

# Tucson Water Dept. Audit Program

The City of Tucson Water Department serves parts of the community of Tucson and some adjacent areas in Pima County, located in southern Arizona. Median household income in Tucson was \$30,981 as of the 2000 Census.<sup>1</sup>

## UTILITY DEMOGRAPHICS

As of 2003, the City of Tucson Water Department maintained an average of 205,000 connections. The total service area of the City of Tucson Water Department is 190 square miles. The population of this service area is 690,000. As of 2004, average customer water use in gallons per capita per day (gpcd) was 160.

The City of Tucson Water Department has 181,000 single family residential, 9,700 multifamily residential, 14,000 commercial, and 500 construction connections.

AUDIT PROGRAM	
<b>Indoor or Outdoor:</b>	<b>Both</b>
<b>Eligible Customers:</b>	<b>SF, MF, ICI</b>
<b>Customers Analyzed:</b>	<b>SF</b>
<b>Program Years:</b>	<b>1996-present</b>
<b>Years Analyzed:</b>	<b>1999, 2000, 2001</b>

## UTILITY RATE STRUCTURE AND PRICES

The City of Tucson Water Department uses a tiered rate structure. The monthly base rate for service is \$5.35 for single family customers, which includes zero gallons of water. Single family residential usage charges are as follows:

Usage	Price
<16 ccf (<11,967 gal)	\$1.03 per ccf (\$1.38/1,000 gal)
16 - 30.99 ccf (11,968 - 23,187 gal)	\$3.60 per ccf (\$4.81/1,000 gal)
31 - 46 ccf (23,188 - 34,407 gal)	\$5.05 per ccf (\$6.75/1,000 gal)
>46 ccf (>34,408 gal)	\$7.13 per ccf (\$9.53/1,000 gal)

## CURRENT CAPACITY AND WATER SOURCES

The City of Tucson Water Department has a storage capacity of 279 million gallons. They currently use groundwater and Central Arizona Project (CAP) water as their water sources, along with reclaimed water for non-potable uses.

## FUTURE PLANS TO MEET DEMAND

In the future, the City of Tucson Water Department plans to more fully use CAP water, become more aggressive with conservation programs, expand effluent reclamation facilities, add, expand, or more fully utilize existing facilities, and possibly acquire more water resources through purchase.

## AUDIT PROGRAM DESCRIPTION

The Zanjero Program is an audit program first initiated in 1996 and is continuing. During the audit, a City staff person reviews customers' indoor and outdoor water use. The staff person checks interior plumbing fixtures for leaks, and installs low flow showerheads and aerators for the customer. The staff person checks for irrigation leaks, reviews the setting of irrigation timers, and gives the customer tips on

<sup>1</sup> U.S. Census Bureau, American Fact Finder.

plant irrigation. The customer is present at the time of the audit. The audit takes about one to one and one half hours, and is available to all residential and commercial customers. The audit process may vary slightly from customer to customer depending on the specific needs and questions of the customer.

**OTHER CITY OF TUCSON CONSERVATION PROGRAMS**  
**Conservation Rates: increasing block rate, 1988-present**  
**Conservation Ordinances, 1984-present, 1991-present**

The initial design of the program included marketing the program to high volume users by direct mailings. There was a low

response with this method, so the program was opened to all customers in 1997. Appointments are now made through customer requests and referrals from Customer Service for customers calling in with high water bills.

**METHODOLOGY**

*Please see the General Methodology for the specific procedures and techniques used for all ECoBA analyses.*

The analysis includes only single family households that participated in the program during the years 1999 through 2001. The water savings were calculated and a cost benefit analysis was performed for the years 1999, 2000, and 2001. Our findings refer to these three years only, not to the ongoing program. The lifespan of the audits was assumed to be five years.

All quantified costs and benefits have been discounted to the first year of the analysis (1999) and inflated to 2004 dollars. The discount rate used in this analysis was 4.8%. The CPI values that were used in this analysis were the 2004 value of 188.9 and the 1999 value of 166.6.

