Annual Report

WATER CONSERVATION IN THE HOME:

An Evaluation of Flow Limiting Devices and Educational Program

E-013

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Funded by

OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE

OKLAHOMA STATE UNIVERSITY

STILLWATER, OKLAHOMA

JULY, 1982

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SECTION I

INTRODUCTION

The population growth and the increase in water usage throughout Oklahoma have required water treatment and distribution facilities to operate at capacity levels and beyond. The capacity crises, periodic drought, the increasing water salinity, and the lowering of many aquifers require all water planning and supply organizations to examine all the alternatives before embarking on major capital improvements and projects. Many of the rural water districts and small communities have the above mentioned problems. Many of the rural water District distribution systems were designed for half the persons they now serve.

Water conservation programs provide the water suppliers and planners an alternative or at least time to plan and construct the necessary capital improvements. Water conservation devices play an important role in any lasting water conservation plan. Water saving devices such as shallow-trap toilets, flow restrictors for shower heads and faucets, together with pressure reducing valves can reduce residential water use from 10 to 40 percent without behavior or life style change.

Plumbing fixture manufacturers have now redesigned the water closet that will go into new construction to use less than 3.5 gallons of water. Shower heads and faucets have also been redesigned to provide an adequate stream of water to accomplish the task but with many fewer gallons of water being used. All projects using new fixtures should then be more water conserving than the existing residences. The problem then is how do we modify the million or so homes in the existing housing stock in Oklahoma that continue to use water

needlessly? It's not that the person living in those existing homes want to use more water, the fixtures just use more water and the people don't have the money, the knowledge, or both to do the changes necessary to reduce water use patterns.

Since the water suppliers are public bodies, the state can encourage change in many ways to accomplish the goals of the State of Oklahoma water plan. This research project examines how a portion of a rural water district reacted to a conservation effort and campaign designed to reduce residential water usage.

Purpose

This study was an investigation of the effectiveness of various measures that could be enacted by the controlling board of small water systems to encourage users to reduce water consumption as an alternative to increased capital investment. Because small rural water districts provide water to such a large area of Oklahoma, the focus of this study was on one of these districts. The rural water district utilized in this study obtains water from ground water wells owned and controlled solely by the district and located within the district, thus eliminating possible political aspects of water pricing that might be associated with purchasing water from an adjacent municipality. The major purpose of this study was to examine the effect of (1) retrofitting single family residences with water conserving hardware and (2) water conservation education on the quantity of water used. The study was restricted to members of a rural water district who consume water primarily for residential purposes.

Objectives

The objectives which guided this study were:

1. To compare the quantity of water conserved through:
    a. retrofitting bathrooms and kitchen faucets with water conserving fixtures and hardware;
    b. providing water conservation education materials to families;
    c. a combination of retrofitting with water conserving hardware and providing water conservation education materials.
2. To obtain evaluation of the water conserving hardware from families who have experienced using it.
3. To conduct indepth interviews with selected families to identify changes in water use practices and key factors that affect water management decisions within the family unit.

SECTION II
BRIEF REVIEW OF THE LITERATURE

The Washington Suburban Sanitary Commission (Maryland) launched the current model of large scale water conservation efforts in 1971. They developed extensive education and device retrofit programs for use in the urban large scale water districts (Brigham, 1981). The effectiveness of flow reduction devices and water conserving toilets have been documented in these East Coast regions as well as in California after the great drought of the 70's. The following is the maximum allowed water usage or flow rates usually used by the various fixtures.

Fixture	Maximum Water Use
Water closets (shallow-trap toilets)	3.5 gallons per flush
Shower heads	3 gallons per minute
Sink basin faucets	2 gallons per minute
Pressure reducing valves setting (BOCA code, 1981)	50 psig

Specifically it is estimated that a family of four persons can save 50-60 gallons of water per day using the above devices (Bailey, Benoit, et al., 1969).

Water use standards have been developed by the American National Standards Institute (ANSI) and by the Government Accounting Office (GAO). The water districts with supply, distribution and pollution problems have adopted into law these model water standards in the form of building and plumbing codes (California Water Code, 1975-1976).

Enactment of a code requirement for the use of water conservation devices as a condition of water service has been enacted, enforced and legally tested by the California water code.

Using an EEAM (Engineering Economy Analysis Model) computer model the replacement of existing fixtures with flow reduction shower heads, dual cycle toilets, and toilet flush reduction inserts is cost effective on a national basis (Chan, Heare, 1975). As water rates escalate and the cost of water conserving fixtures decrease because of mass production and the adoption by the fixture manufacturers of a standard design, the economic picture looks even better.

The attitudes of water professionals have been positive on the side of capital improvement and increasing reservoir capacity, they have generally been anti-conservative (McPherson, 1978). The experience of many water districts is that conservation campaigns cause revenue loss at a time when expenditures are rising and thus conservation causes rate increase and public outcry. The experience of two Pennsylvania water districts was that inflation, not conservation was responsible for 83 percent of water rate changes that occurred after conservation campaigns. The conservation campaigns noted above were not prompted by water supply problems but rather sewage treatment limits, but the results were essentially the same as the water supply prompted conservation campaigns of Marin County, California (Sharpe, AWWA, 1978).

