existing single family and multifamily building owners with high summer water use (the top 50 percent of water users) would be offered an irrigation system audit. Auditors would test the system, reporting any maintenance problems. Separate irrigation schedule for spring, summer, and fall will be developed for the owner. The owner will be encouraged to reset their irrigation controller or otherwise follow the schedules.

New Xeriscape Incentive

This program is aimed at reducing the amount of high-water consuming landscape area. Alternatives include low-water use turf and low-water using plants and shrubs, as well as patios, decks, and walkways. Offer developers and/or builders a rebate for every new house that they sell, that has incorporated landscapes which use Xeriscape principles. Offer rebates for using water-conserving grass species in new residential construction. Home builders/developers could have model houses showing traditional and Xeriscape landscapes. Potential buyers will be informed of the benefits obtained from using Xeriscape principles. The rebate will be calculated at the site of $0.03 per square foot landscaped, up to a maximum of $150.

Large Landscape Irrigation Audits and Retrofit

An irrigation audit is conducted by a water utility representative or Contractor. Only sites larger than one acre (which represents a demand of up to 10 mgd in the summer) are considered applicable for this program. Auditors perform an on-site audit of the irrigation system and produce customized irrigation schedules for each site.

Program implementation would entail:

- Site selection and determination of site specific data
- Determination of priority of sites, based on irrigated acreage and past water use.
- Direct mail of audit program letter and commercial irrigation guides.
- Audits performed by an agency representative which produce a customized schedule for the building owner or landscape manager.
- Continued support of the program by providing weather information for updated schedules, seminars on topical issues, and a follow-up campaign.

The objective is to provide landscape managers with information to enable them to perform timely equipment maintenance and to apply accurate irrigation amounts throughout the year based on explicit customized reports. During the audit process, brochures describing the causes and cures of maintenance and management problems in large turf irrigation systems should be included with the agency's irrigation guide.

Residential Home Water Audits and Retrofit

Free indoor/outdoor water audits are offered to existing residential customers. The City will contact 25 percent of the users who use the highest percent of the water (per dwelling unit) and suggest that they obtain an audit. At the home auditors will:

- Check water flows of faucets, showers, and toilets.
- Perform leak detection test on all toilets.
- Install toilet dam, if applicable, to reduce toilet flush volume.
- Install faucet aerators and low-water use showerheads
- Check domestic meter for determination if domestic leaks exist.
- Evaluate the benefits of installing a 1.6 gpf toilet and whether customer is eligible for rebate. Provide necessary forms to obtain rebate.
- Conduct audit of irrigation system and develop irrigation schedule.
- Advise the customer on the benefits of low water use landscaping.

Commercial/Industrial Audits and Rebate

This measure is applicable to commercial/industrial water use in Austin.

For existing and new sites, an interior and landscape audit is conducted by utility representatives or working closely with the customer's technical staff. Auditors perform an on-site audit of the fixture condition and use pattern and quantity. They will perform leak tests and evaluate the irrigation system. A customized report is produced that describes fixture inspections, leak tests, process and cooling water usage, and landscaping for each site. The report includes a spreadsheet that compares the existing facility operations with conservation standards and potentials. A pay

back analysis will be provided and a description of incentives available. The participant's actions and water use is tracked over time. Standards are based on previous experience.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff or a consultant, will identify state-of-the-art improvements in process and cooling water use and landscape design and irrigation systems. This review will also be available to existing customers.

Manufacturing Audits and Rebate

The largest manufacturers in Austin would be offered assistance with process, cooling, and landscape water use reduction.

Existing customers would be offered an interior and landscape audit by water agency provided specialists. Auditors would work with on-site engineers to audit process, cooling and irrigation systems and produce a customized report that describes fixture inspections, process modifications, leak tests, landscaping and irrigation for each site. The participant's actions and water use is tracked over time.

For new sites, the City will offer applicants for water meters a free plan review. The review, provided by City staff, will identify state-of-the-art improvements in process and cooling water use and landscaping and irrigation systems. A review will also be available for existing customers. To stimulate interest, a rebate of up to $3,000 will be made available per customer. This can be expressed on a dollars per gallons per day saved up to a cap. Note that the City's benefit/cost ratio is much higher than the participant's benefit/cost ratio, so the City can afford to increase the rebate and still have a cost-effective program. The same is true of the other commercial/industrial audit programs.

City Building Retrofit (Interior)

This water conservation program would put up a matching share of about 50 percent of the cost for retrofitting toilets with ultra low-flow models.

1.6 GPF Toilet Replacement Program

This program, initially restricted to residential dwellings, will have an overall goal to replace approximately 60 percent of existing residential toilets with ultra-low-flow toilets by the year 2000. There are approximately 379,000 residential toilets in Austin, assuming 1.7 toilets per residential unit. The residential goal of this program amounts to 4 percent of 379,000 toilets per year or a goal of replacing approximately 15,700 toilets per year.

Incentives to retrofit would be provided by a $75 bill credit or rebate.

School Education

School education serves to educate our future water users in the efficient use of their resources. Education will help children know where water comes from, how it is used, and ways to conserve.

Commercial Landscape Ordinance

The existing Commercial Landscape Ordinance would be amended to reflect a Xeriscape approach to current requirements. The ordinance would be written to require efficient irrigation systems (e.g. automatic rain shut-off devices), give credit for xeric plants, etc.

