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Evaluation of a Cash Award Program for Water Conservation

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EVALUATION OF A CASH AWARD PROGRAM FOR WATER CONSERVATION

by

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Table of Contents

List of Tables

List of Figures

Introduction

This document is the final report of a water conservation study funded by the U.S. Bureau of Reclamation and The University of Texas at El Paso with cooperation from El Paso Water Utilities. The study period was from September, 1997 through January, 2000.

Background

Many areas of the United States are faced with the prospect of potable water shortages now or in the very near future, especially cities located in the Southwestern United States. To alleviate the problem, a number of strategies have already been implemented or are currently in the planning stages, including desalting of brackish water, wastewater recycling, tertiary treatment to near drinking water quality, water importation, and many others. Each of these strategies has high cost, greatly increasing the incremental cost of delivery to meet growing water system demand.

The emphasis these days, however, seems to be in the area of water conservation and demand management as exemplified by the August 1998 EPA Water Conservation Plan Guidelines (1). These guidelines, Basic, Intermediate and Advanced, contain recommendations for water systems of all sizes, from small systems serving less than 10,000 people to large systems serving over 100,000. The Advanced guidelines include replacements and promotions, reuse and recycling, water-use regulation, and integrated resource management. The focus of this thesis described in this report would best fit under the category of promotions. It offers a strategy to formulate a viable positive inducement model to reduce water consumption at the residential level.

Chapter 1: Project Description

Behaviors toward water consumption can be modified through either negative or positive inducements. A negative inducement, for example, would be a price increase. A positive inducement would be a cash rebate. This thesis involved promotion and study of a positive inducement (cash award) for reducing household water consumption during high summer water use months. Its uniqueness lies in the fact that the homeowner was not required to spend any money at all in order to receive the cash award. Neither was the homeowner required to demonstrate any structural change that would guarantee continuing reductions in water consumption for future years. The homeowner was merely required to exceed a targeted percentage reduction in summertime residential demand. The designers of this study aimed to demonstrate that a positive inducement program in the form of a cash award could be an economically viable means to slow the need for development of more expensive water resource options.

The program was carried out in two parts. Part I involved data collection during the Summer of 1998 and was open to the first 100 applicants who volunteered to participate. About one half of the applicants were accepted unconditionally, with the other half told that they would receive an award only if some of the fully accepted participants failed to achieve their targeted reductions. Part II was carried out in the Summer of 1999, but instead of volunteers, participants were randomly selected uniformly across the city and the award structure was slightly different. Specifically, Part I involved offering residential customers the opportunity to earn either $100.00 or $250.00 by conserving water in the four high water usage months of May, June, July, and August of 1998 as compared to the same months of the previous year.

Participants were asked to choose program 1 or program 2, depending on the percent reduction in water use they thought they could achieve. If they thought they could save 35% or more, they could choose program 1, and if successful, they would be given a $250 award. If they thought they could save at least 20%, but not 35%; they could choose program 2 and possibly earn a $100 award. If they did not

reduce their consumption by the minimum required for the program they chose, they would earn nothing, even if program 1 participants saved an amount of water that would have earned them an award had they chosen program 2. Similarly, those who selected program 2 (20% reduction) could not receive the $250 award associated with program 1 even if their reduction exceeded 35%. A copy of the program announcement is included in Appendix A.

For Part II, in addition to participants being randomly selected instead of volunteering, the cash award structure was different as shown in Table 1.1.

Table 1.1: Part II Cash Award Structure

Percent Savings over Previous Year, %	Award Amount, $
0 – 15	0
16 – 30	50
31 – 45	150
>45	250

Those selected to participate in Part II were told that if they decreased their water use by 16% or more over the previous year's summertime consumption, they would receive cash awards commensurate with their reduction as shown in Table 1.1. The procedure for selecting the participants is described in the next section of this report.

A differentiating characteristic of this award program as compared to typical rebate programs is that, besides not requiring any expenditure at all, participants had maximum flexibility to adopt whatever type of water conservation practices they desired, without requirement to make any structural change guaranteeing any specific volume of water consumption reductions continuing into future years. This award structure provided the maximum flexibility and opportunity for virtually everyone in the study area to participate regardless of their present water consumption rates.

Chapter 2: Project Implementation

Once the participants were identified, their water use information for the preceding May thru August time period (i.e. 1997) was obtained from El Paso Water Utility records. The amount of water used by two neighbors of the participant was also recorded for the same May thru August study period to serve as a control group.

For Part II of the project, 122 participants were randomly selected by first constructing a grid on top of a list of street names from a city map and then selecting the streets where the lines intersected each other. Next, one participant from each street was randomly selected from El Paso Water Utility's customer data base. All potential participants were then notified of their selection for the program via a letter and acceptance form. Only one of the persons initially selected declined to participate. As in Part I, two neighbors of the participant were selected to serve as a control group and their previous year's water use (May thru August) was recorded along with that of the participant.

At the end of each part of the study, participants were questioned about what they did to reduce their water use.

Chapter 3: Results and Discussion

3.1 Analysis of Water Use Data – Part I

Initially there were 104 self-selected participants in Part I of the study and 199 neighbor accounts identified to be studied. However of these accounts, one participant account and three of the neighbor accounts had been closed, transferred to another responsible party or otherwise inactivated before the end of the study period. These accounts therefore are not represented any further in the discussion that follows, nor are they considered as participants or controls.

Figure 3.1 is a pre-study period (i.e. 1997) percentile ranking of the average water consumption rates in gallons per day (GPD) of Part I participants (i.e. volunteers) and their neighbors (i.e. control group) for the months of May thru August. The two groups were approximately the same, with the neighbors' median value of 533 gal/day slightly higher than the participants' median of 511 gal/day.

In Figure 3.1, note that water usage is bounded on the lower end at 0 gal/day and unbounded on the upper end. It is also observed that water usage for participants and neighbors in the top 5 percent quickly diverges from the otherwise representative group with excessively high individual water usage at each of these accounts. And note as well that at the lower end of usage at least a couple of the Part I participant and the neighbor accounts show usage under 100 gal/day. These participants likely did not understand the programs offered and would not have volunteered had they a better understanding.

Figure 3.2 is a pre-study period relative frequency histogram for the same 1997 water use data revealing apparent differences between the participants and the neighbor controls. This chart shows the data are not normally distributed, but instead yield a right-skewed distribution.

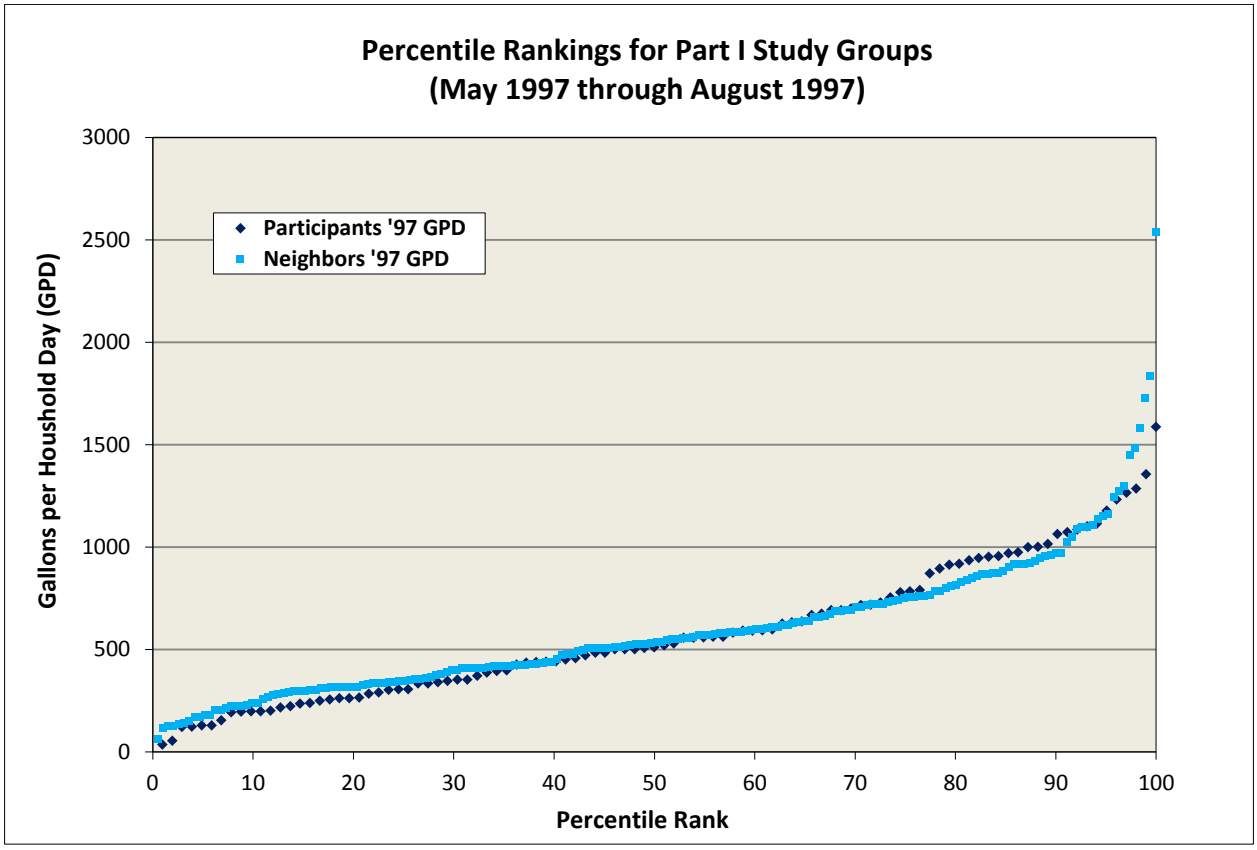

Figure 3.1: Percentile Rankings for Part I Study Groups

Retaining unrepresentative values from the accounts on both the upper and lower end in the evaluation of the Part I study could create error in estimation of the value and influence of the cash awards programs. In order to remove unnecessary influence in the results, the researcher determined it best to remove data for participants and neighbors who had less than 16 CCF usage over the summer period (< 98 gal/day). The researcher also determined to test the data set and remove any potential outliers on the upper end to strengthen the conclusions, and to offer an alternative suggestion to address the excessive consumptive behaviors of this relatively small group of water customers.