The tie between water and energy usage is very real when you consider the amount of laundry, dishwashing, bathing and showering the typical American family uses. The simple installation of flow reduction shower heads eliminates the need for larger water heaters, and even larger energy bills to heat the water. Only a 5-10 percent reduction in shower water flow is required to make a plumber-installed flow restricted shower head economical. Only a one (1) percent reduction would make a self-installed flow restricted shower head economical Penn State University installed flow limiting shower heads which paid for themselves in savings within 28 days of installation (Sharp, AWWA, 1978).

Water conservation fixtures and devices are not the only answer to achieving additional water supply through conservation. A broad education program involving users is also necessary. Water conservation educational programs should contain the following:

1. A constant, reachable goal, usually a daily, per capita consumption target.
2. The importance of water-saving and waste-reduction to water resources planning and management.
3. The benefits (especially cost control benefits) to be derived by customers if per capita demands are controlled, capacity - present and future - is used efficiently, and capital outlays for plant and system expansion are curtailed to fit the new, controlled per capita use pattern.
4. Development of the utility's and the customer's conservation ethic-fostering the "waste not, want not" approach to water consumption.
5. Preparing for a water supply or watewater system emergency. Get into the water-saving habit.
6. A plan to reinforce the conservation effort - to give the program a booster shot - whenever interest seems to be dragging or lagging.

In addition to the above, any serious conservation program should include a program to reduce lawn and outside watering and a concentrated effort to locate and repair leaks in the system and leaks in the customer's systems (Brigham, 1981).

SECTION III

METHODOLOGY

Research Design

The study utilized a design with "before" and "after" measurement of five groups. The groups were identified by those receiving:

1. water conserving hardware only, and
2. water conservation educational materials plus water conserving hardware,
3. water conservation educational materials only with follow-up interview,
4. water conservation educational materials only without follow-up interview,
5. no contact.

The data collected included:

1. Monthly water use data
2. Characteristics of the household
3. Water use practices
4. Attitudes about water use and water conservation
5. Changes in water use behavior
6. Evaluation of water conserving hardware and water conservation educational program.

Sample

The sample for this study was drawn from the members of Rural Water District 3, just south of Stillwater, Oklahoma in Payne County. The controlling board of the water district was interested in encouraging water conservation because of increased demand for tap-on permits and increasing consumption which

was straining a system, now serving nearly twice as many users as it was initially designed to serve. The board members and the two-member staff of the water district were very cooperative in providing insights into the operation of the water district and making data available on a regular basis.

At the time the sample was selected, there were 233 water meters in the district. From this total, the following were eliminated:

a. meters that were only a pasture tap and not used by a residence,
b. meters that serviced commercial enterprises such as dairy farms, irrigation, livestock watering, etc.
c. meters where there had been leaks in the line during the past two years.

These eliminations were made with the assistance of actual water use data for 1978-1981 and information provided by the manager of the rural water district who was very familiar with the conditions surrounding each water meter. A total of 117 water meters remained and could be identified as being used primarily for residential purposes.

The group of 117 meters was divided into two groups: those who would receive water conservation education materials (n=96) and those who would not (n=21). From each of these groups, selection was made of households of two or more persons who had been fairly consistent in their water use over the past two years (1980-1981) and who ranged in family type from retired couples through young marrieds with small children. A total of 45 such families was selected: 33 from the education group and 12 from the non-education group.

Letters were sent to the 45 families inviting them to participate as one of 15 families which would receive water conserving hardware. Twenty families indicated an interest in participating in the project by returning a card containing basic information about the family and its house. Interviews were conducted with these families and inspections were made of the plumbing in their homes. Fifteen families were selected: 11 from the education group and 4 from

the non-education group. Selection of the 15 families to test the water conserving hardware was based on the following criteria:

a. use of water primarily for residential purposes (including lawn and garden)
b. have no more than 2 1/2 bathrooms
c. have a shower (either shower with tub or separate shower)
d. have 2 or more persons living in the home
e. have had no major plumbing leak in past 2 years.

Following three months of receiving education materials and/or using the water conserving hardware, indepth case study interviews were conducted with: (a) the 15 families who were testing the water saving hardware and (b) a sample of 13 families from the education group whose family composition closely matched families in the hardware group. Two families from the hardware-plus-education group were eliminated from the final analysis because it was found that they already had water saving toilets in their homes.