The City staff will provide information on the best landscape turf and plantings to use and how to install the turf and plantings.

Water Savings

This program is projected to reduce peak day demands and average day demands in the year 2000 by 10 percent.

Scheduling

Because of the need to achieve significant water savings by the year 2000, the entire water conservation program will need to be started in late 1992 and be fully operational within eight years.

IMPLEMENTATION AND BUDGET

The implementation plan requires that all measures be implemented simultaneously in order to achieve the 10 percent savings in eight years. If all measures were implemented simultaneously, cost to the City's conservation program would average about 2.45 million in the first year which includes a staff of 16 full-time equivalents (FTEs) shown on Table 5-3 plus approximately 5 temporary auditors. The main contributor to this cost is the ULF rebates offered to stimulate a high market penetration.

TABLE 5-3

PROGRAM PERSONNEL REQUIREMENTS

Personnel	Job Duties	Current Level (FTEs)	Additional Labor Requirements (FTEs)	Program Total (FTEs)
Manager	Manages program and supervises staff, prepares reports.	1	0	1
Administrative/ Clerical	Maintains files, directs customer inquiries on water conservation audits, and performs other administrative duties.	2	2	4
Auditor	Conducts commercial water audits and inspections.	1.5	2[1]	3.5
Landscape Architect/ Irrigation Specialist	Implements Exterior Landscape programs, commercial landscape ordinance.	1	2	3
Analyst	Manages database, evaluate programs.	1	2	3
Education Specialist	Runs school education program.	0.5	0	0.5
Engineer/Expert Auditor	Conducts large commercial, Industrial, manufacturing audits	1	0	1
Landscape Water Auditor	Implements landscape water audits.	0	5.0[1]	5.0[1] temp
	Totals	8	8	16+ 5 temp

1 Auditors do not need to be on staff full time.

APPENDIX A

QUALITATIVE EVALUATION

A qualitative analysis was performed, as shown in Exhibit A, which indicates non-monetary factors affecting selection of the various water conservation measures. The applied methodology is an adaptation of a method described in the American Water Works Associating publication "Water Conservation". Measures are listed in the column on the left and possible impacts are listed across the top of the table. In the table, a "+" was assigned for a positive impact, a "-" for a negative impact, and a blank space indicates little or no net impact.

This table shows the applicable technical and environmental impacts. Mandatory measures have the largest negative equity impacts. Mandatory measures could engender significant opposition by customers and special interest groups because of the additional expenses they may incur. It is recommended that the City's water conservation program should emphasize an appropriate mix of mandatory and voluntary measures.

Application of qualitative criteria to evaluate measures begins the detailed thought process for thoroughly considering every measure. A description of each qualitative criteria and examples of how they were applied in this study are provided below.

Initial Impacts on Conservers

This criteria evaluates the initial impacts that implementing the measure would have on the customer. For example, if a manufacturing customer were to make process or equipment changes as a result of the Manufacturing Audit program, the costs could be quite large. Thus, in the table, a negative impact was noted.

Long-Term Financial Impact on Conservers

Long-term impacts include water, wastewater, and energy savings, as well as labor savings. All of the measures are thought to have certain long-term benefits, and that is why they were included in this study.

Equity to all Customers

Not all measures apply to all people, and therefore, some sectors of the City of Austin's service area may be asked to do more than others.

Impact on Lifestyle

While certain measures may save water and money, they may also have an impact on lifestyles. This criteria evaluates impacts such as lawns that require significantly less maintenance and lawns that do not fit the social norms.

Acceptance of Measure

Some measures will be readily and easily accepted by most of the City's residents, others will not be readily accepted. This evaluation criteria helps understand how hard or easy a measure will be to implement due to its acceptance.

Impact on Peak Demand

The conservation measures with the largest exterior savings are rated positively against this peak demand criteria. The impact on peak demand is significant in that it also impacts the need for future facilities.

Impact on Existing Customers

This criteria indicates the conservation burden is borne by the City's existing customers.

Reason/Incentives to Conserve

The ability for the measure to provide adequate incentives or reasons for the customer to conserve is evaluated by this criteria.

Example Set By City

It is common sense for City departments to set a good water conservation example for others to follow. This measure points out which measures set this "good example".

Reduce Chemical/Energy Costs

This criteria indicates whether water reduction also results in chemical and energy use reductions for the customer. In many instances, the dollar savings from these reductions are greater than the dollar savings from water reductions alone.

Impacts On Wastewater Volume

Measures aimed at reducing interior water use, thus, wastewater flows are given a positive score for this criteria. Is is well documented that in 1984, the City of Austin was more concerned with wastewater flow reduction than water reductions. This was due to a overloaded sewage treatment plant.

Ability to Implement

Some measures can be implemented and continued with minimal effort. Others may require additional staff, contractors, supplies, etc. Whether the measures are easy or hard to implement by the City is evaluated by this criteria.

Long-Term Savings Reliability

Reliability of measures is extremely important in that it impacts the long-term water conservation savings. Some measures will save a great deal if implemented correctly, but their reliability is suspect. An example of this is the On-Site Greywater Use measure. Savings potential is unreliable because this is a complicated measure that may fall to disrepair in the future.