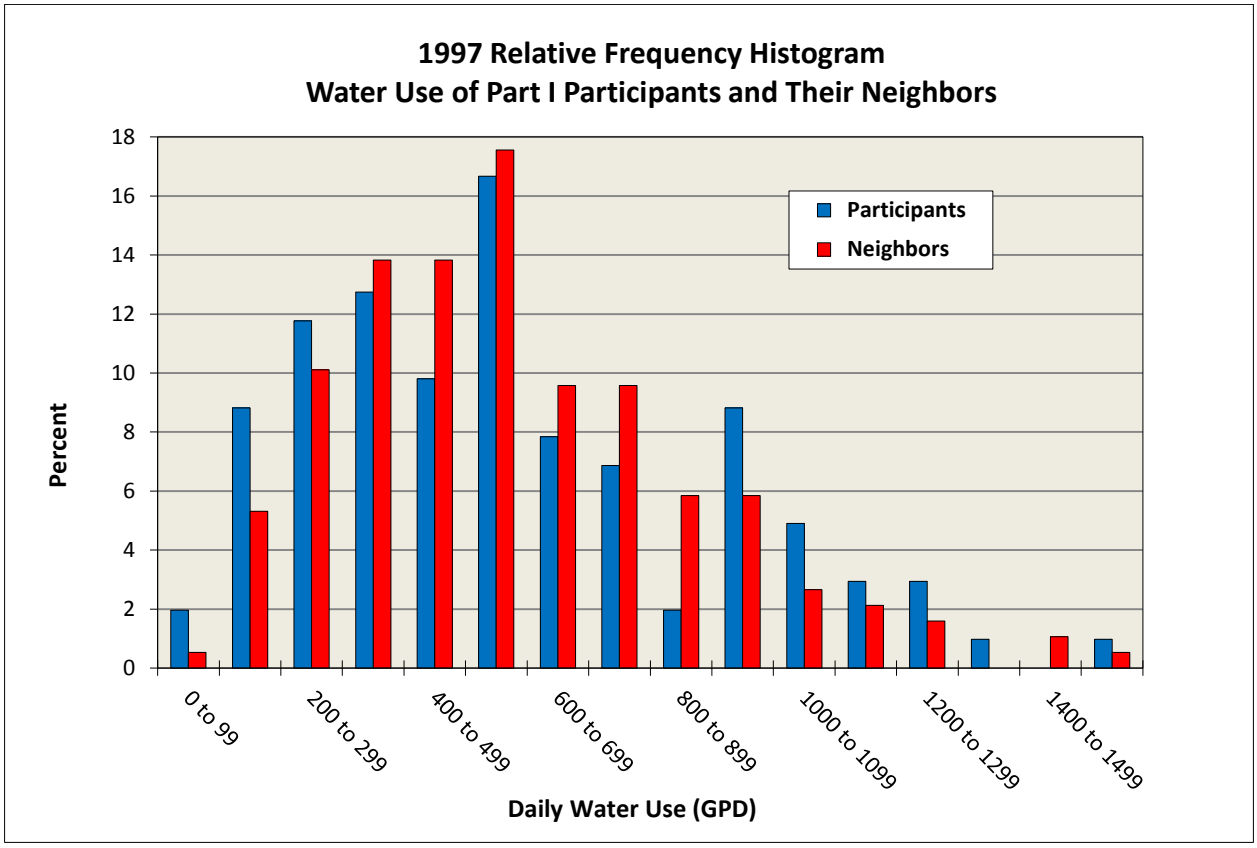

Figure 3.2: 1997 Relative Frequency Histogram

A common rule of thumb tool used to identify potential outliers in a data set is to identify the interquartile range ($IQR = Q_3 - Q_1$) and to consider value(s) 1.5 x IQR below the first quartile (Q_1) or above the third quartile (Q_3) as possible outliers. Applying this method within the control neighbor accounts in 1997, Q_1 equals 356 and Q_3 equals 757. Therefore the IQR equals 401 and we consider values above (1.5 x 401) + 757 = 1,358 gal/day to be unrepresentative. Of the total 299 participants and neighbors studied in Part I, a total of eight (8) accounts (~2.64%) exceeded 1,358 gal/day and were excluded when determining the impact of the offered awards in Part I. Also excluded were four (4) accounts (~1.32%) that used less than 98 gal/day. Following removal of the unrepresentative data, 100 participant accounts and 187 neighbor accounts remained to be examined for change during the 1998 summer test period.

Table 3.1 shows the results at the end of Part I of the study for the 100 remaining participants and their 187 neighbors.

Table 3.1: Part I Results

Group Name, (n = 287)	1997 GPD_{med}	1997 GPD_{avg}	1998 GPD_{med}	1998 GPD_{avg}	ΔGPD_{avg} %	% Pos +	% Neg -
Program 1 Accepted, (n=21)	472	502	497	496	-1.3%	38%	62%
Program 2 Accepted, (n=33)	440	493	423	482	-2.2%	55%	45%
Combined Accepted, (n=54)	**462**	**497**	**439**	**488**	**-1.8%**	**48%**	**52%**
Program 1 Alternate, (n=21)	692	707	505	603	-14.8%	29%	67%
Program 2 Alternate, (n=25)	653	662	589	574	-13.3%	40%	56%
Combined Alternate, (n=46)	**656**	**683**	**568**	**587**	**-14.0%**	**35%**	**61%**
Program 1, (n=42)	571	605	501	549	-9.2%	33%	64%
Program 2, (n=58)	515	566	491	522	-7.8%	47%	50%
Programs 1 and 2, (n=100)	**524**	**582**	**501**	**533**	**-8.4%**	**42%**	**56%**
Neighbor Controls, (n=187)	**525**	**554**	**544**	**572**	**+3.1%**	**56%**	**42%**

Table 3.1 provides an opportunity for discussion of the differences between the participants and their neighbors used as controls. The table shows adjusted median values for daily water use (gal/day) for both groups of participants (i.e. those who were unconditionally accepted and those selected as alternates) and their neighbors for the pre-study 1997 and the post study 1998 study periods (i.e. May thru August). The mean water use by the combined volunteer groups decreased considerably, averaging about a 8.4% reduction, while mean water use by the neighbors increased by 3.1%, yielding an apparent net reduction of 11.5% by program participants. When the two groups of participants are considered separately, the results show that those accepted as alternates reduced their water usage by a significantly greater volume and percentage than those who were unconditionally accepted. This occurred even though some of the alternates would have probably believed they had almost no chance of receiving an award. (This is because the notification letter stated that there were only 58 participants chosen

unconditionally and that the alternate was the *x*th alternate, where *x* varied from 1 to 46). These results would seem to imply that many if not most of the people who volunteered for the program would have reduced their water usage even without the cash incentive program, and perhaps some were merely being opportunistic after the program was announced.

Examination of the 1997 pre-study data in Table 3.1 reveals that there was only a slight difference in daily water use between the self-selected participants and their neighbors used as a control, with median water usage at 524 gal/day and 525 gal/day respectively. But when one distinguishes between the unconditionally accepted participants and those accepted as alternates, the differences in pre-study 1997 data are quite apparent, with median water use among the accepted participants at 462 gal/day and the alternates at 656 gal/day.

The study in Part I was to determine if cash awards create influence towards water reductions in a self-selected group of participants in the water conservation programs. However the results shown in Table 3.1 are mixed in determining if in fact the offer of a cash award was indeed an influencing factor, or if something else came into play for those who self-selected to participate. In consideration of the design it must be noted that the Part I cash award programs were first come, first served. Therefore it is possible that the accepted participants were 'early adopters', ambitious optimists who were earliest to self-select. The alternate participants self-selected later in the program adoption period, most likely due to a recognized opportunity to benefit due to changes already planned or implemented. Oftentimes utilities term these type award program participants as 'free-riders' because they would have made the desired adjustments in consumption with or without the influence created by the offer of an incentive.

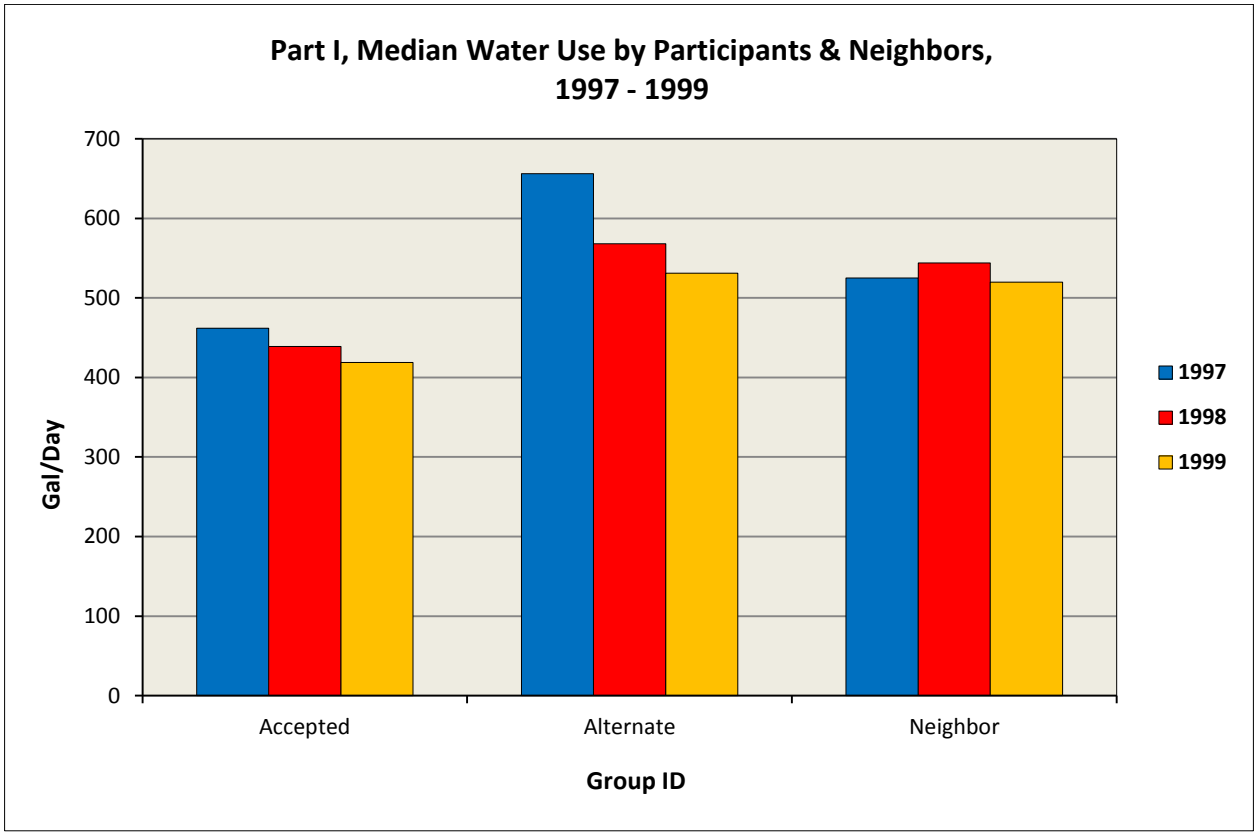

Figure 3.3: Part I, Median Use by Participants and Neighbors

In order to determine if the reduced water use by the participants was only temporary or if it was permanent, the Part I participants' and their neighbors' water consumption records were checked in 1999 (i.e. one year after the 1998 test period). Figure 3.3 is a graph of the median water use amounts for the participants and neighbors for the years 1997 (pre-study period), 1998 (test period) and 1999 (one year after test period). The graph shows that water use for all three groups decreased in 1999. Because of the similarity in the reductions by both the participants and the neighbor control group, these reductions were probably due to some other cause or condition in the summer of 1999 rather than changes intentionally made by the customers to reduce their water consumption. These results indicate that the permanent physical changes and/or behavior modifications which were responsible for the participants' reduced water consumption persisted for at least one year following the award period.

However, as discussed later in this report, their reduced water consumption is believed to be due to something other than the cash award program.

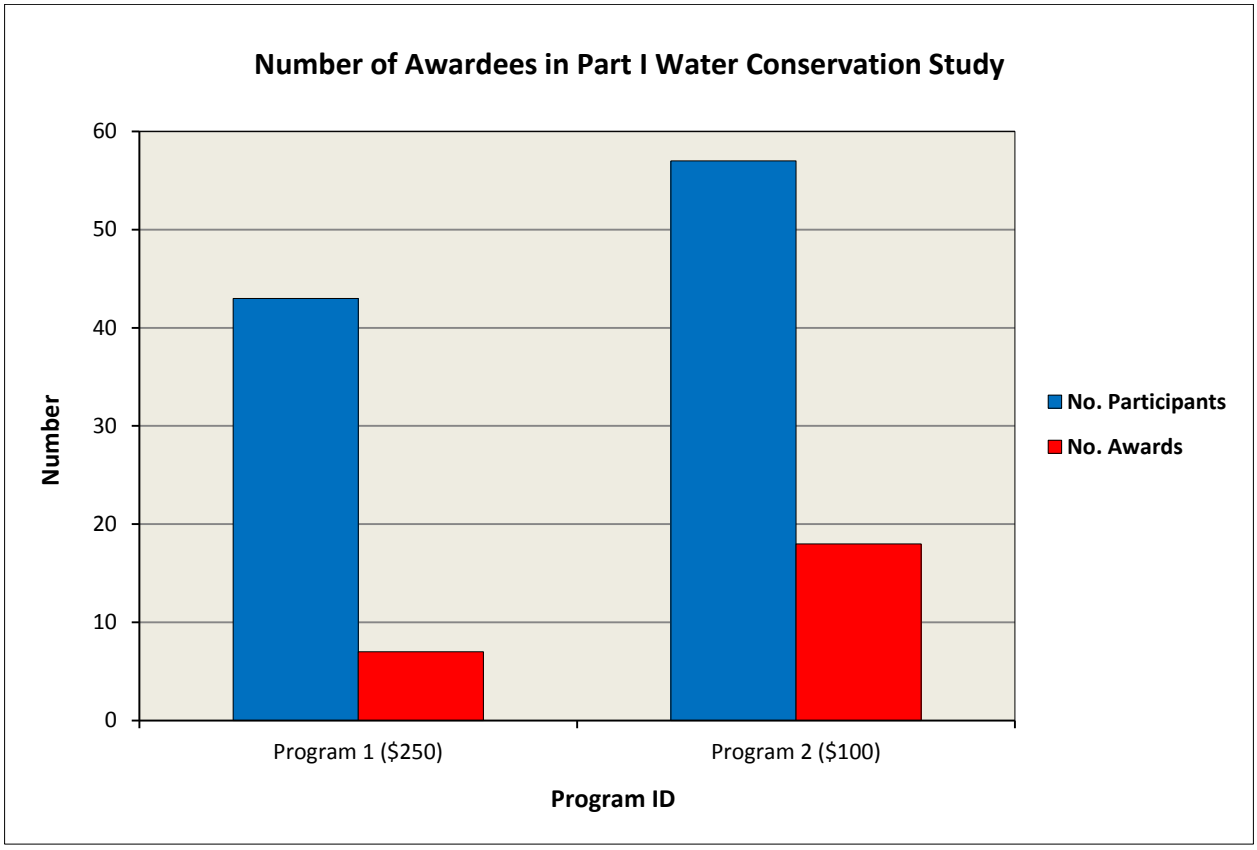

Figure 3.4: Number of Awardees, Part I

Figure 3.4 shows the number of participants in each program who were successful in meeting or exceeding their water conservation goals. Of the 100 participant accounts, both accepted and alternate, only 25% of all participants reduced their water use by the amount they said they would, with only 16% of the participants in Program 1 (>35% reduction) and 32% of the participants in Program 2 (>20% reduction) qualifying for an award. The total amount of money awarded to both groups was $3,050. This equates to an average award cost of $7.63 per summer month for the entire self-selected group of participants as compared to $12.38 per summer month had this self-selected group been more accurate regarding their potential reductions. Further comparison can be made with the neighbors who would