The number of respondents in each of the sub-samples used in the final analysis is as follows:

Group One: Water saving hardware only	4
Group Two: Water saving hardware plus education	9
Group Three: Education only	72
Group Four: Education plus follow-up interview	13
Group Five: No Contact	17
TOTAL	115

Data Collection

Data were collected from the 15 test families in December using an interview schedule designed to collect information about the family characteristics, attitudes about water conservation and water use practices (See Appendix Folder 1). Once the test families were selected, the questionnaire (including items similar to the above mentioned interview schedule) was sent to the remainder of families in the education sample. A cover letter explained the research project

and a letter from the President of the Board of the rural water district encouraged the members' participation. After one follow up reminder, a total of 31 questionniares were received from the 85 families in the education-only sub-sample.

Data on water use for the past four years (1978-1981) were collected from the records of the rural water district for all 233 meters. These data were used in eliminating meters for households that did not meet criteria of the study. Data for the 117 households in the sample came from the records of water use for 1980 and 1981 only. Data for water use during the test period (March-June, 1982) were collected monthly from records of the water district.

Data were collected again from the 15 families who tested the hardware at the end of May, 1982, following 3 months of use. These data were collected through indepth interviews with the adult household heads and included information about changes in water use practices, water use management, attitudes about water conservation and evaluation of the water conserving hardware. The same indepth interview was conducted with 13 families from the education group who closely matched the test families in family composition. These 13 families were selected from the 31 families who returned the initial questionnaire.

Water Conserving Hardware

Participants who were to receive the water conserving hardware were notified on January 15, 1982 that the plumber would contact them for an appointment. One of the larger plumbing contractors in Stillwater contracted to do the complete installation in the 15 homes. The installation of hardware was completed by February 15, 1982. The following is a list of the equipment installed:

Water closets: Mansfield "Jet Flush Water Saver"
(Uses less than 3 1/2 gallons of water per flush)

Low flow shower heads: Delta #RP-6122 which uses 2.7 gallons of water per minute under pressure of 60 psi.

Faucet areators with flow restrictors of various kinds had to be installed to match the faucets of the homeowners; however, those installed provided approximately 2.3 gallons of water per minute under a pressure of 60 psi.

Faucet assembly
For kitchens - Delex #2100 with flow rate of 2.20 gpm at a pressure of 60 psi.
For lavatories - Delex #2502 with flow rate of 2.30 gpm at a pressure of 60 psi.

The 60 psi pressure is not the general rule of service pressure throughout the district. One user in Group One has a pressure of nearly 100 psi and others have normal pressures as low as 35 psi. During peak service hours some users have even lower pressures toward the end of the piping system.

All of the faucets, shower heads, and water closets comply to the Federal specifications that were written to encourage the use of less water, i.e., WW-P-541/1A for water closets, WW-P-541-4A Type 1 for lavatory faucets and WWP-541/4A for shower heads.

Water Conservation Educational Materials

Beginning the first week in February, all respondents in the education group were sent water conservation education materials. These materials were designed to increase water awareness as to the source of water, water use practices and future availability of water supply. Six sets of materials were mailed at approximately two-week intervals. (See Appendix A & B for list and samples of the materials.)

To increase awareness of the need for water conservation, participants received a brochure giving information about their particular water district. This included information about the water supply, demand, cost and impact of current conditions on future availability. To reach all members of the family, a children's coloring book with water conservation information was included.

A water wheel, identifying the quantity of water associated with various activities, was the second mailing its purpose was to encourage participants t consider changes in behavior that their families might make to reduce water consumption. To further increase water awareness, participants received a gr showing their monthly water use over the past four years compared to the mea monthly water use for those families in all five groups from the district, i. those who were primarily residential users. A reminder was sent with the gr to all families who had not yet returned the initial questionnaire.

The third and fourth mailings presented information about water saving devices which could be installed by the user and information about how to spot leaks and make repairs. Resources for obtaining devices and their approximat costs were included.

The fifth and sixth mailings included information on changing water use behaviors inside and outside the home. Information in the pamphlets was base on research findings and described specific behavioral changes that could lo water consumption.

A seventh mailing was sent as a follow-up to the study. This mailing included an evaluation form requesting participants reactions to the educatio materials and suggestions for improvements.

Data Preparation and Analysis

Data from the first questionnaire and the monthly water use for 1978-19 were coded and punched into computer cards. Analysis was done using the Stat tical Analysis System and employed frequencies, percentages, crosstabulation t-tests and Duncan's Multiple Range Test.

SECTION IV

FINDINGS AND DISCUSSION

Description of Respondents

The initial questionnaire was completed for the 15 test families who received the hardware (11 families from the education group and 4 from the non-education group). The remaining 85 families in the education group received the same questionnaire with their first education packet and were asked to complete it and return it promptly. Following one reminder letter, 31 questionnaires were returned. This represents 36 percent of the education group. The following description is based on data from these 46 respondents.

Characteristics of the household heads, size of the family and number of toilets and bathtubs per household are shown in Tables 1 and 2. Of the total of 46 families, 39 percent had no children while 28 percent had one child and 31 percent had two or more children. The age of the household head ranged from 25 to 72 years with a mean of 47.3 years. Over 80 percent had at least a high school education and 48 percent had some college work. The full time employed household heads made up 85 percent of the respondents while only 4 percent were retired.