There were 488 usable participants out of 1,722 total in 1999, 294 out of 1,276 in 2000, and 243 out of 1,076 in 2001, for a total of 1,025 usable participants out of 4,074. Approximately 75 percent of the participants over these three years were unusable because insufficient data was available to perform the analysis.

All City of Tucson Water Department single family residential households were used as the control group in this analysis. The average annual pre-measure water use of the participants (171,887 gallons) was higher than that of the control group (112,465 gallons).

The exact number of households in the control group is unknown, as the utility provided average yearly single family residential water use for the years in question. As a result, the participant data could not be removed from the control group. Despite being unable to remove participants from the control sample, a significant difference in the average water use would be unlikely because the control group is so large (approximately 181,000 households).

## ASSUMPTIONS

Please see the General Assumptions for the specific conditions and rules underlying all ECoBA analyses.

The total cost for the program over the three year period of 1999 through 2001 was divided by three for a total cost for each of the three years.

The weighted average could not be used in determining control group pre- and post-measure average water use as the number of participants with which to weight these were not known. The average was used instead.

The utility saves \$122 in variable costs for each AF of water saved.

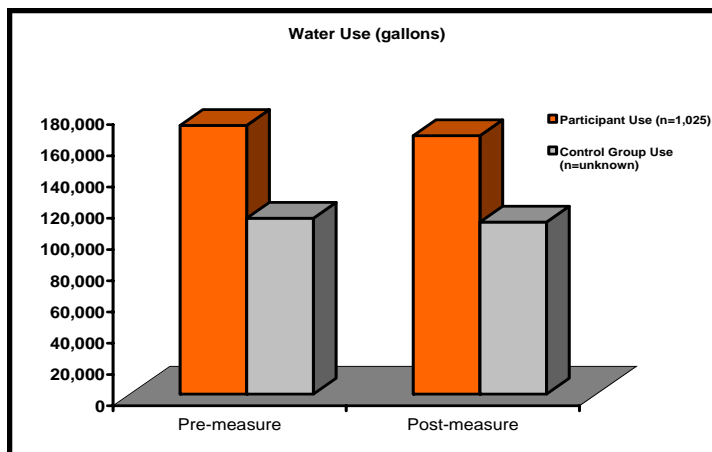
The utility saves \$200 in replenishment avoidance for each AF of water saved.

The value of the water saved was calculated by multiplying the amount of water saved by the price of water (\$4.81 per 1,000 gallons) at the average level of use of the participants (falls into the second tier: 11,968 – 23,187 gallons per month).

Participants who had two or more consecutive months of no water use were included in the study.

The discount rate used in this analysis was 4.8%.

The CPI values that were used in this analysis were the 2004 value of 188.9 and the 1999 value of 166.6.