have had the potential to earn on average over the entire control group $5.47 per summer month given the reduction in use that some of the accounts happened to achieve even without the incentive offer. These figures do not attempt to account for the net reduction in utility revenue caused by the reduction in volumetric sales, nor do they account for the reduced variable costs of production and development associated with lower levels of product delivery.

It should also be clarified at this time that we began this process with 104 participant accounts and 199 neighbor accounts. Of the 104 self-selected participant accounts, the four excluded from consideration in the analysis were 1) two accounts using less than 98 gal/day; 2) a single account whose owner had left El Paso for the Summer of 1998, shutting off the water during the study period; and 3) another account whose water use was 1,587 gal/day in the Summer of 1997. The two low use accounts usage was unchanged in 1998 study period. And, although the 1587 gal/day user did reduce usage in 1998 by 10.1% to 1,426 gal/day, it did not seem likely that this reduction had anything to do with a decided intent to reduce water usage. By comparison to the neighbors whose accounts were also excluded as being unrepresentative from the upper range due to excessive use (i.e. > 1,358 gal/day), these too remained essentially unchanged by any amount more than ±15%, and they did not have an incentive offered to them other than the magnitude of their water bills. Therefore removal of the outlier accounts is not considered to have effect upon the conclusions of the study for Part I.

3.2 Analysis of Water Use Data – Part II

In Part II of this study, 122 El Paso Water Utility customers were randomly selected to participate in the award program. Of those randomly identified 121 agreed to participate and were studied to determine if the offer of the Part II award structure created sufficient incentive to entice participants to conserve as compared to their neighbor controls. Sufficient data resources were made available to the researcher for Part II of the study to view records including the May thru August periods of 1996, 1997, 1998 and the award offer study period of 1999.

Figures 3.5, 3.6 and 3.7 represent pre-study periods (i.e. 1996, 1997 and 1998) percentile ranking of the average water consumption rates in gallons per day (GPD) of Part II participants (i.e. randomly selected and alerted to the award offer) and their neighbors (i.e. control group) for the months of May thru August for each of the three years preceding the study period (1999). The comparison period for the Part II award program was the change from 1998 to the target conservation period of 1999. As seen in each of the Figures 3.5, 3.6 and 3.7, the two groups (neighbors and participants) were approximately the same. The neighbors' median values in each of the pre-study years were 541, 532 and 566 gal/day respectively for each consecutive year, whereas the participants' median values were 537, 548 and 533 gal/day in 1996, 1997 and 1998 respectively.

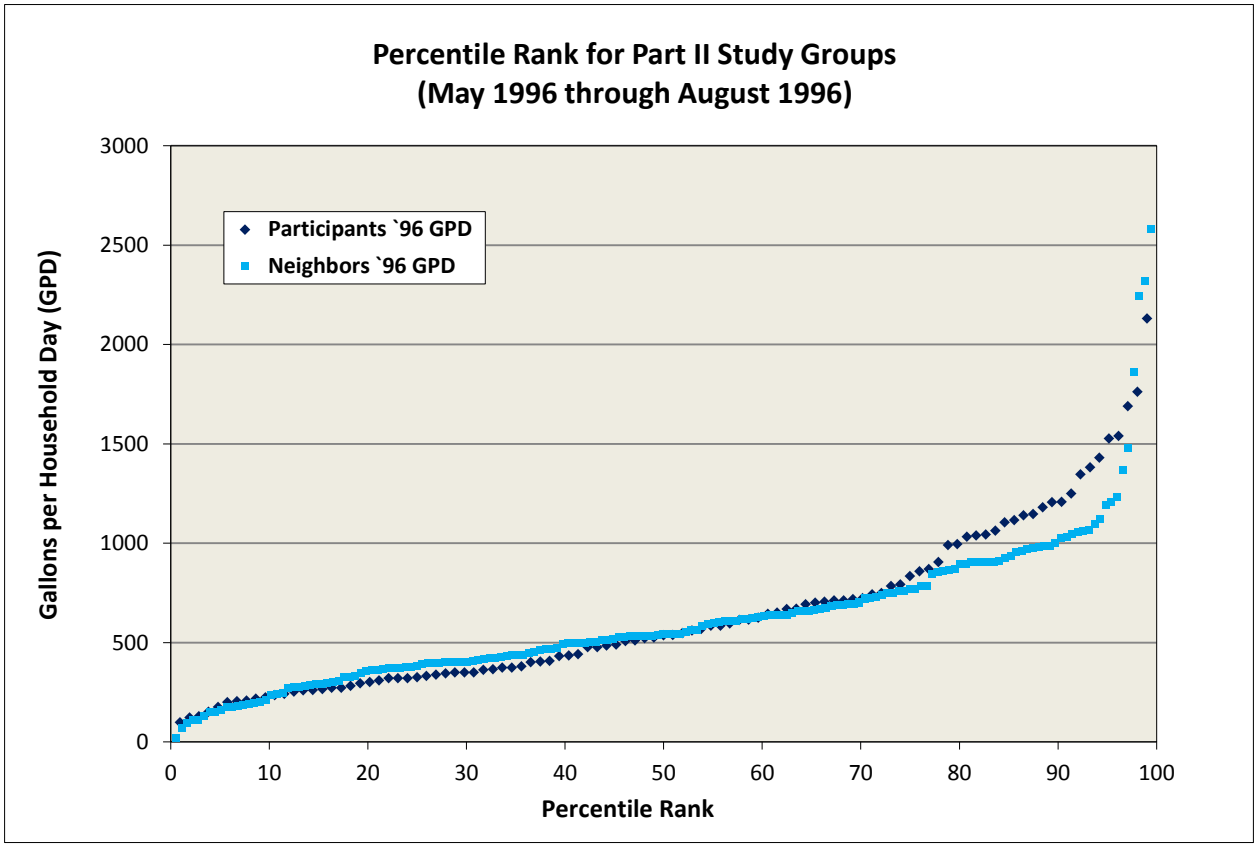

Figure 3.5: Percentile Rank for Part II, Summer 1996

As was discussed with Figure 3.1, note in Figures 3.5, 3.6 and 3.7 that water usage is bounded on the lower end at 0 gal/day and unbounded on the upper end. It is also observed in each of the three years that the characteristic water usage for participants and neighbors in the range above the 95 percentile rank quickly diverges from the otherwise representative group with excessively high individual water usage at each of these accounts.