Forty-three percent of the homes had only one bathroom and 17 percent had three or more. Only one bathtub was present in 82 percent of the homes.

The water use activities and conservation attitudes for all respondents and for the sub-group of families who received the water saving hardware are shown in Tables 3-10. The mean number of toilet flushes per day for all families in the sample was 12.2. The mean number of shower per week per household was

12.09 and baths 7.75. On the average, over eight loads of laundry were done per week and the dishwasher was run about 6 times.

Nearly one-third of the respondents reported that they never did loads of laundry that were not completly full. Of the approximately 60 percent of respondents who reported occasionally doing less than full loads of laundry over 70 percent reported that they reduce the water level for small loads.

When running the dishwasher, 70 percent reported that they "never" ran it unless it was full and only three percent reported that they "often" ran it with a small load. However, only 13 percent used a short cycle even though many of them rinsed the dishes before putting them in the dishwasher.

Approximately one-half of the respondents considered their housholds to be "medium" water users and 37 percent thought they were "low" water users. The average water bill was considered to be "medium" by 46 percent of the respondents and only 11 percent considered it to be "high".

Water conservation was considered to be "very important" by over one-third of the respondents and another 49 percent considered it "important". It is very likely that the questionnaires were returned by the families who were more concerned about water conservation so this high percentage of response was not unexpected. The hardware group was not asked this question in the initial interview but their desire to be involved in testing the water saving devices indicated that water conservation was important to them.

TABLE 1

CHARACTERISTICS OF THE HOUSEHOLDS

CHARACTERISTICS	All Respondents			Hardware Group		
	Number of Households	%	Mean	Number of Households	%	Mean
Age of Head			47.3			
Education of Head						
<12 years	6	13		4	27	
12 years	15	33		5	33	
13-16 years	12	26		4	27	
17+ years	10	22		2	13	
N.R.	3	6				
Employment of Head						
Full-time	39	85		13	87	
Retired	2	4		2	13	
Homemaker	1	2		-		
N.R.	4	9		-		
Number of children						
None	18	39		5	33	
One	13	28		4	27	
Two	10	22		4	27	
Three	4	9		2	13	

TABLE 2

TOILETS AND BATHTUBS PER HOUSEHOLDS

NUMBER OF:	All Respondents		Hardware Group	
	Number of Households	%	Number of Households	%
1. Toilets				
(a) One	20	43	7	47
(b) Two	17	37	7	47
(c) Three	7	15	1	6
(d) Four	1	2	-	-
(e) N.R.	1	2	-	-
TOTAL	46	100	15	100
2. Bathtubs				
(a) One	38	82	11	73
(b) Two	7	15	3	20
(c) N.R.	1	2	1	7
TOTAL	46	100	15	100

TABLE 3

WATER USING ACTIVITES

ACTIVITY:	All Respondents				Hardware Group			
	Number of Households	Range Min	Max	Mean	Number of Households	Range Min	Max	Mean
1. Toilet Flushes (Per Day)	44	2	30	12.20	15	5	24	15.4
2. Showers (Per Week)	44	3	35	12.09	15	0	35	11.7
3. Baths (Per Week)	44	1	35	7.75	15	2	35	13.0
4. Loads of Laundry (Per Week)	44	1	25	8.61	15	2	25	10.13
5. Run Dishwasher (Per Week)	31	1	14	5.71	15	0	9	4.47

TABLE 4

FREQUENCY OF LAUNDRY LOADS
THAT ARE NOT COMPLETELY FULL

FREQUENCY:	All Respondents		Hardware Group	
	Num.	%	Num.	%
1. Never	14	30	7	47
2. Occasionally	28	61	8	53
3. Often	3	7	-	-
N.R.	1	2	-	-

TABLE 5

REDUCTION OF WATER FOR
LAUNDRY LOADS NOT FULL

	All Respondents		Hardware Group	
	Num.	%	Num.	%
Yes	33	72	7	50
No	7	15	7	50
N.R.	6	13	1	-

TABLE 6

FREQUENCY OF OPERATING DISHWASHER
WITHOUT A FULL LOAD

FREQUENCY:	All Respondents		Hardware Group	
	Num.	%	Num.	%
1. Never	20	70	6	60
2. Sometimes	8	27	3	30
3. Often	1	3	1	10
N.A.	15		5	
N.R.	2			

TABLE 7

DISHWASHER CYCLE MOST OFTEN USED

TYPE:	All Respondents		Hardware Group	
	Num.	%	Num.	%
1. Regular	26	87	10	91
2. Short	4	13	1	9
N.A.	15		3	
N.R.	1		1	

TABLE 8

WATER USER TYPE

TYPE:	All Respondents		Hardware Group	
	Num.	%	Num.	%
1. Low	17	37	5	33.3
2. Medium	24	52	8	53.3
3. High	4	9	2	13.3
N.R.	1	2	-	-