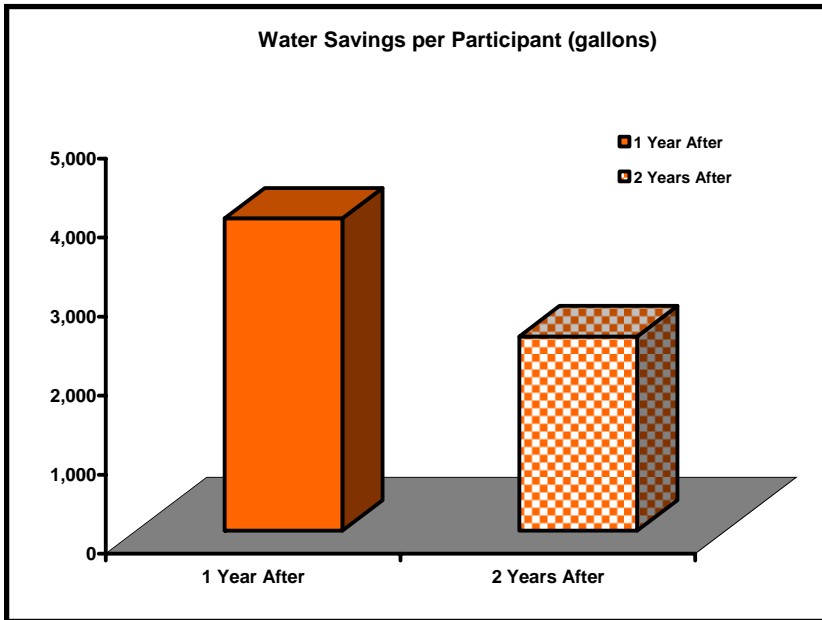
## RESULTS - WATER SAVINGS

The first year after the 1999 Zanjero Program, the water savings amounted to 3,810,175 gallons, or 7,808 gppy (5.1% of pre-measure water use). The second year after, the water savings amounted to 869,591 gallons, or 1,782 gppy (1.2% of pre-measure water use). The average savings per year was 2,339,883 gallons, or 4,795 gppy (3.1% of pre-measure water use). **The total savings over the five year assumed lifespan was 11,699,415 gallons (35.9 AF), or 23,974 gallons per participant.**

The first year after the 2000 Zanjero Program, the water savings amounted to 1,251,063 gallons, or 4,255 gppy (2.5% of pre-measure water use). The second year after, the water savings amounted to 563,200 gallons, or 1,916 gppy (1.1% of pre-measure water use). The average savings per year was 907,131 gallons, or 3,085 gppy (1.8% of pre-measure water use). **The total savings over the five year assumed lifespan was 4,535,657 gallons (13.9 AF), or 15,427 gallons per participant.**

The first year after the 2001 Zanjero Program, no water savings

occurred. There was an increase in participant water use, relative to control group water use, of 1,008,906 gallons, or 4,152 gppy (2.4% of pre-measure water use). The second year after, the water savings amounted to 1,089,130 gallons, or 4,482 gppy (2.6% of pre-measure water use). The average savings per year was 40,112 gallons, or 165 gppy (0.1% of pre-measure water use). **The total savings over the five year assumed lifespan was 200,560 gallons (0.6 AF), or 825 gallons per participant.**



Total water savings for the three years studied was 4,052,332 gallons, or 3,953 gppy (2.3% of weighted pre-measure water use) during the first year after and 2,521,921 gallons, or 2,460 gppy (1.4% of weighted pre-measure water use) during the second year after. **The total savings over the five year assumed lifespan was 16,435,632 gallons (50.4 AF), or 16,035 gallons per participant.**

During the two years before participating in the audit program, the participant group's water use was, on average, 159.1% of the control group's use. During the two years after, the participant group's water use was 156.7% of the control group's use, on average. The participant group's water use decreased by 3.8%, whereas the control group's use decreased by 2.1%. **The resulting overall water savings attributed to this program was 1.7%.**

## RESULTS - COST BENEFIT ANALYSIS

*Costs and benefits listed below represent the entire lifespan of the program (five years).*

### 1999 PROGRAM

- ◆ The quantified cost to the utility was \$46,923 (\$96 per participant). This cost includes capital expenditures and labor, \$46,923.
- ◆ The quantified benefit to the utility was \$0.
- ◆ The quantified cost to the participants was \$0.
- ◆ The quantified benefit to the participants was \$55,828 (\$114 per participant). This benefit reflects participant water bill savings, \$55,828.