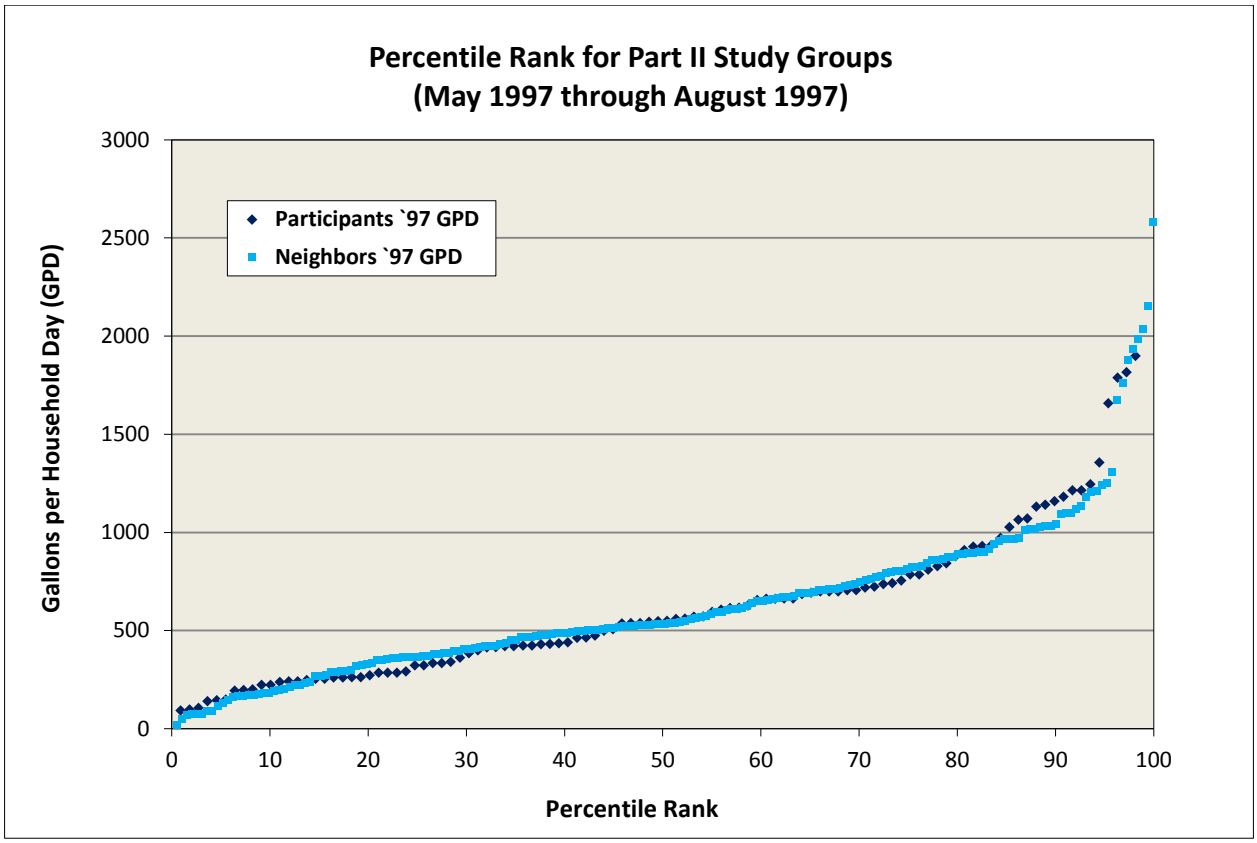

Figure 3.6: Percentile Rank for Part II, Summer 1997

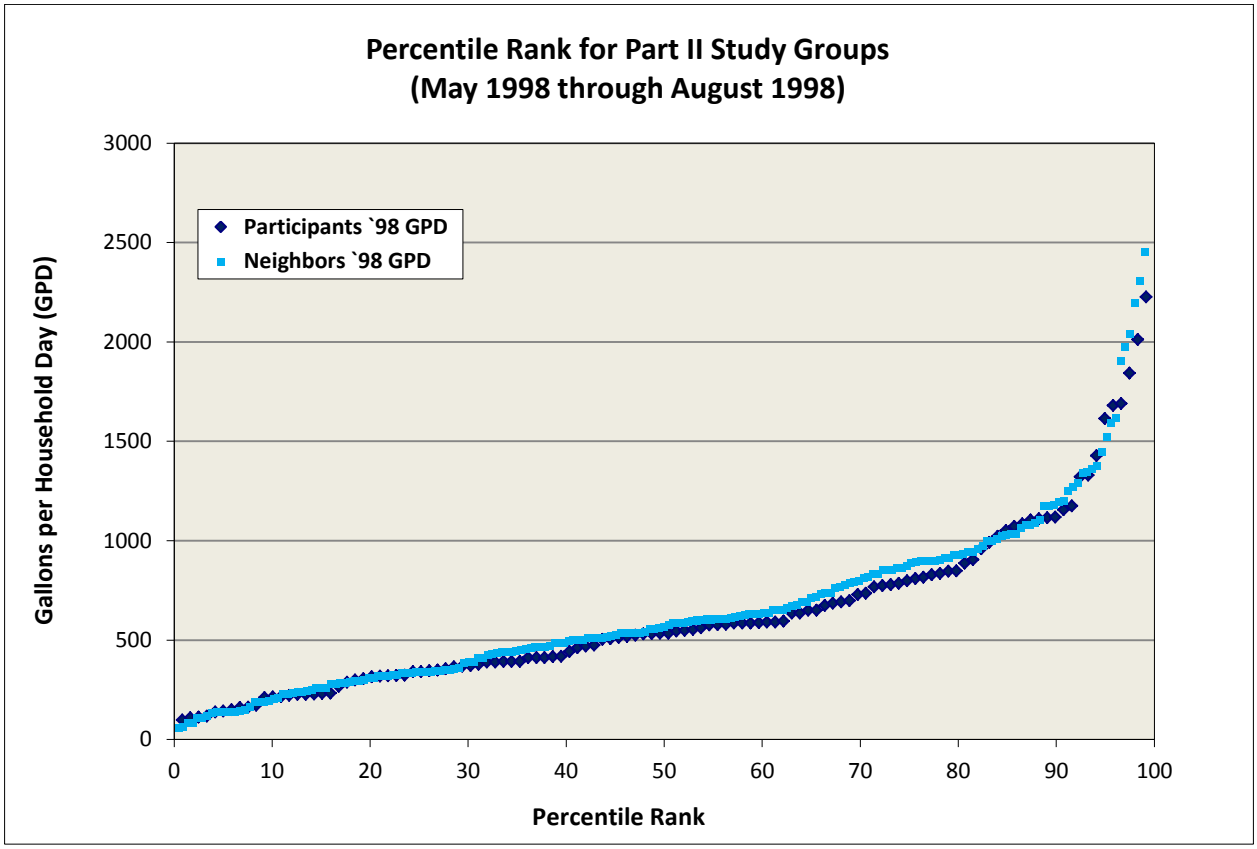

Figure 3.7: Percentile Rank for Part II, Summer 1998

As in Part I of the study, the researcher determined it best in Part II to perform the comparison of participants and neighbors on as equal of terms as possible. Since three years' worth of pre-study data were available, and a significant number of accounts were selected to work from, the evaluation of costs and benefit were limited in scope to only those accounts that were active and without faulty meters for all four years (1996 through 1999). Furthermore, to reduce unnecessary influence upon the results by outlier behavior among the participants or neighbors, the same sample range of accounts was considered as in Part I (i.e. accounts with usage between 98 and 1,358 gal/day). The other accounts were still eligible for awards if they achieved the desired reductions, but in the analysis they were excluded if their usage fell out of the representative sample range of confidence. Thereafter 91 participant accounts and

155 neighbor accounts remained to evaluate the influence of the award incentive program of Part II of the study.

Table 3.2 below summarizes the remaining data evaluated for the 91 remaining participants and the 155 neighbor accounts used as a control group.

Table 3.2: Part II Results

Group Name, (n = 246)	1996 GPD_{med}	1996 GPD_{avg}	1997 GPD_{med}	1997 GPD_{avg}	1998 GPD_{med}	1998 GPD_{avg}	1999 GPD_{med}	1999 GPD_{avg}	ΔGPD_{avg} %
Participants, (n=91)	498	552	503	548	528	561	445	521	**-7.1%**
Neighbors, (n=155)	531	571	533	586	584	608	510	555	**-8.7%**

Table 3.2 shows both the median and average daily amount of water use by the participants and their neighbors through the four summers (1996 through 1999). Clearly there was no significant difference between the participants and the neighbors in any of the years. The participants' water use decreased from a median value of 528 GPD in 1998 to 445 GPD in 1999, but their neighbors' water use decreased a near equal amount, from 584 to 510 GPD. Furthermore, if the criteria for receiving a cash award were applied to the neighbors, they would have earned an average award of $42 per household versus only $40 per household for the participants. Therefore, the reduction by the participants (and the neighbor controls) was purely coincidental, likely related to other favorable conditions or factors, rather than the cash award program that the participants were randomly enrolled in. The questionnaire results discussed below support this supposition.

Figure 3.8 shows the percentage of Part II participants and neighbors who would have qualified for an award (i.e. at least a 15% reduction) as a function of average daily water usage (by quartiles). This graph shows that, in general, the households with the highest water usage were the ones most likely to achieve at least a 15% reduction in water use between the summers of 1998 and 1999. It also shows

that a significant percentage (~33%) of EPWU customers (i.e. neighbors) reduced their water usage by more than 15% between '98 and '99 even though they had nothing to do with this program.

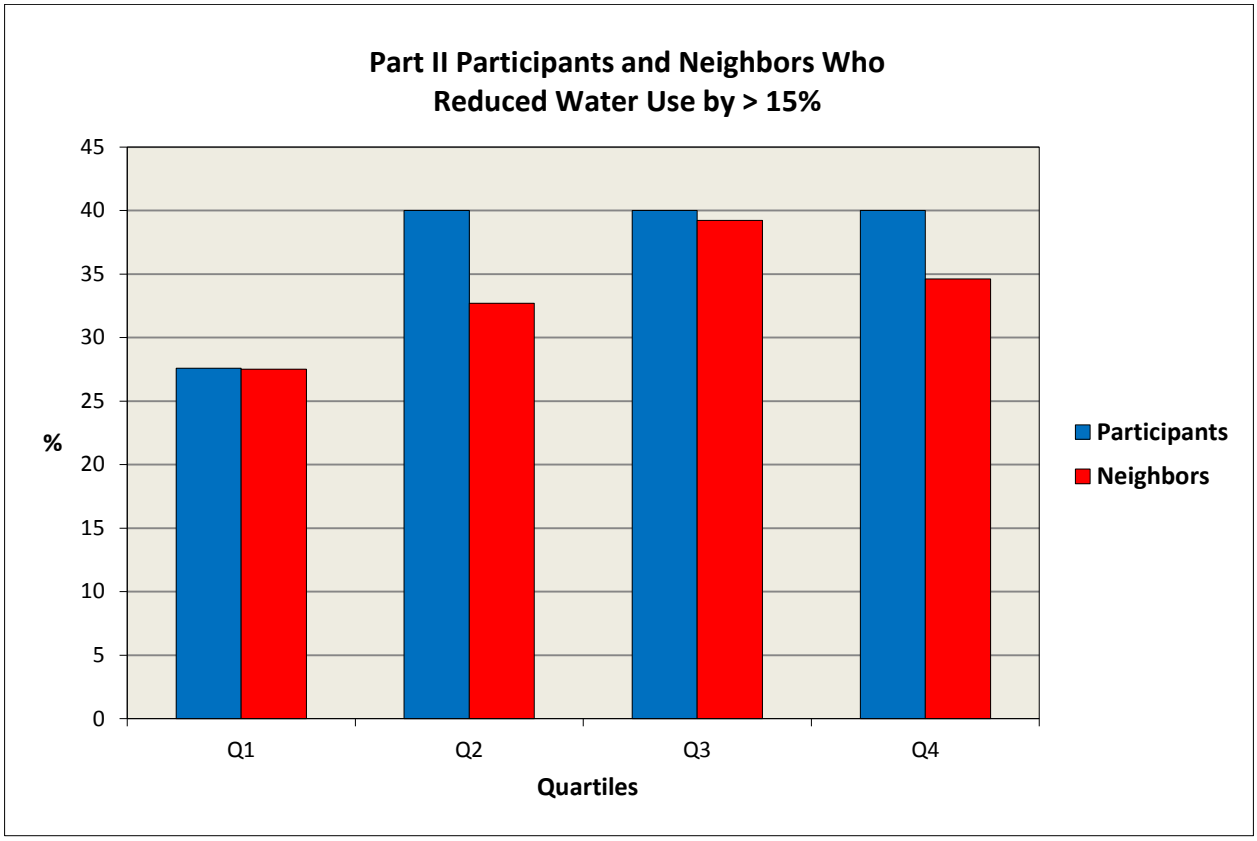

Figure 3.8: Awardee Comparison, Part II, Summer 1999

3.3 Conservation above the 90th Percentile

In both Part I and II we observed that water use diverged quickly among the customers above the 95th percentile, and so our analysis of the award programs excluded some of these accounts using the Interquartile Range rule-of-thumb (IQR method) to identify and consider potential outliers. We also observed above in Figure 3.8 that the households with the highest water usage were the ones most likely to achieve at least a 15% reduction in water use. The question remaining is whether or not the highest water consumers were in fact truly outliers, or if instead there was a measure of changed usage observed in the high use accounts due to the conservation award offers. In order to make this determination the

researcher investigated the changes above the 90th percentile in the Participant and Neighbor accounts for the two study periods. Results of this analysis are shown below in Table 3.3.

Table 3.3: Results for Accounts above 90th Percentile

Group Name, (n = 40)	1997 GPD_{med}	1997 GPD_{avg}	1998 GPD_{med}	1998 GPD_{avg}	1999 GPD_{med}	1999 GPD_{avg}	ΔGPD_{avg} %	$/n	$/CCF
Part I Participants, (n=10)	1205	1228	1025	1011	-	-	**-17.7%**	$80.00	$2.29
Part I Neighbors, (n=19)	1132	1293	1162	1331	-	-	**+2.9%**	$15.79	**LOSS**
Part II Participants, (n=11)	-	-	1680	1822	1521	1640	**-10.0%**	$36.36	$1.24
Part II Neighbors, (n=20)	-	-	1555	1893	1218	1634	**-13.7%**	$47.50	$1.13

From the Table 3.3 results for accounts with water usage above the 90th percentile, it is clear that the Part I self-selected participants in the Summer of 1998 study reduced their water usage by 17.7% at an average award program cost of $80 per participant, while their neighbors increased 2.9%. This suggests an overall reduction among the motivated self-selected group of ~20%. This cost averaged $2.29 per CCF (100 cubic feet) of 1998 conserved water within the self-selected participants group having 1997 pre-study usage above the 90th percentile. Presuming that some of the conservation achieved in this group is due to some fraction of permanent changes implemented at the residences, it would be a cost effective means for EPWU to solicit self-selected participation in such a program from high water consumers in order to motivate change. However, it is also noted that among the neighbor accounts, if the award were not advertised to customers but broadly applied to all customers in the top ten percent of water consumers, there would have been a cost to the utility of $15.79 per account above the 90th percentile with absolutely no resulting conservation efforts and only coincidental reductions in

some accounts. Therefore the utility would necessarily need to be highly specific with its participating customers and targeted exclusively within the highly consumptive group in order for such a program to be both successful and cost effective.

For the Part II program during the Summer of 1999, similar to the findings in Table 3.2, likewise there appears in Table 3.3 to have been savings of water in the randomly selected participants' accounts. But as previously noted the neighbors' savings were greater than the participants' and therefore it likely was due to some other coincidental cause of reduction rather than due to the award opportunity offered to the Part II randomly selected participants.

3.4 Responses to Questionnaires

The results obtained from the questionnaires that were administered after Parts I and II of this study are summarized in Appendix B. Some of these results are discussed below. Figure 3.9 is a plot of the percent grass in the front and back yards of the people who volunteered for Part I of this study. The graph shows that while most of the people had no grass at all in their front yard, over 69% of them had at least $^1/_2$ of their back yard covered with grass. Most (i.e. 83%) of the participants in the study indicated that their landscape had been in place for more than one year. However, of those who said their landscaping was less than one year old, 78% reduced their water use by at least 20%, as might be expected. Clearly, removal of grass lawns is one major way to reduce summertime water use by a significant amount.