TABLE 9

EVALUATION OF AVERAGE WATER BILL

TYPE:	All Respondents		Hardware Group	
	Num.	%	Num.	%
1. Low	20	43	6	40
2. Medium	21	46	7	47
3. High	5	11	2	13

TABLE 10

IMPORTANCE OF WATER CONSERVATION

DEGREE:	All Respondents Num.	%
1. Very Important	10	32
2. Important	15	49
3. Neutral	16	19
4. Unimportant	-	-
5. Very Unimportant	-	-
N.R.	15	

Change in Water Consumption

The success or failure of the water conservation techniques tested in this study could be measured by the water meter. The answer to the question, "Did the rural water district customers use less water following the exposure to the conservation techniques?" is yes! Findings show that all groups receiving hardware and/or education reduced their water consumption in March through June of 1982 compared with the same months of the two preceeding years. However, the reasons for, reactions to and problems with residential conservation are not so simplistic.

This entire analysis must be viewed within the constraints of the budget that allowed a very small number of homes to receive the retrofit of water conserving fixtures and hardware. The samples were so small that individual

behavior could, and no doubt did, make large differences in usage. For example, two of the test homes had inoperable showers prior to the installation of the new water saving shower heads. The new shower head probably encouraged more use for some time. One of the test families had a leak in a pipe under their home during the month of March, 1982. The leak went undetected for some time and caused the mean water use for Group Two to be higher than it would have been under normal use conditions. Although the data used for establishing the "before" usage was limited to the two years preceeding the test period, there were some changes within the families as new babies wer born or children left home. Such changes as these were documented for Groups One, Two and Four but not for Groups Three and Five.

Residents of a rural area in north central Oklahoma may seem like a rather homogeneous group; however, the water use patterns demonstrate considerable variance. The type of farm operation had the most impact on water usage within this water district. The dairy farm operations were by far the largest users. The mean monthly water use for the lowest user was 730 gallons per month with a standard deviation of 174 gallons while the mean for the highest user was 15,178 gallons with a standard deviation of 5,974 gallons.

The first objective of this study was:

To compare the quantity of water conserved through:

a. retrofitting bathrooms and kitchen faucets with water conserving hardware;

b. providing water conservation education materials to families; and

c. a combination of retrofitting with water conserving hardware and providing water conservation education materials.

The water used monthly by each household for 1980 and 1981 was averaged together to obtain the water use "before" the test period. This two year period was

selected in order to minimize the time during which changes might have occurred in the composition of the household while including more than a single year's use. Table 11 shows the actual gallon and percent of change in mean water use for each group in the study from the "before" to the "after" period. The percent change was obtained by subtracting the mean water use of the group for the 1980-81 period from the mean use of the group during the test period, March through June, 1982. (A supplemental report will be issued early in 1983 to incorporate data from July through December 1982.) See Figures 1 through 5 for a line graph showing water savings in 1982 as compared with 1980 and 1981.

The water conserving hardware was installed for Groups One and Two by about the middle of February and the first set of educational materials were mailed to Groups Two, Three and Four during the first week of February. Thus the March data show the effects of the devices since the February meter reading (which occurs usually on the 25th of the month).

It should be noted that Group One consisted of households that were somewhat lower water users than the average for the district. This was not planned into the research design; instead it was a result of the use of a volunteer sample. The persons from the non-education group who volunteered to test the hardware were those who used less water than the average. It should also be noted that Group Four is more comparable to Group Two in that the follow-up interview identified any leaks in water lines or fixtures that occurred during the test period. No leaks occurred for these two groups from April on through June. Because follow-up interviews were not conducted with Groups Three or Five, the actual water use during the test period might have been affected by leaks that were unknown to the researchers.

Table 11 shows that all groups which received hardware and/or education consistently reduced their water consumption throughout the test period. There were substantial decreases in water use for May 1982 compared to the average May usage for the two preceeding years for the four test groups. There was also a decrease for the no-contact group (Group 5) but that decrease was smaller. Rainfall in the area was excessive during May of 1982 so the amount of water usually used for watering yards and gardens in May of this year was no doubt much less than for the preceeding years.

Data for June were not affected by such unusual weather conditions as were May data. The largest reduction in water use for June occurred in Group Two (-45%). The comparable group (Group Four) that received education only showed a 34 percent decrease while the group that received hardware only reduced consumption by only 18 percent.

Table 12 shows the results of the t-tests for significant differences in the mean monthly water use "before" and "after" for each group. The change in water use was significantly lower in both May and June for both Group Two and Four. The decrease in water use was also significant for Group Three in May. There were no significant differences for Group Five which received no contact. The decrease in water use by Group One (hardware only) approached significance for May but was not significant during the other months. The return of a daughter with a small child had a great effect on the water consumption of one of the four (4) families in Group One (hardware only) as a result of this change the entire group averages were effected.

From these findings it can be concluded that a combination of hardware and education produces the greatest reduction in water consumption. One might also conclude that the reduction that can be brought about through the installation

of water conservation hardware is less for households that are already low users than for households that are average to higher users.