Flexibility

Both water conservation measures and programs have their own degree of flexibility. This criteria indicates those measures that do not have much implementation flexibility .

Environmental Impact

All measures selected would have a positive contribution to the environment.

FIGURE A-1

EVALUATION CRITERIA

Measure:	Initial Impacts on Conservers	Long-Term $ Impact on Conservers	Equity To All Customers	Impact on Lifestyle	Acceptance of Measure	Impact on Peak Demand	Impact on Existing Customers	Reason/ Incentives to Conserve	Example by City	Reduce Chemical/ Energy Cost	Impacts on Wastewater Volume	Ability to Implement	Longterm Savings Reliability	Flexibility	Environmental Impact
Xeriscape Program	-	+		+	-	+	+	+		+		+	+	+	+
Irrigation Efficiency Program	+	+			+	+	+	+		+		+		+	+
Cash for Grass	-	+	-	+		+	+	+		+		-	+		+
Large Landscape Irrigation Audits	+	+	-		+	+	+	+		+		+		+	+
On-Site Greywater Reuse	-	+	-	-		+				+	+	+	-		+
Residential Audit and Loan/Rebate	+	+	+		+		+	+		+	+	+			+
Large Commercial/Industrial Audits	+	+	-		+	+	+	+		+	+	+	+	+	+
Cmml/Indl Audit Program	+	+	-		+	+	+	+		+	+	+	+	+	+
Manufacturing Program	-	+	-		+	+	+	+		+	+	+	+	+	+
Rainwater Harvesting	-	+	-	-		+		+	-	+		-	-		+
Municipal Retrofit Program	+	+	-		+	+	+	+	-	+	+	+	+	+	+
1.6 gpf Toilet Replacement Program	+	+	+		+		+	+	-	+	+		+	+	+
Goal Billing	+	+	+		-	+		+		+	+	-	+	-	+
Approach Main Discounts for for New Const	+	+	-		+	+		+		+	+	-	+	-	+
School Education Program	+	+	+	+	+		+	+	+	+	+	+		+	+
Irrigation from Stormwater Sed./Infil Basins	+	+	-		-	+				+		-	-		+
Weather Station Controlled Subdivisions	-	+	-		-	+	+	+		+		-	+		+
Shared Savings for MF,Office, Apts, Indl.	+	+	+				+	+		+	+	+	+	+	+
Commercial Landscape Ordinance	-	+	-			+		+	+	+	+				+
Water Awareness Ordinance	-	+	+		-	+	+	+		+	+			+	+
Submetering Ordinance	-	+	+			+		+		+	+	-	+		+
Toilet Flapper Valve Replacement	+	+	+		+		+	+		+	+	+		+	+

Impact:
Positive (+)
Negative (-)
NA/Minimal ( )