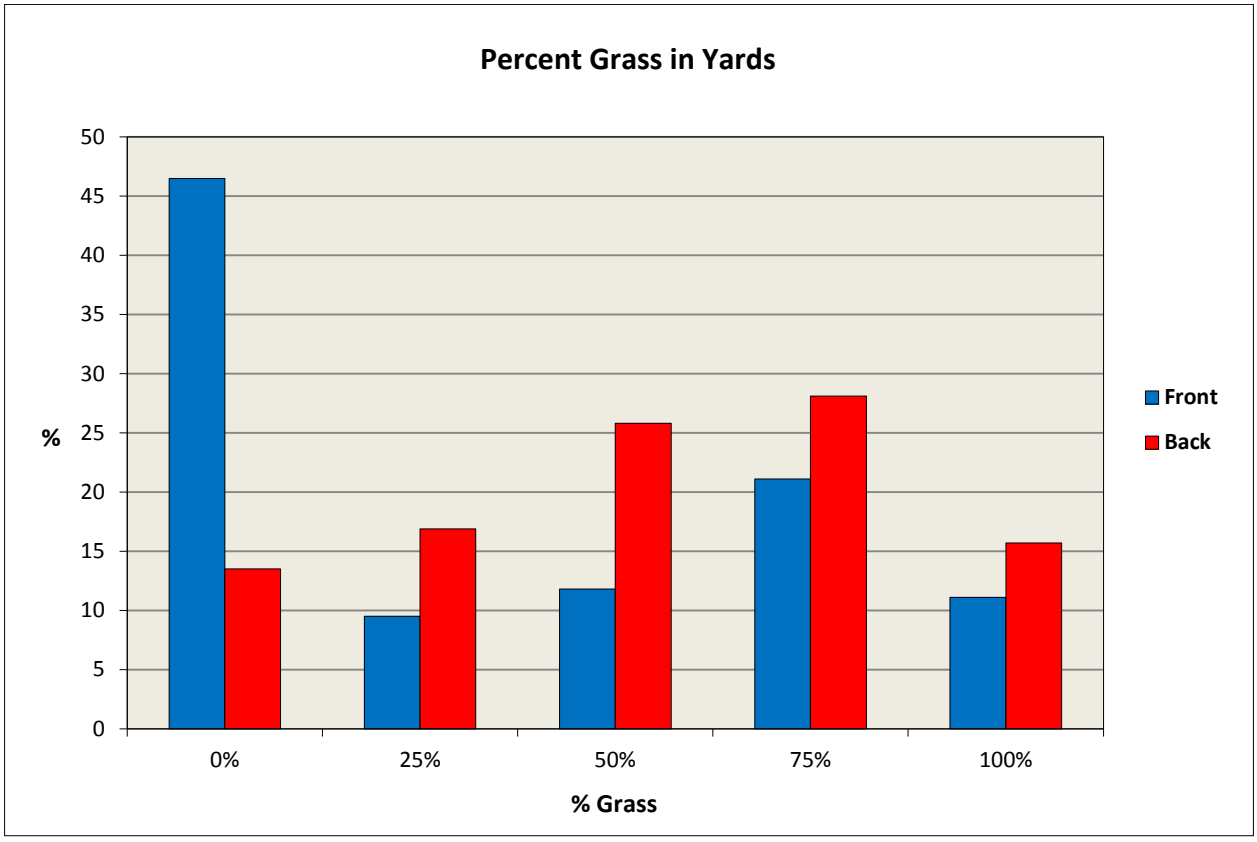

Figure 3.9: Percent Grass on Yards

Figure 3.10 shows the percentage of Part I participants who have taken advantage of El Paso Water Utility's toilet rebate program. It is surprising to find that even among people who are relatively highly motivated to conserve, over 65% have not taken advantage of a very economically attractive opportunity to reduce water use.

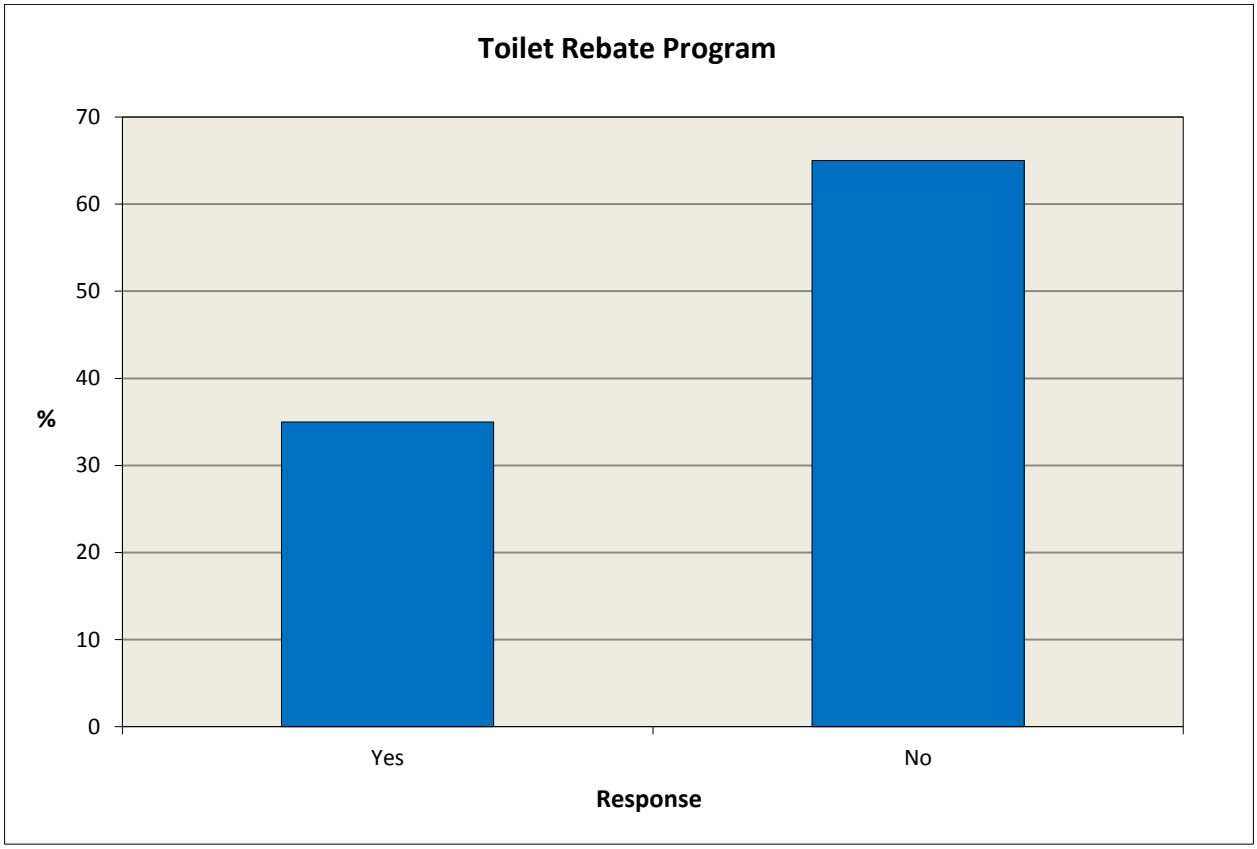

Figure 3.10: Participation in Toilet Rebate Program

Figure 3.11 is a graph showing the extent to which participants in Parts I and II of the study intentionally decided to conserve water, as well as whether or not the offer of a cash award influenced them to do so. The figure shows that over 93% of people who participated in Part I and 86% of those who participated in Part II said they did make some changes which could have affected their water use during the study period. However, the figure also shows that while 75% of the respondents in Part I (i.e. volunteers) said that their changes were made because of the cash award program, over 68% of the participants in Part II said that their changes were not. In fact, many said that they had forgotten about the program completely.

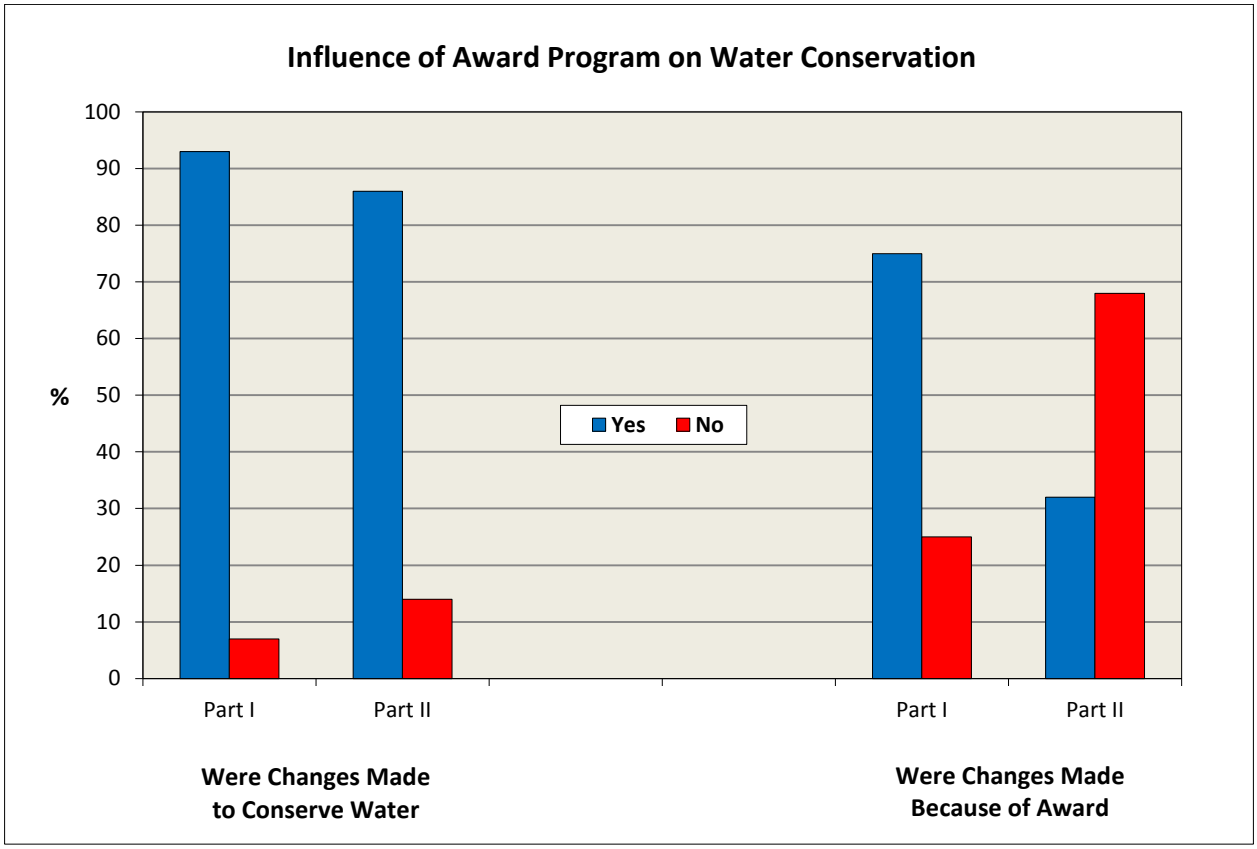

Figure 3.11: Award Influence on Conservation of Water

The results previously discussed for Part I show that both groups of volunteers saved water (i.e. those who were accepted unconditionally and the alternates), but they also indicate that the opportunity for an award by the program did not create the inducement for the volunteers to conserve water. Similarly Figure 3.12 also reinforces the negative sentiments of the participants in Part II. It shows that, on a scale of 0-10 (0 representing no influence by the program and 10 maximum influence), over 51% of the respondents said the program had zero influence upon them, with only 5.1% saying that the cash award program had maximum influence on their conservation efforts. The difference in the responses between the volunteers and randomly selected participants could be related to the way the participants were queried. The volunteers were queried via a phone call from the researcher while those who were randomly selected were sent a questionnaire through the mail. It is likely that the people who were

phoned felt more compelled to answer the questions in a way perceived to be favorable to the researcher than did the people answering the same questions via the "less threatening", non-personal-contact mail format.