Duncan's Multiple Range Test was conducted to determine if the four groups were significantly different from each other in terms of the mean difference in the quantity of water used from the "before" to the "after" period. No significant differences were found between groups for March or for June. However, significant differences were found between Groups Four and Five for the month of April and between Groups Two and Five for the month of May. The conclusion is that the group receiving no contact (Group Five) was significantly different from the groups that received education (Group Four) or education and hardware (Group Two) for two of the four months studied. The results of the Duncan's Multiple Range Test were impacted by the large variation in water use by families within each of the groups.

TABLE 11

CHANGE IN MONTHLY WATER USE BY GROUP

	March		April		May		June	
	gallon differ.	% change	gallon differ.	% change	gallon differ.	% change	gallon differ.	% change
Group One								
Hardware only N= 4	- 1000	- 6.37	800	4.2	- 5950	-28.95	- 3700	-18.14
Group Two								
Hardware and Education N = 9	- 3500	- 6.22	- 4100	- 5.64	- 27600	-34.80	-41850	-44.54
Group Three								
Education only (No follow-up interviews) N = 72	-33600	- 7.89	-11700	- 2.27	-112450	-21.76	-66550	-10.95
Group Four								
Education only (with follow-up interviews) N = 13	- 3600	- 5.25	-21750	-23.03	- 30050	-33	-37150	-34.29
Group Five								
No Contact N = 17	10400	13.03	13850	14.24	- 9100	- 8.53	-15900	-12.79

(-) indicates a reduction in water use from the mean of the same month in the past 2 years

TABLE 12

THE T-TEST OF DIFFERENCE* IN MEAN MONTHLY WATER USE BEFORE AND AFTER BY GROUP

	Mean Difference in Monthly Mean in 100's gal.	t - value	Probability
GROUP ONE			
March	- 2.50	- 0.29	.788
April	2.00	0.19	.861
May	-14.87	- 2.87	.064
June	- 9.25	- 1.13	.039
GROUP TWO			
March	- 3.89	- 0.63	.545
April	- 4.56	- 0.37	.721
May	-30.67	- 2.72	.026**
June	-46.50	- 4.55	.002**
GROUP THREE			
March	- 4.67	- 1.31	.193
April	- 1.62	- 0.34	.737
May	-15.62	- 3.88	.000**
June	- 9.24	- 1.20	.233
GROUP FOUR			
March	- 3.00	- 0.38	.7139
April	-18.12	- 1.73	.112
May	-25.04	- 3.47	.005**
June	-30.96	- 2.16	.054**
GROUP FIVE			
March	6.12	1.16	.265
April	8.15	1.84	.085
May	- 5.35	- 0.90	.379
June	- 9.35	- 0.99	.388

*Difference = Mean monthly use (in hundreds of gallons) for 1982 minus mean monthly use for 1980 and 1981 combined.