### UTILITY PERSPECTIVE - 1999

Results of cost benefit analysis show a net benefit (net present value) of -\$46,923 from the utility perspective over the five year assumed

1999 Quantified Costs and Benefits					
Utility			Participants		
Costs		Benefits	Costs	Benefits	
Capital & Labor	\$46,923	Not Quantified	Not Quantified	Water Bill Savings	\$55,828
Total	\$46,923			Total	\$55,828

lifespan. This is a net benefit of -\$96 per participant. The quantified costs to the utility were greater than the quantified benefits to the utility. **The cost per acre-foot of water saved from the utility perspective was \$1,307.**

#### PARTICIPANT PERSPECTIVE - 1999

Results of cost benefit analysis show a net benefit (net present value) of \$55,828 from the participant perspective over the five year assumed lifespan. This is a net benefit of \$114 per participant. The quantified costs to the participants were less than the quantified benefits to the participants. **The cost per acre-foot of water saved from the participant perspective was \$0.**

#### OVERALL PERSPECTIVE - 1999

Results of cost benefit analysis show a net benefit (net present value) of \$8,905 from an overall perspective over the five year assumed lifespan. This is a net benefit of \$18 per participant. The quantified costs to the participants and utility were less than the quantified benefits to the participants and utility. **The cost per acre-foot of water saved from an overall perspective was \$1,307.**

#### 2000 PROGRAM

- ◆ The quantified cost to the utility was \$36,405 (\$124 per participant). This cost includes capital expenditures and labor, \$36,405.
- ◆ The quantified benefit to the utility was \$0.
- ◆ The quantified cost to the participants was \$0.
- ◆ The quantified benefit to the participants was \$21,357 (\$73 per participant). This benefit reflects participant water bill savings, \$21,357.

#### UTILITY PERSPECTIVE - 2000

Results of cost benefit analysis show a net benefit (net present value) of -\$36,405 from the utility perspective over the five year assumed lifespan. This is a net benefit of -\$125 per participant. The quantified costs to the utility were greater than the quantified benefits to the utility. **The cost per acre-foot of water saved from the utility perspective was \$2,615.**

#### PARTICIPANT PERSPECTIVE - 2000

Results of cost benefit analysis show a net benefit (net present value) of \$21,357 from the participant perspective over the five year assumed lifespan. This is a net benefit of \$73 per participant. The quantified costs to the participants were less than the quantified benefits to the participants. **The cost per acre-foot of water saved from the participant perspective was \$0.**

#### OVERALL PERSPECTIVE - 2000

Results of cost benefit analysis show a net benefit (net present value) of -\$15,046 from an overall perspective over the five year assumed lifespan. This is a net benefit of -\$51 per participant. The quantified

costs to the participants and utility were greater than the quantified benefits to the participants and utility. **The cost per acre-foot of water saved from an overall perspective was \$2,615.**

**2001 PROGRAM**

- ◆ The quantified cost to the utility was \$34,046 (\$140 per participant). This cost includes capital expenditures and labor, \$34,046.

2000 Quantified Costs and Benefits					
Utility			Participants		
Costs		Benefits	Costs	Benefits	
Capital & Labor	\$36,405	Not Quantified	Not Quantified	Water Bill Savings	\$21,357
Total	\$36,405			Total	\$21,357

- ◆ The quantified benefit to the utility was \$0.
- ◆ The quantified cost to the participants was \$0.
- ◆ The quantified benefit to the participants was \$719 (\$3 per participant). This benefit reflects participant water bill savings, \$719.

**UTILITY PERSPECTIVE - 2001**

Results of cost benefit analysis show a net benefit (net present value) of -\$34,046 from the utility perspective over the five year assumed lifespan. This is a net benefit of -\$140 per participant. The quantified costs to the utility were greater than the quantified benefits to the utility.

2001 Quantified Costs and Benefits					
Utility			Participants		
Costs		Benefits	Costs	Benefits	
Capital & Labor	\$34,046	Not Quantified	Not Quantified	Water Bill Savings	\$719
Total	\$34,046			Total	\$719

**The cost per acre-foot of water saved from the utility perspective was \$55,315.**

**PARTICIPANT PERSPECTIVE - 2001**

Results of cost benefit analysis show a net benefit (net present value) of \$719 from the participant perspective over the five year assumed lifespan. This is a net benefit of \$3 per participant. The quantified costs to the participants were less than the quantified benefits to the participants. **The cost per acre-foot of water saved from the participant perspective was \$0.**