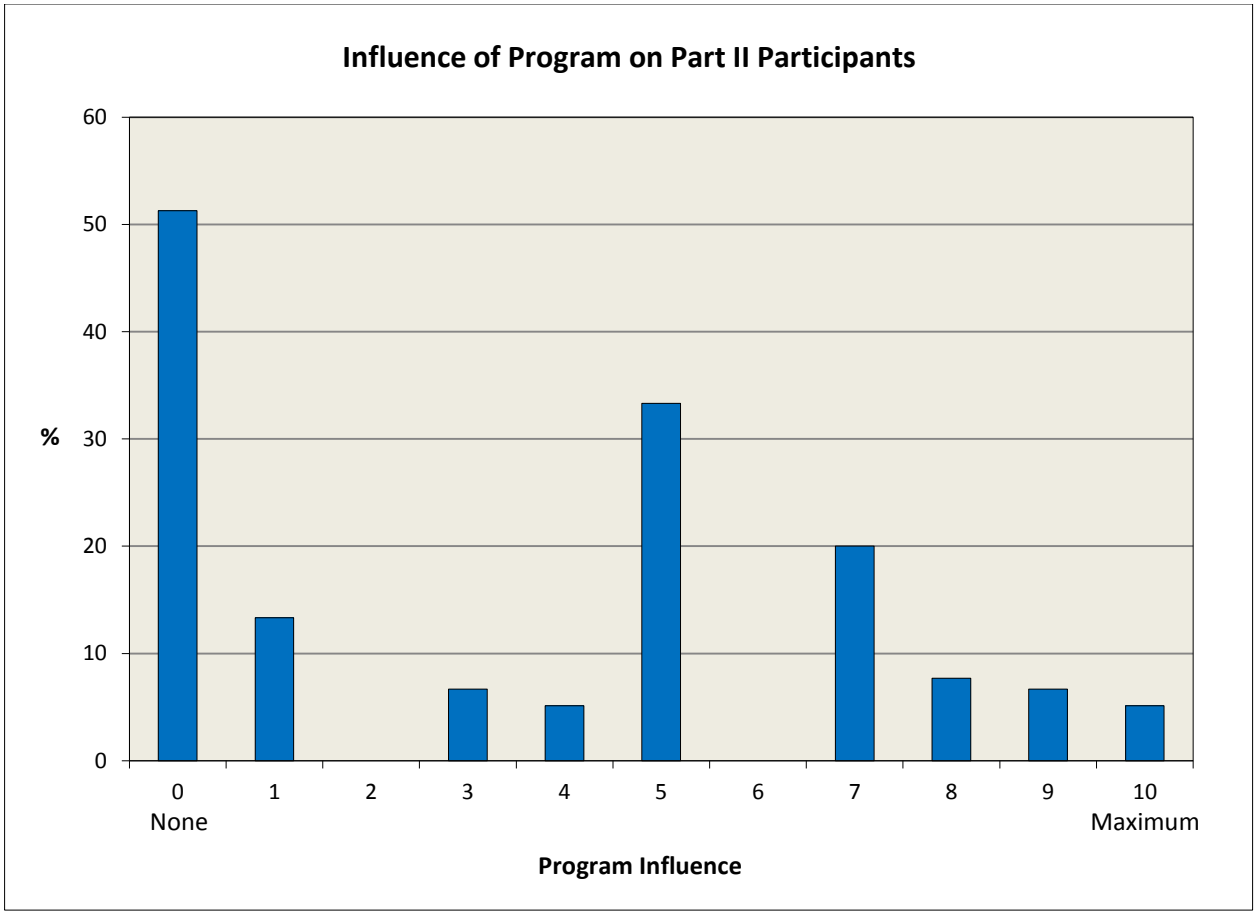

Figure 3.12: Award Influence on Part II Participants

The open-ended question regarding what types of changes were made by participants to conserve water elicited a variety of responses as shown in Table 3.4. The most common one was “less watering”. The most honest one was probably “we flush toilet only after two or three # ones.”

Table 3.4: Changes Made by Participants to Reduce Water Usage

Response	Frequency of Response	
	Part I	Part II
Less lawn watering	21	16
Reduced shower time	24	--
Changed hygiene habits	9	--
Installed ultra-low flow flush toilet(s)	5	5
Installed low flow fixtures	6	--
Installed desert landscaping	7	4
Repaired leaks	5	4
Put wastewater on grass	4	--
Washed clothes less frequently/full loads	9	3
Changed watering time of day	--	3
Improved watering system	2	2
Installed drip irrigation	--	2
Planted smaller garden	5	2
Left town	2	--
Put water in refrigerator for drinking	--	1
Used dishwater to wash clothes	2	--
Placed bottles in toilet tanks	--	1
Rinsed dishes in pan	2	--
Let grass die	1	1
Exchanged evaporative cooler by-pass w/periodic pump	2	--
Collected rainwater	1	1
Quit watering by hose	1	--
Flushed only after two or three # ones	2	1
Installed pool cover	1	--
Didn’t wash car	1	--
Changed mop water weekly, not daily	1	--

3.5 Other Observations

This project was clearly directed toward inducing customers to reduce water consumption through reduced landscape watering, and although it didn't work, it was definitely aimed in the right direction. Figure 3.13 is a plot of the amount of water used as a function of the average amount of grass (i.e. % grass) in the front and back yards of the homeowner. The figure shows that as the percentage of grass goes up, the average daily water use increases significantly. In fact, homeowners with all grass in their front and back yards used nearly twice as much water as homeowners with no grass in either yard (i.e. 797 gal/day vs. 448 gal/day). The intercept represents the summertime water usage for a homeowner who has no grass (i.e. 448 gal/day). At 130,000 residential customers, the domestic demand would be 58 MGD if there were no grass lawns. Summertime demand over the five years preceding the study averaged 114 MGD. Assuming the residential demand represents 61% of the total, the residential summertime demand is 70 MGD, an increase of about 30 MGD over the average wintertime demand. The increase is used for landscape watering, evaporative cooling, car washing, swimming pools, etc. As discussed below, it is likely that much of the water used for evaporative cooling goes unbilled and, therefore, is not included in this amount. If the relatively small sample of persons who volunteered for Part I of this study is representative of the households in El Paso, then approximately 12% of the houses have swimming pools. If the average pool is estimated to be 35' X 20' and the evaporation rate in the summer months is assumed to average a little less than W' per day, then swimming pool make-up water would amount to about 3 MGD. If the wintertime demand of 40 MGD (i.e. an average of 307 gal/day/household) is subtracted from the 448 gal/day/summertime usage which is for all purposes besides landscape watering, a value of approximately 18 MGD is obtained for "other" summer uses (evaporative cooling, car washing, extra bathing, swimming pool evaporation, extra loads of clothes washing, etc.). The remaining 23 MGD is probably used for summertime landscape watering. When added to the "base" 8 MGD wintertime landscape watering amount (see below), the average

summertime landscape amount is 31 MGD. In a few peak months (May, June), the volume exceeds 35 MGD.

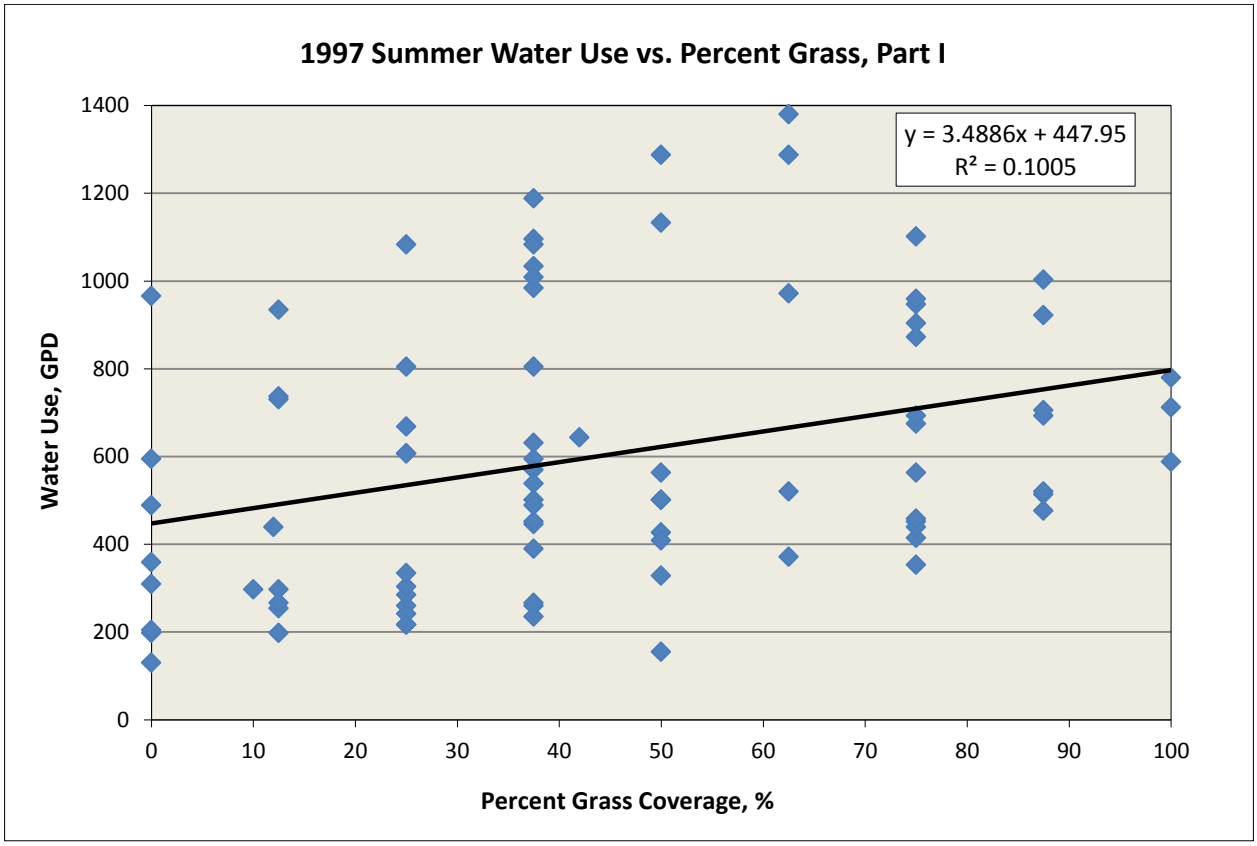

Figure 3.13: 1997 Water Use vs. Percent Grass

The approximate amount of water used for landscape watering in the winter months (Nov-Feb) can be obtained by plotting water use versus the number of persons in the household as shown in Figure 3.14. The y-intercept value (i.e. 83 gal/day) represents the amount of wintertime water use that is not a function of the number of persons in the household. This would presumably represent water used for wintertime landscape watering. If the 83 gal/day amount is multiplied by 130,000 residential customers, a value of about 11 MGD is obtained. The slope of the line represents the average billed wintertime water use per person exclusive of landscape watering and other fixed volume uses and, as shown, it amounts to about 69 gallons per person per day, or 28 MGD. This is fairly close to the AWWA-

reported average of 74 gallons per person per day (2). The residential demand for evaporative cooling in El Paso is about 11 MGD (3). However, it is likely that 80-90% of this water goes unbilled because the average 4 to 11 gal/hour flow rate (due to evaporation and bleed-off water) is below the detection limit of the commonly-used water meters. The same can be said for most household water leaks. These values can be quantified by examining the difference between the finished water volume and the billed water volume in the winter and summer months (known as unaccounted-for water).