** Significant at $p<.05$.

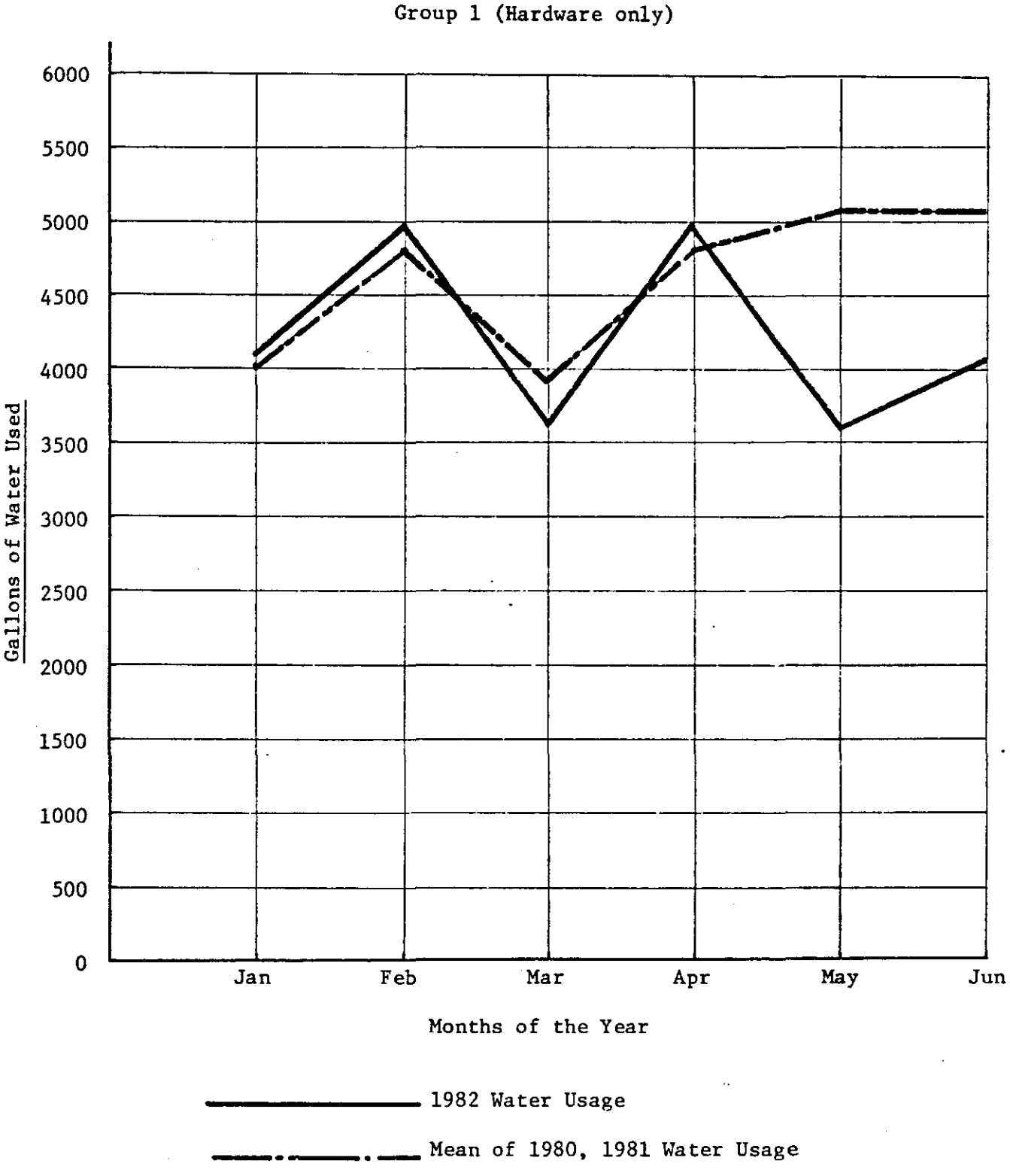

FIGURE 1. Mean Monthly Water Use - Group One

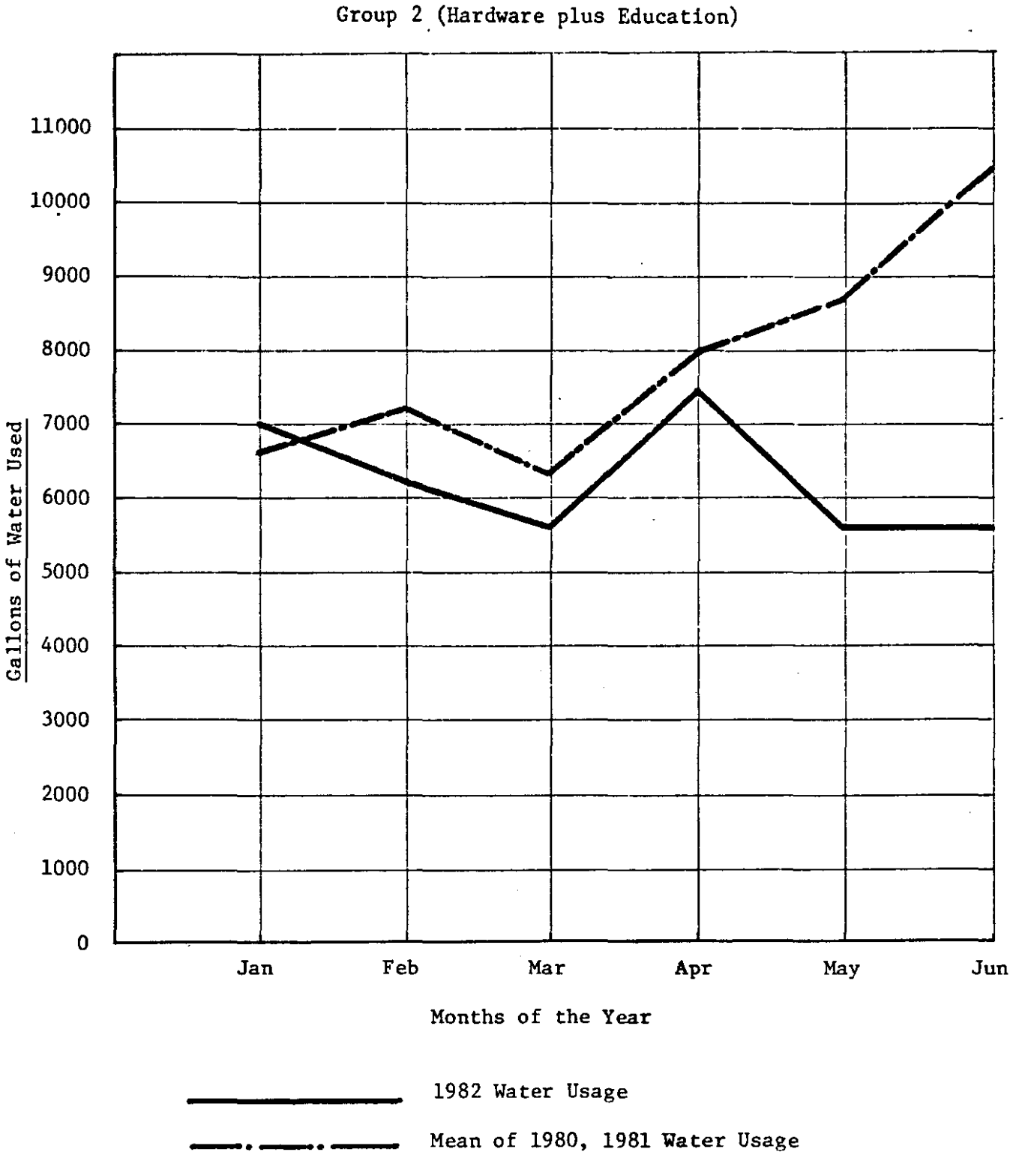