********** BUILDING USE FROM SUMMARY TAPE OF BILLING DATA **********

BLD USE CODE	CATEGORY	FY 89-90 AVG DAY WTR MGD	89-90 AVG WW MGD	# 89-90 # INDOOR MGD	1990 JUL/AUG MGD	FY 89-90 YR TOTAL MGY	PEAK DAY * MINUS * JUL&AUG AVG	PEAK DAY WITHOUT 7% UNACCT WTR	PEAK DAY * MINUS * INDOOR	AVG DAY MINUS INDOOR
(COMMERCIAL)										
4	HOTEL/MOTEL	1.201	1.007	0.85595	1.380	438.365	0.307	1.687	0.831	0.34505
5	OTHER GROUP SHELTER	0.155	0.140	0.119	0.156	56.575	0.022	0.178	0.059	0.036
6	OFFICE	4.293	3.180	2.703	7.117	1566.945	2.585	9.702	6.999	1.59
7	RETAIL/WHLSALE	2.079	1.381	1.17385	2.140	758.835	0.566	2.706	1.532	0.90515
8	SERVICE	2.127	1.420	1.207	2.734	776.355	0.894	3.628	2.421	0.92
9	RESTAURANT/BAR	1.392	1.236	1.0506	1.464	508.080	0.242	1.706	0.655	0.3414
10	FOOD STORE	0.379	0.347	0.29495	0.426	138.335	0.077	0.503	0.208	0.08405
11	HEALTH CARE INSTITUTION	1.034	0.923	0.78455	1.156	377.410	0.218	1.374	0.589	0.24945
12	NON-HEALTH CARE INST.	0.081	0.061	0.05185	0.099	29.565	0.028	0.127	0.075	0.02915
13	INST. GROUP RESIDENCE	0.621	0.569	0.48365	0.748	226.665	0.155	0.903	0.419	0.13735
14	OTHER INST. BLDG	0.022	0.019	0.01615	0.028	8.030	0.007	0.035	0.019	0.00585
15	AMUSEMT/REC FACILITY	0.209	0.144	0.1224	0.298	76.285	0.103	0.401	0.278	0.0866
16	RADIO/TV STUDIO	0.076	0.103	0.087295	0.050	27.740	-0.022	0.028	-0.059	-0.011295
20	ELEM/SECOND SCHOOL	0.970	0.760	0.646	1.230	354.050	0.342	1.572	0.926	0.324
21	COLLEGE/OTHER SCHOOLS	2.704	2.212	1.8802	3.015	986.960	0.665	3.680	1.799	0.8238
22	MUSEUM/LIBRARY	0.025	0.018	0.0153	0.038	9.125	0.013	0.051	0.036	0.0097
23	EDUC GROUP RESID	0.129	0.108	0.0918	0.138	46.903	0.027	0.165	0.073	0.0367
24	OTHER EDUC BLDGS	0.046	0.029	0.02465	0.060	16.790	0.021	0.080	0.056	0.02135
25	GARAGE/CARPORT	0.002	0.002	0.001275	0.003	0.730	0.001	0.004	0.002	0.000725
26	PARKING GARAGE	0.012	0.007	0.00578	0.025	4.380	0.011	0.036	0.030	0.00622
27	SERVICE STATION	0.247	0.220	0.187	0.298	90.155	0.065	0.363	0.176	0.06
29	COMMERCIAL WAREHOUSE	0.217	0.192	0.16303	0.284	79.205	0.071	0.354	0.191	0.05397
34	SANCTUARY	0.210	0.169	0.143565	0.298	76.650	0.091	0.389	0.245	0.066435
35	OTHER RELIG BLDGS	0.135	0.107	0.090865	0.186	49.202	0.056	0.242	0.151	0.043935
36	OTHER BLDGS	1.577	0.677	0.57545	3.681	575.605	1.818	5.499	4.924	1.00155
39	FARM BLDGS	0.008	0.005	0.00425	0.010	2.920	0.003	0.013	0.009	0.00375
40	OTHER STRUCTURES	0.454	0.038	0.032215	1.144	165.674	0.651	1.795	1.763	0.421685
41	ACCESSORY STRUCT	0.009	0.002	0.00153	0.025	3.249	0.014	0.038	0.037	0.00737
42	BOATDOCK	0.000	0.000	0	0.001	0.110	0.000	0.001	0.001	0.0003
43	BILLBOARDS/SIGNS	0.007	0.000	0.00017	0.009	2.555	0.005	0.014	0.014	0.00683
44	MISC. COMMER.	0.135	0.002	0.001445	0.275	49.275	0.160	0.436	0.434	0.133555
TOTAL COMMERCIAL:		20.555	15.076	12.815	28.514	7502.721	9.193	37.707	24.893	7.741
(INDUSTRIAL)										
28	INDUSTRIAL WAREHOUSE	0.021	0.018	0.015045	0.024	7.556	0.005	0.030	0.015	0.005655
30	MANFACTURING BLDG	6.962	6.209	5.277225	7.781	2541.130	1.466	9.247	3.969	1.684775
TOTAL INDUSTRIAL:		6.983	6.226	5.292	7.805	2548.686	1.471	9.276	3.984	1.690
(PUBLIC)										
17	POOL/FOUNTAIN	0.344	0.190	0.16167	0.614	125.487	0.265	0.880	0.718	0.18213
18	PARKS/OPEN LAND	0.674	0.355	0.30192	1.176	245.864	0.512	1.688	1.386	0.37168
19	CIVIC LAND:VACANT	0.310	0.000	0	0.092	113.187	0.054	0.145	0.145	0.3101
31	PUBLIC WORKS/UTILITY	7.830	6.181	5.25385	10.302	2857.950	2.956	13.258	8.004	2.57615
32	TRANSPORTATION TERMINAL	0.144	0.126	0.10727	0.178	52.684	0.041	0.219	0.112	0.03707
33	STREETLIGHTS/SIGNALS	0.001	0.001	0.00051	0.002	0.438	0.001	0.003	0.002	0.00069
37	POLICE/FIRE STATION	0.025	0.020	0.01717	0.034	8.943	0.010	0.044	0.027	0.00733
38	CONVENTION CENTER	0.003	0.003	0.00221	0.003	1.022	0.001	0.004	0.002	0.00059
TOTAL PUBLIC:		9.330	6.876	5.845	12.401	3405.574	3.839	16.240	10.395	3.486

(RESIDENTIAL)										
?	SINGLE FAMILY (1)	48.900	36.700	31.2	64.200	17848.500	19.327	83.527	52.327	17.7
3C	MULTI-FAMILY (2)	13.700	12.300	10.45	15.300	5000.500	2.837	18.137	7.687	3.25
TOTAL RESIDENTIAL:		62.600	49.000	41.650	79.500	22849.000	22.164	101.664	60.014	20.950
_DUA1:[ANDERSON_B]BLD90.D20;1								20-MAY-1992 16:18		
GRAND TOTAL (3):		99.468	77.178	65.602	128.220	36305.981	36.668	164.888	99.286	33.867

PEAK INCLUDING UNACCOUNTED WATER: 177.28 MGD

ESTIMATED INDOOR USE: WW AVERAGE LESS 15% FOR OUTDOOR USE IN THE WASTEWATER AVERAGE PERIOD (WINTER).
THIS FIGURE WAS DETERMINED BY CONSIDERING TOTAL WW BILLED VERSUS AMOUNT OF WW TREATED
AT THE PLANT,WHICH WAS 20% IN FY 1989-1990. A LOWER FIGURE OF 15% WAS USED TO BE CONSERVATIVE.