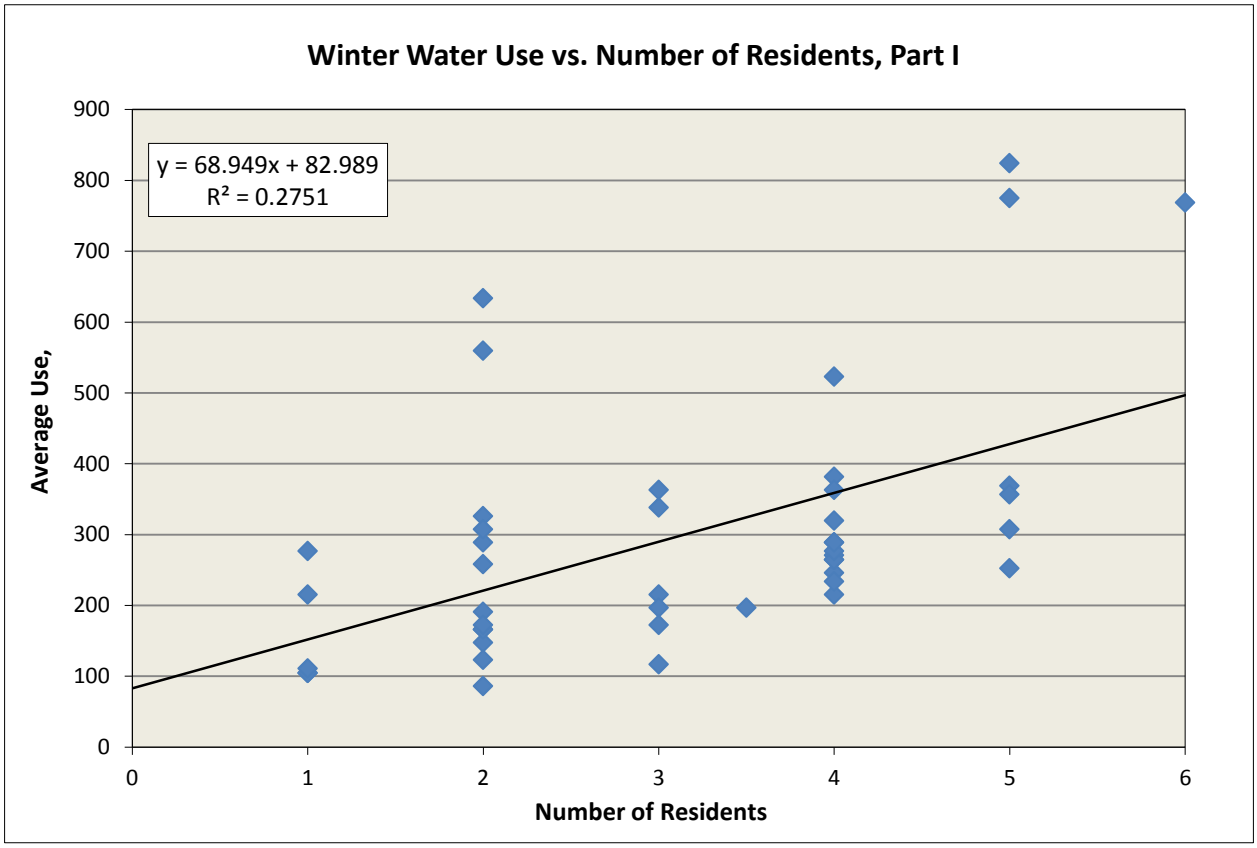

Figure 3.14: 1997 Winter Use vs. Number of Household Residents

In the winter months of Nov-Feb, unaccounted-for water has averaged about 4 MGD over the five years preceding the study. Since residential water use represents about 58% of total winter use, the amount attributable to residential unaccounted-for water in January is about 2 MGD. When the same calculation is made for the high-demand-months of May thru August, the residential unaccounted-for

water increases to about 13 MGD, indicating that most of the water used for evaporative cooling is not billed. These values and those discussed previously are displayed graphically in Fig. 3.15, showing approximately the amount of water used for various purposes by El Paso Water Utility customers on an annual basis, as derived in part from the 1997 annual use data and survey results collected from Part I accepted and alternate program participants.

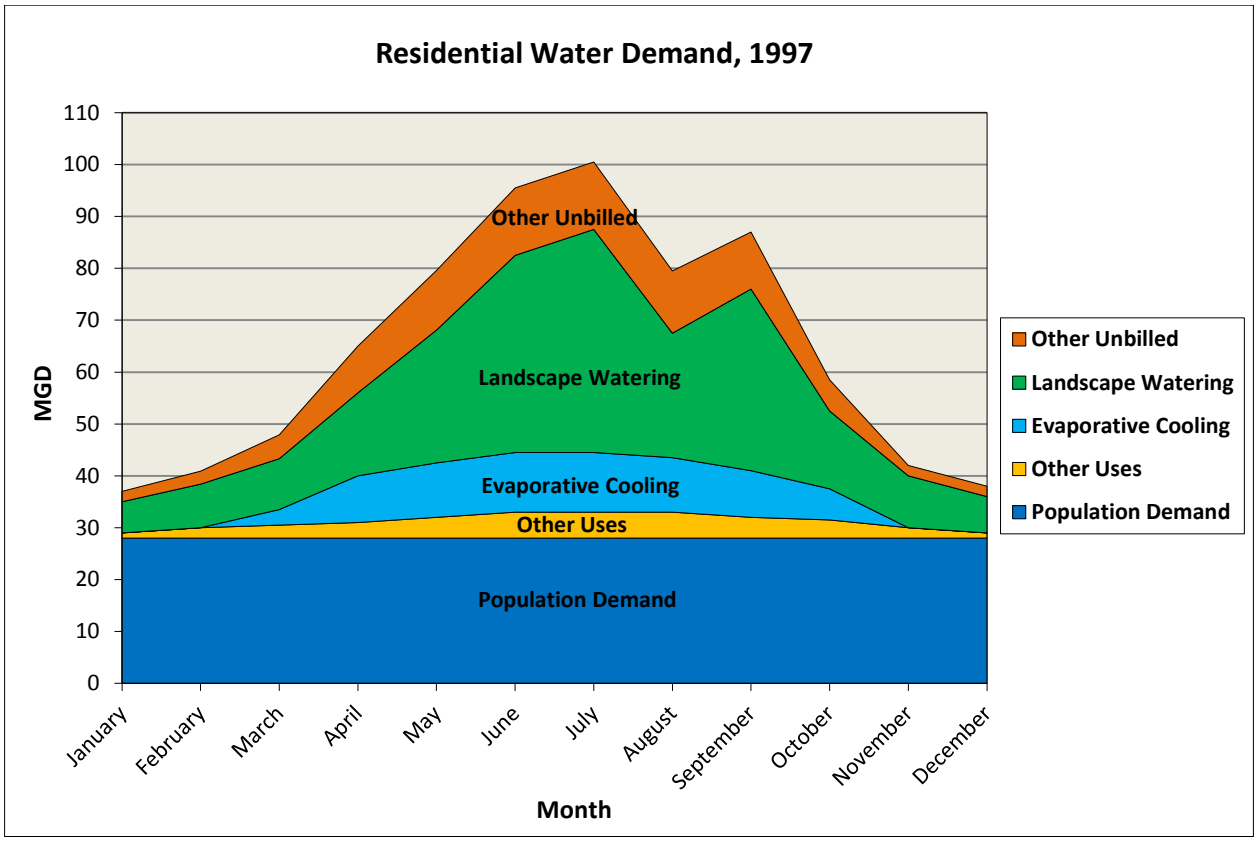

Figure 3.15: 1997 Residential Water Demand

As discussed previously in this report, Fig. 3.1 shows the percentile rankings of water used by participants and neighbors for Part I of this study. The area under either curve represents the amount of water used by the households which make up that group. Using the data from the control group, it can be shown that the top 29% of El Paso Water Utility residential customers consumed slightly more water during the Summer of 1997 than the bottom 71% of all residential accounts. This means half of all

residential water use occurred in only 29% of the higher use accounts. Similarly, the consumption from the top 10% of customers accounted for 23% of the water used by residential accounts during the summer months of 1997.

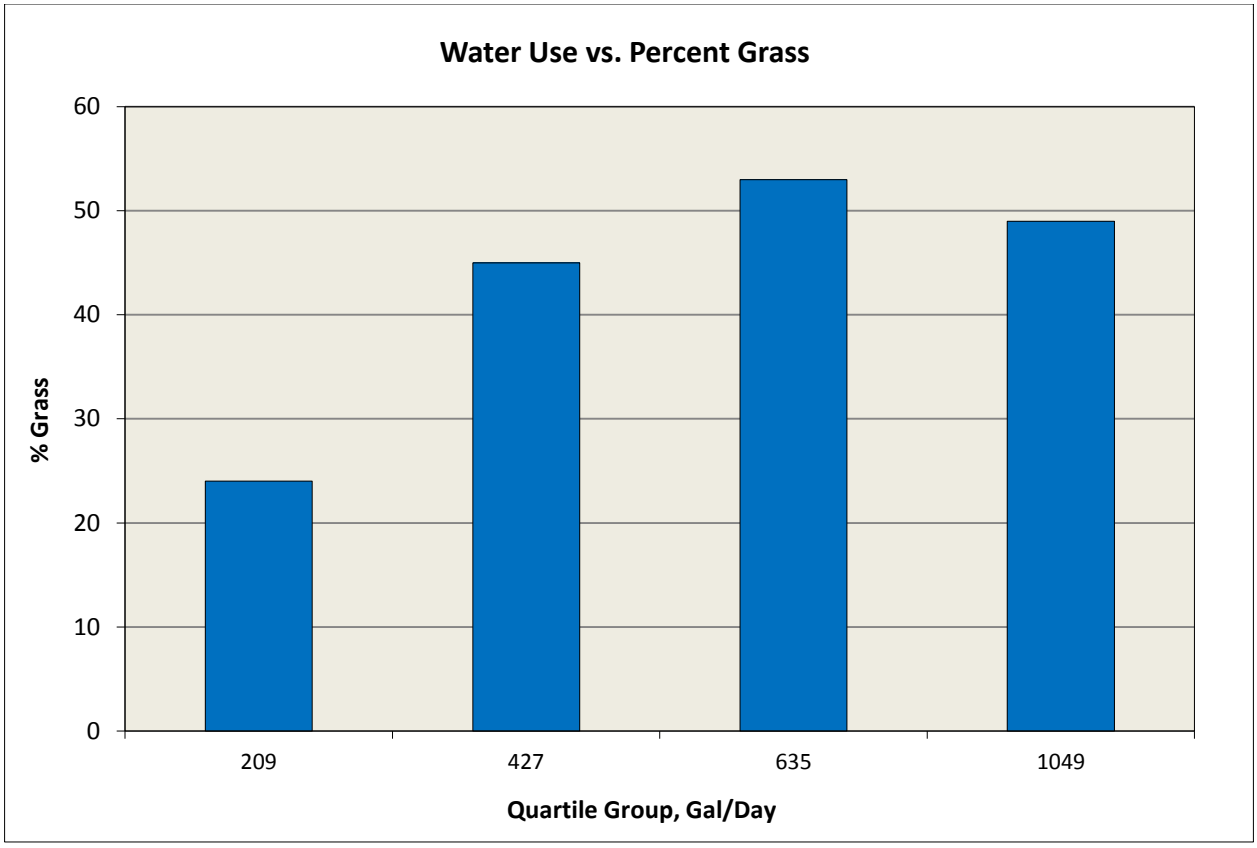

Figure 3.16: 1997 Water Use vs. Percent Grass

Figure 3.16 shows the average amount of water used by customers divided into quartiles and the percentage of their yards that have grass. The graph shows that the average amount of grass in the yards of the upper 25% of water users (i.e. 49% grass) is not significantly different than the percentage of grass cover in the yards of the two middle quartiles (i.e. 45% and 53%), but they used nearly as much water as all three of the others groups combined. Since the average number of persons per household in each group is approximately the same (3.1, 3.2, and 3.2 respectively), this indicates that the excessive water use might be related to overwatering of grass. It also suggests that, at an average of 3.1 persons

per household, the lawns of the top water users (representing about 100,000 persons, or about 14% of El Paso's population) account for as much water use in the summer months as the other 86% of residential accounts do.

Chapter 4: Conclusions

Based on the results obtained in this study, the following conclusions can be made with reasonable certainty:

1. El Paso Water Utility customers who volunteered to participate in a one-time cash award program used significantly less water (7% less) as compared to the neighbor control group. However, the volunteers who were not fully accepted (those accepted as alternates who would receive an award only if money was left over after other awards to fully accepted participants were paid) had an even greater percentage reduction (17% less) as compared to the neighbor control group. This would seem to indicate that the customers who volunteered to participate were largely "free riders" who had already planned to alter their water use habits before the cash award program was announced and thus they were merely being opportunistic in trying to earn money for something they had already planned to do.

2. When participants were randomly selected for inclusion in a cash award program, there was no measurable reduction in water among the program participants as compared to their neighbor control group. These results indicate that the cash award program did not influence the water use behavior of randomly selected participants (at least not the way the program was structured in this study). The results of the follow-up questionnaire supported this finding, showing that even among the participants who received cash awards, over 68% said that the program did not influence them to conserve water.

3. Of the people who volunteered to participate in the cash award program, over 75% said the program did influence them to alter their water use habits. However, of the people who were randomly selected to participate in the cash award program, over 68% said that the program did not influence them to alter their water use habits. The discrepancy in the two groups' responses could be related to the way the groups were queried. The volunteer participants were contacted directly via a phone call by one of the project researchers while the randomly selected participants were queried via a mailed questionnaire. The participants queried by phone were probably more compelled to answer the questions in a way they

perceived to be favorable to the person on the phone than did participants answering the same questions in the solitude of their homes.