**OVERALL PERSPECTIVE - 2001**

Results of cost benefit analysis show a net benefit (net present value) of -\$33,328 from an overall perspective over the five year assumed lifespan. This is a net benefit of -\$137 per participant. The quantified costs to the participants and utility were less than the quantified benefits to the participants and utility. **The cost per acre-foot of water saved from an overall perspective was \$55,315.**

**ALL YEARS**

- The quantified cost to the utility was \$117,373 (\$115 per participant). This cost includes capital expenditures and labor, \$117,373.
- The quantified benefit to the utility was \$0.
- The quantified cost to the participants was \$0.
- The quantified benefit to the participants was \$84,974 (\$83 per participant). This benefit reflects participant water bill savings, \$84,974.

ALL YEARS Quantified Costs and Benefits					
Utility			Participants		
Costs		Benefits	Costs	Benefits	
Capital & Labor	\$117,373	Not Quantified	Not Quantified	Water bill savings	\$84,974
Total	\$117,373			Total	\$84,974

**UTILITY PERSPECTIVE - ALL YEARS**

Results of cost benefit analysis show a net benefit (net present value) of -\$117,373 from the utility perspective over the five year assumed lifespan. This is a net benefit of -\$115 per participant. The quantified costs to the utility were greater than the quantified benefits to the utility. **The cost per acre-foot of water saved from the utility perspective was \$2,327.**

**PARTICIPANT PERSPECTIVE - ALL YEARS**

Results of cost benefit analysis show a net benefit (net present value) of \$84,974 from the participant perspective over the five year assumed lifespan. This is a net benefit of -\$83 per participant. The quantified costs to the participants were less than the quantified benefits to the participants. **The cost per acre-foot of water saved from the participant perspective was \$0.**

**OVERALL PERSPECTIVE - ALL YEARS**

Results of cost benefit analysis show a net benefit (net present value) of -\$32,398 from an overall perspective over the five year assumed lifespan. This is a net benefit of -\$32 per participant. The quantified costs to the participants and utility were less than the quantified benefits to the participants and utility. **The cost per acre-foot of water saved from an overall perspective was \$2,327.**

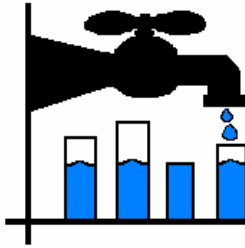
## UNQUANTIFIED COSTS AND BENEFITS

### Costs

- Landfill disposal of old devices.

### Benefits

- Financial savings on sewer bills for participants.
- Avoided costs of acquisition and distribution of water saved.
- Environmental benefits of reduced use of water.
- Increased public awareness about water conservation.
- Improved public relations for the utility.
- Reinforces need to conserve water and desirability of conserving.
- Participants received new water saving devices..



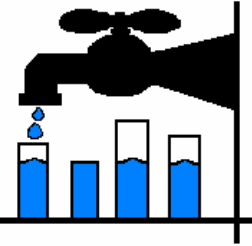
# Tucson Water Dept. Audit Program

Results of Cost Benefit Analysis-Lifespan (5 Years)		1999	
	UTILITY	PARTICIPANT	OVERALL
<u>Present Value Costs</u>			
Costs to Utility	46,923	NA	46,923
Costs to Participants	NA	0	0
Costs to Others	NA	NA	0
<b>Total Costs</b>	<b>\$46,923</b>	<b>\$0</b>	<b>\$46,923</b>
<u>Present Value Benefits</u>			
Total Water Savings	35.90 AF	35.90 AF	35.90 AF
Benefits to Utility	0	NA	0
Benefits to Participants	NA	55,828	55,828
Benefits to Others	NA	NA	0
<b>Total Benefits</b>	<b>\$0</b>	<b>\$55,828</b>	<b>\$55,828</b>
<u>Cost Benefit Calculations</u>			
Net Present Value (NPV) (Total Benefits - Total Costs)	-\$46,923	\$55,828	\$8,905
Cost Effectiveness Analysis (CEA) (Total Costs ÷ Total Water Savings)	\$1,307 /AF	\$0 /AF	\$1,307 /AF