* ALLOCATION OF DIFFERENCE BETWEEN AVERAGE DAY IN JULY/AUG AND PEAK DAY WAS COMPUTED BY
USING THE SAME % INCREASE AS FOR THE INCREASE FROM INDOOR USE AND JULY/AUG AVERAGE.

PEAK DAY WITHOUT UNACCOUNTED WATER=
[(JULY&AUG AVG DAY-WW*.85)/(TOTAL JULY&AUG-TOTAL WW*.85)]*[(PEAK DAY-PERCENT UNACCOUNTED)-TOTAL JULY&AUG]

(1) INCLUDES SINGLE FAMILY, DUPLEX, TRIPLEX, AND FOURPLEX.
TOTAL 1990 POPULATION = 404,760

AVERAGE GPCD = 121
INDOOR GPCD = 77
OUTDOOR GPCD = 44

(2) INCLUDES COMPLEXES WITH MORE THAN FOUR UNITS AND MOBILE PARKS.
TOTAL 1990 POPULATION = 139,243

AVERAGE GPCD = 98
INDOOR GPCD = 75
OUTDOOR GPCD = 23

(3) OVERALL AVERAGE GPCD = 183

APPENDIX C

UNIT COST OF WATER

Summary of Planning Level Unit Cost of Water Based on Deferred Facilities Only And Savings For Remaining Useful Life

CAPITAL ULLRICH COSTS:

INFLATION 0.00%
REAL INTEREST 3.00%

COSTS, $MILLION

YEAR	SITUATION	40 MGD	COMMENTS
			Approved by Tom Ellison
1998	NO WC	27.7	Tel con w/ Tom Ellison 4/92 re initial yr to construct
2004	WATER CONS	27.7	Same cost in deferred construction yr since 0 inflation
1992	NO WC	23.2	Present worth analysis
1992	WATER CONS	19.4	Present worth analysis
1992	SAVINGS	3.8	

AVG DEMANDS AVG TREATMENT

		YEAR	SITUATION	40 MGD		
		1998	NO WC	133.3	40 MGD	From Austin Plan
		1998	W/WATER CONS	127	0 MGD	<==95% of NO WC demand
		1998	WATER SAVED	2433	14600 MG	<==(NO WC-W/WATER CONS) x 365 days/yr
FROM/TO==>	1998	2004	WATER SAVED	14596	87600 MG	<==(NO WC-W/WATER CONS) x 365 x Δ deferral Years
FROM/TO==>	2004	2004	WATER SAVED	0	0 MG	<==(NO WC-W/WATER CONS) x 365 x Δ remaining Years

UNIT SAVINGS, $/1000 GAL

	40 MGD	
1992 UNIT SAVINGS	0.26	<==$savings/total (avg.) water saved in deferral years

VARIABLE ULLRICH COSTS:

OPERATING COSTS, $

	40 MGD	
PER MG TREATED	115.858	<==$/MG based on info by Eric Rothstein
1998	1691104	<==1998 $/MG x tot water saved for Δ yrs of nondelayed operation
2004	0	<==2024 $/MG x tot water saved for Δ remaining Years
2004		
1992	1416273	Present worth analysis

UNIT SAVINGS, $/1000 GAL

	40 MGD	
1992 UNIT SAVINGS	0.10	<$Annl savings/tot (avg.) h20 saved deferred yrs and remaining yrs

FIXED ULLRICH COSTS:

OPERATING COSTS, $MILL/YR

	40 MGD	
$MILL/MGD	0.042287	<==$million/MGD based on info by Eric Rothstein
ANNUAL	1.69	<== $MILL X 40 MGD
1998	9.16	<==1998 $ for Δ years of non-delayed operation
2004		
1992	7.67	Present worth analysis

UNIT SAVINGS, $/1000 GAL

	40 MGD	
1992 UNIT SAVINGS	0.53	<==$Annl savings/total (avg.) water saved in deferred years

SUMMARY OF ULLRICH COSTS:

	40 MGD	
UNIT SAVINGS	0.88	$/1000 GAL

APPENDIX C

UNIT COST OF WATER
(Continued)

CAPITAL WTP NO. 4 COSTS:

INFLATION 0.00%
REAL INTEREST 3.00%

		COSTS, $MILLION	
YEAR	SITUATION	100 MGD	160 MGD
2017	NO WC	162	0.00
2025	WATER CONS	162.00	0.00
1992	NO WC	77.37	0.00
1992	WATER CONS	61.08	0.00
1992	SAVINGS	16.29	0.00

Tel con w/ Tom Ellison 6/92

				AVG DEMANDS	AVG TREATMENT	
		YEAR	SITUATION	DEMANDS	100 MGD	160 MGD
		2017	NO WC	168.14	100	0 MGD
		2017	W/WATER CONS	160	0	0 MGD
		2017	WATER SAVED	3069	36500	0 MG
FROM/TO==>	2017	2025	WATER SAVED	24548	292000	0 MG
FROM/TO==>	2025	2025	WATER SAVED	0	0	0 MG

UNIT SAVINGS, $/1000 GAL

	100 MGD	160 MGD
1992 UNIT SAVINGS	0.66	0.00

VARIABLE WTP NO. 4 COSTS:

OPERATING COSTS, $

	100 MGD	160 MGD
PER MG TREATED	115.858	0
2017	2844133	0
2025	0	
2025		
1992	1358374	0

<==same demand, whether 100 or 300 mgd

UNIT SAVINGS, $/1000 GAL

	100 MGD	160 MGD
1992 UNIT SAVINGS	0.06	0.00

<==$Annl savings/total (avg.) water saved

FIXED WTP NO. 4 COSTS:

OPERATING COSTS, $MILL/YR

	100 MGD	160 MGD
$MILL/MGD	0.042287	0
ANNUAL	4.23	0.00
2017	29.68	0.00
2025		
1992	14.18	0.00

<==$mil/yr based on CH2M Hill TM #5 Reuse report

UNIT SAVINGS, $/1000 GAL

	100 MGD	160 MGD
UNIT SAVINGS	0.58	0.00

SUMMARY OF WTP NO. 4 COSTS:

	100 MGD	
UNIT SAVINGS	1.30	$/1000 GAL

GRAND TOTAL: **2.18 $/1000 GAL**

APPENDIX D

BENEFIT COST CALCULATIONS
SAMPLE FOR A 1.6 GPF TOILET REPLACEMENT PROGRAM
FOR MULTI-FAMILY

TOTAL WATER SAVINGS:

Calcs==> (# of households in given yr) X (persons per household) X (gals saved per person/day) = Water saved in gal/day

Sample==> (5652) X (1.81) X (15) = 153,452

TOTAL PROGRAM COSTS:

Calcs==> (cust cost/installation X (# of households) X (# fixtures/installations) + (annual city cost) + (city cost/installation) X (# of households) = total cost in $/yr

Samples==> (140 (materials + labor) - 75 (rebate) X (5652) X (1) + (64,000) + (86) X (5652) = $917,452/yr

TOTAL PROGRAM BENEFITS:

Calcs==> (water saved gal/day) X (365) X (cost of water $/1000 gal) + (wastewater saved gal/day) X (365) X (cost of wastewater $/1000 gal) = program costs/yr

Samples==> (153,452) (365)(2.18/1000) + (153,452)(365)(0.2/1000) = $133,304

Note:

1. The total resource costs test was used to perform calculations for the Austin Water Conservation Plan. The total resource cost test (a.k.a. society test) examines the impact of implementing a water conservation program on the society as a whole. Further details are shown on the attached table from the Water Users Manual p 89.

2. See attached Water Plan computer printout for future year calculations.

Table 2

Program and Measure Cost Assignments by Perspective

TYPE OF COST	SOCIETY	AGENCY	PARTICIPANT
Capital	Sum of all	If assigned under program	If assigned under program
Installation	Sum of all	If assigned under program	If assigned under program
O & M	Sum of all	If assigned under program	If assigned under program
Delivery	Included	Included	0
Incentive	0 (seen as simple transfer)	Included	0 (included as a benefit)
Administrative	Included	Included	0
Foregone Revenue	0 (seen as simple transfer)	Savings * customer rate	0 (included as a benefit)

TYPE OF BENEFIT	SOCIETY	AGENCY	PARTICIPANT
Avoided Cost to Customer	0 (seen as simple transfer)	0 (included as a cost)	Savings * customer rate
Avoided Cost to Agency	Savings * marginal cost	Savings * agency marginal cost	0
Secondary Benefits	Secondary Benefits * marginal cost	0	Secondary Benfits * customer rates
Incentive	0 (seen as simple transfer)	0 (included as a cost)	Included