4. The people who volunteered to participate in the cash award program (both fully accepted and alternates combined) used significantly less water (i.e. 11 to 12% less) than their neighbors. In the year following the award period, the participants still used less water (i.e. 7% less) than their neighbors, indicating that most of the changes made during the award period persisted even after the award period ended. However, as stated above, these reductions were not likely attributable to the cash award program.

5. While the cash award program tested in this project was not successful in inducing people to conserve water, there is obviously some type of financial inducement program that would compel them to do so. How the program should be structured, and whether or not it would be economically attractive to both a water utility and its customers, are questions which remain unanswered at this time.

6. Summertime landscape watering by EPWU residential customers averages approximately 31 MGD for the six warmest months, or about 44% of the billed residential demand. The top 29% of water users account for more than half of the water used, and the reason appears to be overwatering of lawns and other landscape elements.

7. The top 10% of customers consume nearly one quarter of all of the residential water. This was seen in the comparison performed in Table 3.3 where the comparative reduction among the self-motivated volunteers was near 20% as compared to their control neighbors who also were among the top 10% consumers. These are customers whose monthly water use averages 42 CCF or more.

8. Residential unaccounted-for water increases from 2 MGD in the winter months to an average of 13 MGD in the high demand months of May thru August. Most of the increase is due to water use for evaporative cooling, the biggest percentage of which is not recorded by the water meters and, therefore, is not billed in a volumetric manner.

Chapter 5: Recommendations

The results from this study indicate that several courses of action might be appropriate for consideration. The most obvious and probably the most beneficial action that could be undertaken to conserve water would be that El Paso Water Utilities significantly steepen the rate structure. This seems to be necessary because a small percentage of people use a disproportionately large percentage of the water, clearly inferring that a precious resource is being wasted by a relative few. While other actions could be taken (i.e. education), a steep rate structure is more likely to bring over-users in line with everybody else.

Because the top 10% of customers consume nearly one quarter of all of the residential water, a targeted conservation program should be consider to focus on these specific customers and their unique water use behaviors. A targeted conservation program, along with a steeper rate structure, holds considerable promise to achieve significant reductions. This was seen in the comparison performed in Table 3.3 where the comparative reduction among the self-motivated volunteers was near 20% as compared to their control neighbors who also were among the top 10% consumers. Such a targeted conservation program can be paid for by layering an additional surcharge into the unit cost rate paid for consumption above the monthly CCF level corresponding with the 90^{th} percentile consumption level. In this report, that level is 42 CCF, but it should be a moving target, adjusted each month to continue attention on the most wasteful water use practices. The targeted conservation efforts should be triggered for any residential account exceeding 90^{th} percentile level in any two consecutive months, thus justifying the added cost to the high-use consumers.

Landscape watering is certainly the single largest activity that results in the greatest seasonally variable amount of water consumption, increasing system native peak demand to more than double the lowest flow months. Thus, if any water conservation cash incentive or rebate programs are considered in future years, they clearly should be directed toward reducing landscape watering through surface area

reductions in lawns and greater reuse of gray water for landscapes and expanding installation of subsurface drip irrigation systems.

Finally, the utility should address the issue of unaccounted-for water through evaporative cooling. This is a problem which is unique to the arid Southwestern United States and, therefore, has probably not received the attention it deserves. In any case, a significant amount of revenue requirement is being redistributed due to slow implementation of modern meters capable of capturing the low flows associated with evaporative cooling. This being the case, the customers are not seeing their true consumption reflected in their bills, and as such they are not responding to accurate price queues to conserve. Accelerating implementation of meter modernization and leak detection would greatly improve upon this water pricing issue and allow for greater awareness to improve conservation.

References

1. U.S. EPA Water Conservation Plan Guidelines, EPA-832-D-98-001, 1998

2. AWWA Internet Website http://www.awwa.org.

3. "Water Use through Evaporative Cooler Bleed-offs in the City of EI Paso", U.S. Bureau of Reclamation Final Report, submitted by Anthony J. Tarquin, University of Texas at El Paso, June 2000.

Appendix A

Program Announcement

New Water Conservation Program

The University of Texas at El Paso, in conjunction with the Bureau of Reclamation, is undertaking a research project aimed at reducing residential water consumption. The program will award cash incentives of up to $250 for participants who successfully reduce their summer water usage.

Cash awards of either $100 or $250 will be made in October 1998 for participants who successfully reduce their 1998 summer water consumption by as much as 20% or 35%, respectively. **There is absolutely no cost to the program participants.**

Funds available for this research project may limit the number of applicants accepted into the program. To receive an application at no cost or obligation call 747-8800 and leave your name, address and phone number. Applications will be mailed out in December for participation in the 1998 Summer Water Conservation Program.

747-8800

Some Restrictions Apply

Qualified applicants must have lived in their current home for a minimum of 3 years and must be customers of El Paso Water Utilities

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

UTEP

(FRONT SIDE)

Pilot Incentive Program for Water Conservation

The University of Texas at El Paso, in conjunction with the Bureau of Reclamation, announces a pilot program designed to promote water conservation in El Paso. The program will award money to selected customers of El Paso Water Utilities who can voluntarily reduce their usage by 20% or more.

Ever since strict water conservation measures like the toilet rebate program and rate increases were enacted in the City of El Paso at the start of the decade, residential water users have been taking steps to reduce the amount of water they use. Nevertheless, most residential customers still use nearly 50% of their total annual water within only 4 months of the year (May through August). The greatest majority of this water is used for lawn watering.

In attempting to reduce water used for residential purposes, a variety of alternatives could be considered. These alternatives might include restrictive ordinances regarding landscape design, steep rate structures, strict enforcement of new or existing regulations, bans on evaporative cooler bypass lines, various forms of incentive programs, and a host of other strategic options.

The basic strategy will involve setting up a program which will pay cash incentives to customers who reduce their summer water consumption by at least 20% as compared to the previous year baseline period. As an inducement to get customers to reduce the water they use during the summer months, they may choose to participate in one of two incentive programs. First, a $250 incentive will be offered for those who elect to decrease their water use by at least 35%. Alternatively, those who expect they may achieve a reduction of only 20% may elect to participate in the $100 incentive program.

Applications to participate in the pilot program will be accepted through January 1998. Due to the limited funds available for the pilot study, only a limited number of applicants may be chosen as incentive program participants. **There are no application fees, nor are there program costs to the participants selected.** In order to be eligible for a cash award, one must have resided in the same home since April 1995, be a customer of EPWU, and must apply to and be accepted as a participant in the study. All qualified applicants will receive a complimentary water conservation information packet.

Cash incentives will be paid in October 1998, following analysis of the 1998 summer season water use. In order to receive an application and information concerning the pilot program rules and schedules, interested parties should call 747-8800 and leave a name, address, zip code and telephone number. Applications will be mailed through the month of December and early January, or until an adequate number of respondents have been chosen.

(BACK SIDE)

Application for Water Conservation Study

Applicant's Name: _____

Address of Residence: _____

City: _____ State: _____ Zip Code: _____

Participants in this water conservation study are invited by UTEP's Civil Engineering Department to apply for a water conservation cash award. Funding for the award programs is from the Bureau of Reclamation. Two award programs exist but you may choose to participate in only one of the two. Program 1 involves a $250 award to any program participant who successfully reduces water usage in the months of May through August, 1998 by 35% or more below the average for those months in the three previous years (1995, 1996 and 1997). Program 2 involves a $100 award for participants who reduce their water usage by 20% or more below the average use for the same period during the three previous years.

The program is limited to customers of El Paso Water Utilities who are selected as participants. Further limitations are:

- You must have lived in claimed residence since May 1st, 1995;
- You must by signature below, authorize El Paso Water Utilities to release water use and billing data since May 1st, 1995;
- You must fully answer initial questionnaire section below;
- You must choose to participate in either the $250 program (Program 1) or the $100 program (Program 2); and
- You must answer a follow-up questionnaire at the end of the study period concerning water use information and how conservation in your home was achieved.

Initial Questionnaire

How did you hear about this program? _____

Which program do you wish to participate in? **(Circle one)** Program 1 ($250 for 35% reduction) Program 2 ($100 for 20% reduction)

Do you own or rent the home? **(Circle one)** Own Rent

How many people live in the home now? **(Circle one)** 1 2 3 4 5 6 7 8 more

In previous years how many people lived in the home in? _____1995 _____1996 _____1997

Do you have grass areas in your front or back yard? **(Circle one)**

	Front		Back	
	Yes	No	Yes	No

In your front yard, what fraction of your yard is grass? **(Circle one)** 0 ¼ ½ ¾ All

In your back yard, what fraction of your yard is grass? **(Circle one)** 0 ¼ ½ ¾ All

Do you have areas of lawn with desert landscaping, concrete or rock? **(Circle one)** Yes No

Authorization for use of information

The information provided in this application, combined with water use records on file at the El Paso Water Utilities and the Public Service Board, is intended to serve as data for a water conservation study by UTEP's Civil Engineering Department under a grant by the Department of the Interior Bureau of Reclamation. The undersigned customer of El Paso Water Utilities does hereby authorize the PSB and EPWU to release monthly water use records for use in the study of water conservation.

Signature: _____ Date: _____

Printed Name: _____ Phone #: _____

Appendix B

Questionnaire Summaries

SUMMARY PART I QUESTIONNAIRE

Number of People in Home	1	2	3	4	>4
1996	7	20	10	8	7
1997	5	19	7	12	9
1998	6	21	4	12	9

Percent Grass	0	¼	½	¾	All
Front	54	7	13	18	11
Back	20	12	27	19	23

How long has existing landscape been in place?

One year or less	9
Over one year	43

Sprinklers

Yes	28
No	15

Pool

Yes	6
No	46

Evaporative Cooler(s)

Yes	50
No	2

Evaporative Cooler Pump Bypass

Yes	29
No	10
Don’t know	11

Have you taken advantage of toilet rebate program?

Yes	17
No	32

Did you make changes that could have influenced your water use?

Yes	48
No	3

Did you make any changes because of rebate program?

Yes	37
No	12

SUMMARY PART II QUESTIONNAIRE

What changes did you make to cause reduction in water use?

Changes Made	Number of Responses
Installed desert landscaping	4
Leak repairs	4
Change in watering system	2
Less watering	16
ULF toilet installed	5
Drip irrigation	2
Wash clothes less frequently	3
Watering time of day	4
Place drinking water in fridge	1
Bottles in toilets (vol. reduction)	1
Vacation (leave home vacant)	1
Less garden	1

Did you repair any leaks?

Yes	10
No	28

Did number of people in house increase, decrease or stay the same?

Increase	1
Decrease	11
Same	26

Did you change water use habits?

Yes	30
No	5

Did you change areas of lawn?

Yes	10
No	27

Have you taken advantage of toilet rebate program?

Yes	17
No	32

Did you decide to save water?

Yes	27
No	10

How much did you consider award program when using water?

Not at all Maximum

0	1	2	3	4	5	6	7	8	9	10
20	2		1	2	5		3	3	1	2

Did offer of award induce you to save water?

Yes	12
No	26

Vita

Robert D. Moss received a Bachelor of Science in Civil Engineering in 1997 from the University of Texas at El Paso. He is in his twentieth year of service to the University in his current role as Assistant Vice President for Environmental Health Safety and Risk Management. As the administrative lead over the campus health and safety function, Mr. Moss has served on a variety campus and University of Texas System advisory committees. Among these Mr. Moss has served as Chair of the UTS Environmental Advisory Committee, and voting member of the UTS Emergency Management Advisory Committee, the UTS Interim Storage Facility oversight committee for radioactive materials storage, the UT El Paso Institutional Biosafety Committee, the Institutional Animal Care and Use Committee, and the Student Health Center Advisory Board.

Among Mr. Moss' many interests he holds considerably high his efforts at expanding the use of renewable energy. To that end he has offered his ideas to the campus in developing and scoping photovoltaic solar projects such as the 108 kW solar installations atop the roof at the Student Recreation Center, and also the 76 kW parking canopy structure at the Facilities Services Complex. And as a citizen of El Paso and West Texas, Mr. Moss has worked tirelessly in support of renewable energy growth within our region, serving in various roles to speak on behalf of solar and to advocate, such as serving an advisory role to Senator Jose Rodriguez' Renewable Energy Advisory Committee.

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