Results of Cost Benefit Analysis-Lifespan (5 Years)		2000	
	UTILITY	PARTICIPANT	OVERALL
<u>Present Value Costs</u>			
Costs to Utility	36,403	NA	36,403
Costs to Participants	NA	0	0
Costs to Others	NA	NA	0
<b>Total Costs</b>	<b>\$36,403</b>	<b>\$0</b>	<b>\$36,403</b>
<u>Present Value Benefits</u>			
Total Water Savings	13.92 AF	13.92 AF	13.92 AF
Benefits to Utility	0	NA	0
Benefits to Participants	NA	21,357	21,357
Benefits to Others	NA	NA	0
<b>Total Benefits</b>	<b>\$0</b>	<b>\$21,357</b>	<b>\$21,357</b>
<u>Cost Benefit Calculations</u>			
Net Present Value (NPV) (Total Benefits - Total Costs)	-\$36,403	\$21,357	-\$15,046
Cost Effectiveness Analysis (CEA) (Total Costs ÷ Total Water Savings)	\$2,615 /AF	\$0 /AF	\$2,615 /AF

# Tucson Water Dept.

## Audit Program



2001	Results of Cost Benefit Analysis-Lifespan (5 Years)					
	UTILITY		PARTICIPANT		OVERALL	
<b><u>Present Value Costs</u></b>						
Costs to Utility	34,046		NA			34,046
Costs to Participants	NA		0			0
Costs to Others	NA		NA			0
<b>Total Costs</b>	<b>\$34,046</b>		<b>\$0</b>			<b>\$34,046</b>
<b><u>Present Value Benefits</u></b>						
<b>Total Water Savings</b>	<b>0.62</b>	<b>AF</b>	<b>0.62</b>	<b>AF</b>		<b>0.62 AF</b>
Benefits to Utility	0		NA			0
Benefits to Participants	NA		719			719
Benefits to Others	NA		NA			0
<b>Total Benefits</b>	<b>\$0</b>		<b>\$719</b>			<b>\$719</b>
<b><u>Cost Benefit Calculations</u></b>						
<b>Net Present Value (NPV)</b> (Total Benefits - Total Costs)	<b>-\$34,046</b>		<b>\$719</b>			<b>-\$33,328</b>
<b>Cost Effectiveness Analysis (CEA)</b> (Total Costs ÷ Total Water Savings)	<b>\$55,315 /AF</b>		<b>\$0 /AF</b>			<b>\$55,315 /AF</b>

ALL YEARS	Results of Cost Benefit Analysis-Lifespan (5 Years)					
	UTILITY		PARTICIPANT		OVERALL	
<b><u>Present Value Costs</u></b>						
Costs to Utility	117,373		NA			117,373
Costs to Participants	NA		0			0
Costs to Others	NA		NA			0
<b>Total Costs</b>	<b>\$117,373</b>		<b>\$0</b>			<b>\$117,373</b>
<b><u>Present Value Benefits</u></b>						
<b>Total Water Savings</b>	<b>50.44</b>	<b>AF</b>	<b>50.44</b>	<b>AF</b>		<b>50.44 AF</b>
Benefits to Utility	0		NA			0
Benefits to Participants	NA		84,974			84,974
Benefits to Others	NA		NA			0
<b>Total Benefits</b>	<b>\$0</b>		<b>\$84,974</b>			<b>\$84,974</b>
<b><u>Cost Benefit Calculations</u></b>						
<b>Net Present Value (NPV)</b> (Total Benefits - Total Costs)	<b>-\$117,373</b>		<b>\$84,974</b>			<b>-\$32,398</b>
<b>Cost Effectiveness Analysis (CEA)</b> (Total Costs ÷ Total Water Savings)	<b>\$2,327 /AF</b>		<b>\$0 /AF</b>			<b>\$2,327/AF</b>