COA PROGRAM SUMMARY

PROGRAM	PEAK GAL/DAY	AVERAGE GAL/DAY	% OF MKT	TOTAL RESOURCE B/C	PARTIC B/C	UTILITY B/C	RATE B/C	TOTAL COST PER YR	UTILITY COST PER YR	NUMBER PER YEAR		TOTAL MARKET NUMBER	INCENTIVES BY CITY $/PRG	TOTAL INCENTIVE YEARLY COST	ANNUAL FIXED COST	ANNUAL VARIABLE $/PRG	TOTAL ANNUAL VARIABLE	ONE TIME FIXED COST
(BBTOLRMF)TOILET RETROFIT MULTI-FAMILY	1,227,615	1,227,615	60%	1.65	3.93	2.75	0.95	$917,000	$550,000	5652	TOILETS	84786	$75.00	$423,900	$64,000	$11.00	$62,172	$2,000.00
(BBTOLRSF)TOILET RETROFIT SINGLE FAMILY	3,238,191	3,238,191	60%	2.42	5.56	4.00	1.07	$1,650,000	$996,000	10069	TOILETS	151030	$75.00	$755,175	$130,000	$11.00	$110,759	$3,000.00
(CBRPPUBI) TOILET RETROFIT PUBLIC BLDGS	33,536	33,536	75%	2.29	7.09	2.29	0.88	$23,000	$23,000	131	TOILETS	1400	$120.00	$15,720	$2,000	$40.00	$5,240	$0.00
(TOPHWA MFE)HOME WATER AUDIT MULTI-FAMILY	170,762	90,933	5%	4.04	N/A	4.04	1.05	$26,000	$26,000	530	UNITS	84786	$0.00	$0	$5,000	$40.00	$21,200	$0.00
(TOPHWA SFE)HOME WATER AUDIT SINGLE FAMILY	1,725,345	718,661	5%	19.55	N/A	19.55	1.32	$43,000	$43,000	944	HOMES	151030	$0.00	$0	$5,000	$40.00	$37,760	$0.00
(TOPIREF MFG)IRRIGATION EFFICIENCY MANUFACT	249,169	70,620	8%	6.36	102.97	6.56	1.10	$10,000	$10,000	2		143	$90.00	$180	$8,500	$640.00	$1,280	$0.00
(TOPIREFP MF)IRR EFFICIENCY MULTI-FAMILY	267,364	75,776	8%	4.66	48.62	4.77	1.04	$15,000	$15,000	848	UNITS	84786	$0.90	$763	$8,500	$6.40	$5,427	$0.00
(TOPIREFP SF)IRR EFFICIENCY SINGLE FAMILY	1,499,165	424,893	6%	3.55	4.05	6.51	1.10	$111,000	$60,000	1007		151030	$30.00	$30,210	$10,000	$20.00	$20,140	$0.00
(TOPIREF CM)IRR EFFICIENCY COMMERCIAL	954,191	270,437	8%	3.32	10.71	3.91	0.99	$75,000	$64,000	76		7591	$90.00	$6,840	$8,500	$640.00	$48,640	$0.00
(TOPIREF PUB)IRR EFFICIENCY PUBLIC	1,320,576	374,278	30%	20.95	109.00	23.14	1.21	$19,000	$17,000	12		357	$90.00	$1,080	$8,500	$640.00	$7,680	$0.00
(MFGEX)AUDIT MANUFACTURING EXTERIOR	747,508	211,859	30%	20.09	153.82	21.43	1.24	$14,000	$14,000	6		143	$90.00	$540	$1,000	$2,000.00	$12,000	$0.00
(MFGIN)AUDIT MANUFACTURING INTERIOR	936,799	936,799	30%	4.26	8.48	32.23	1.36	$325,000	$43,000	6		143	$3,000.00	$18,000	$1,000	$4,000.00	$24,000	$0.00
(TOPAUD COMEX)AUDIT COMMERCIAL EXTERIOR	2,624,025	743,701	22%	3.71	10.71	4.46	1.02	$186,000	$154,000	209		7591	$90.00	$18,810	$10,000	$600.00	$125,400	$0.00
(TOPAUD COMIN)AUDIT COMMERCIAL INTERIOR	1,113,803	1,113,803	22%	3.50	14.78	4.63	1.09	$317,000	$240,000	209		7591	$300.00	$62,700	$10,000	$800.00	$167,200	$0.00
(FLAP MFE)REPLACE FLAPPER MULTI-FAMILY	31,457	31,457	15%	0.67	1.63	2.74	0.93	$46,000	$11,000	1590	FLAPS	84786	$0.00	$0	$2,500	$5.50	$8,745	$0.00
(FLAP SFE)REPLACE FLAPPER SINGLE FAMILY	83,458	83,458	15%	1.01	2.41	4.50	1.07	$80,000	$18,000	2831	FLAPS	151030	$0.00	$0	$2,500	$5.50	$15,571	$0.00
(XERIS SFE)LANDSCAPE RETROFIT SINGLE FAMILY	171,270	48,541	1%	0.16	0.19	1.79	0.76	$435,000	$38,000	189		151030	$150.00	$28,350	$1,000	$45.24	$8,550	$5,000.00
(XERIS PUB)LANDSCAPE RETROFIT PUBLIC	77,611	21,996	1%	0.77	0.74	4.26	1.02	$37,000	$7,000	1		357	$4,725.00	$4,725	$2,000	$45.24	$45	$0.00
(XERISCME)LANDSCAPE RETROFIT COMMERCIAL	87,871	24,905	1%	0.84	0.79	5.13	1.05	$42,000	$7,000	10		7591	$534.00	$5,340	$1,000	$45.24	$452	$5,000.00
(XERISMFE)LANDSCAPE RETROFIT MULTI-FAMILY	27,800	7,879	1%	0.81	0.79	4.04	1.00	$14,000	$3,000	105	UNITS	84786	$14.00	$1,680	$1,000	$0.45	$47	$5,000.00
(XERIS SFN)LANDSCAPE RETROFIT NEW SINGLE FAM	219,298	62,150	8%	1.07	1.63	1.47	0.71	$66,000	$48,000	242		3020	$150.00	$36,300	$1,000	$45.24	$10,948	$5,000.00
(XERIS PUBN)LANDSCAPE RETROFIT NEW PUBLIC	77,611	21,996	8%	5.05	5.73	5.04	1.07	$5,000	$5,000	1		14	$3,939.00	$3,939	$1,000	$45.24	$45	$0.00
(XERISCNN)LANDSCAPE RETROFIT NEW COMMERCIAL	26,361	7,471	8%	3.46	5.73	3.46	0.97	$2,000	$2,000	3		32	$445.00	$1,335	$1,000	$45.24	$136	$1,000.00
(XERISMFN)LANDSCAPE RETROFIT NEW MULTI-FAMILY	36,007	10,205	8%	4.05	5.93	3.60	0.98	$3,000	$3,000	136	UNITS	1696	$16.00	$2,176	$1,000	$0.45	$61	$5,000.00
(TOPLLA CM)LARGE LANDSCAPE AUDIT COMMERIAL	715,643	202,828	6%	4.07	12.54	5.35	1.08	$57,000	$43,000	57		7621	$0.00	$0	$8,000	$690.00	$39,330	$1,580.00
(TOPLLA IN)LARGE LANDSCAPE AUDIT INDUSTRIAL	124,585	35,310	6%	13.77	124.45	15.00	1.24	$3,000	$3,000	1		144	$0.00	$0	$2,000	$690.00	$690	$1,580.00
(TOPLLA MF)LARGE LANDSCAPE AUDIT MULTI-FAMILY	204,622	57,994	6%	8.25	31.50	10.23	1.19	$8,000	$6,000	649	UNITS	84483	$0.00	$0	$2,000	$6.90	$4,478	$1,580.00
(TOPLLA PUB)LARGE LANDSCAPE AUDIT PUBLIC	330,144	93,569	6%	22.32	109.93	26.28	1.29	$5,000	$4,000	3		371	$0.00	$0	$2,000	$690.00	$2,070	$1,580.00
PLUMBING CODE SINGLE FAMILY	1,225,719	1,225,719	100%	N/A	N/A	N/A	N/A	N/A	N/A	3020		3020	N/A	N/A	N/A	N/A	N/A	N/A
PLUMBING CODE MULTI-FAMILY	464,894	464,894	100%	N/A	N/A	N/A	N/A	N/A	N/A	1696		1696	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	20,012,600	11,931,674						4,534,000	2,453,000					14,026	1,417,763	296,000	11,849	740,067	37,320

******* P L A N *******										
1.6 GPF TOILET REPLACEMENT	4,465,806	4,465,806	60%	2.14	4.97	3.56	1.03	$2,568,000	$1,545,000	
CITY BUILDING RETROFIT. INT	33,536	33,536	75%	2.29	7.09	2.29	0.88	$23,000	$23,000	
RESIDENTIAL HOME AUDIT	1,896,107	809,594	5%	13.65	N/A	13.65	1.28	$69,000	$69,000	
IRRIGATION EFFICIENCY	4,290,465	1,216,004	8%	4.58	7.99	6.40	1.09	$230,000	$166,000	
MANUFACTURING AUDIT	1,684,307	1,148,658	30%	4.94	9.17	29.64	1.34	$339,000	$57,000	
COMMERCIAL AUDIT	3,737,928	1,857,504	22%	3.58	13.71	4.57	1.07	$503,000	$394,000	
TOILET FLAPPER REPLACEMENT	115,115	115,115	15%	0.89	2.13	3.83	1.02	$127,000	$29,000	MARGINAL COST = $2.18/1000 GALLONS
LANDSCAPE RETROFIT	364,552	103,321	1%	0.28	0.29	2.68	0.89	$527,000	$54,000	
NEW XERISCAPE	359,277	101,822	8%	1.52	2.11	1.98	0.80	$77,000	$59,000	
LARGE LANDSCAPE IRRIGATION AUDITS	1,374,994	389,701	6%	6.12	20.35	7.87	1.15	$73,000	$57,000	
PLUMBING CODE	1,690,613	1,690,613						0	0	
TOTAL	20,012,600	11,931,674						4,534,000	2,453,000	

MODEL OUTPUT

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ANALYSIS RESULTS FOR: BBTOLRMF BBTOLRMF

WATER SAVINGS in (gal/day)	Net (to Utility)	Gross (to Customer)
Total Lifecycle Water Savings	26240219	26240219
Average Savings per Year (over 18 years)	1457790	1457790

Perspective	Benefit / Cost Ratio	Net Present Value (000 $)	Present Value of Total Costs (000 $)	Average Lifecycle Unit Cost ($/000 gal)	Internal Rate of Return (%)
TOTAL RESOURCE COST TEST	1.649	6309	9728	2.00	20.1
UTILITY TEST	2.750	10204	5832	1.20	41.6
PARTICIPANTS TEST	3.927	24555	8390	1.72	812.0
RATE IMPACT MEASURE TEST	0.952	-806	16842	3.46	1.4
SOCIETAL TEST	1.649	6309	9728	2.00	20.1

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DETAILED RESULTS FOR: BBTOLRMF BBTOLRMF

Perspective Shown is: TOTAL RESOURCE COST TEST

Year	Water Savings (gal/day)	Value of Water Saved (000 $)	Total Cost of Program (000 $)	Total Benefits (000 $)	Total Net Benefits (000 $)	Packages Installed (#/year)
DDDD	DDDDDDDDDD	DDDDDDDDDD	DDDDDDDDDD	DDDDDDDDDD	DDDDDDDDDD	DDDDDDDDDD
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	153452	133	917	146	-771	5652
1994	306904	274	917	300	-617	5652
1995	460355	421	917	461	-456	5652
1996	613807	576	917	630	-288	5652
1997	767259	739	917	805	-112	5652
1998	920711	908	917	988	71	5652
1999	1074163	1085	917	1179	261	5652
2000	1227615	1270	917	1377	459	5652
2001	1381066	1462	917	1582	664	5652
2002	1534518	1661	917	1794	876	5652
2003	1687970	1867	917	2014	1096	5652

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