FIGURE 2. Mean Monthly Water Use - Group Two

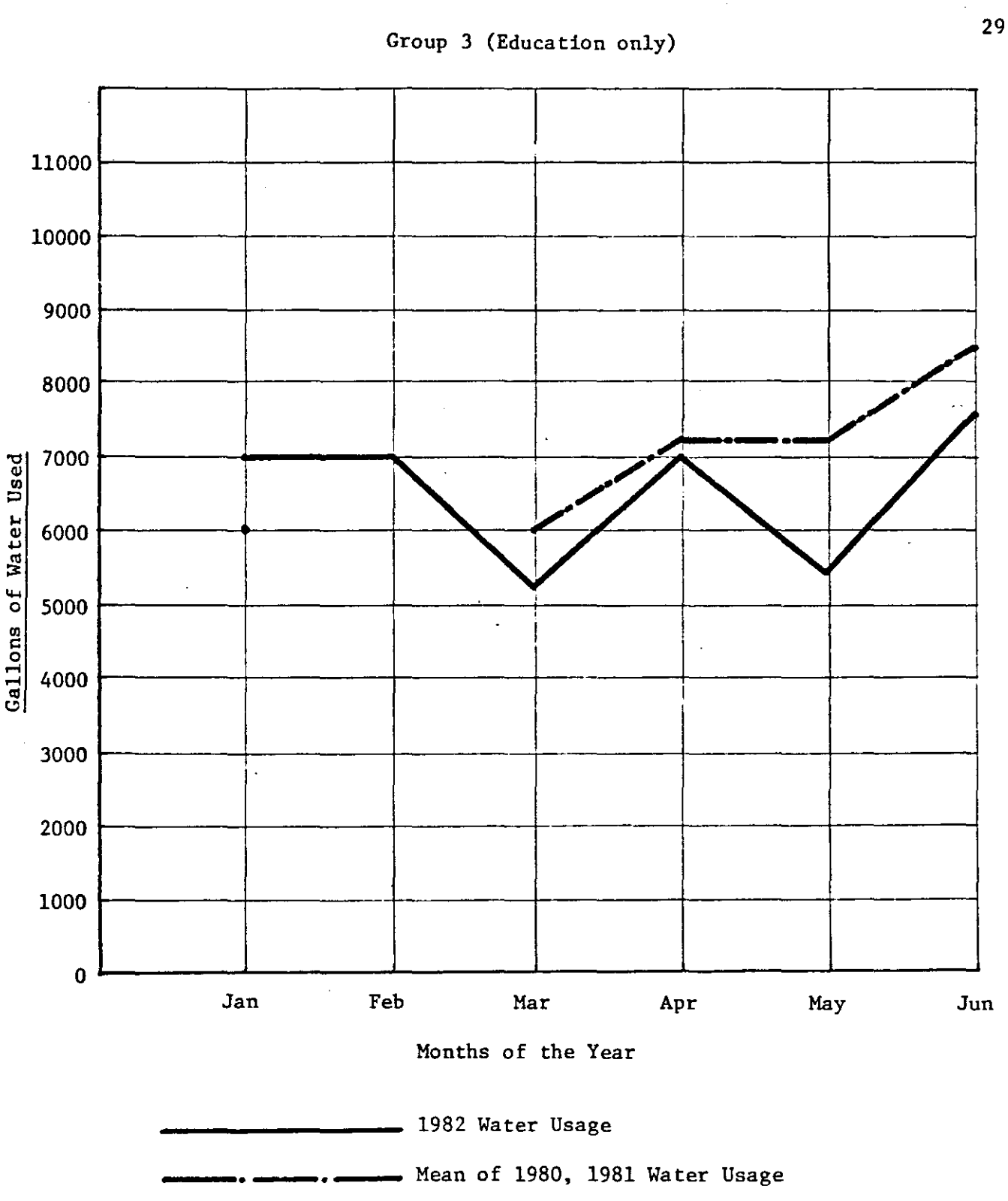

FIGURE 3. Mean Monthly Water Use - Group Three

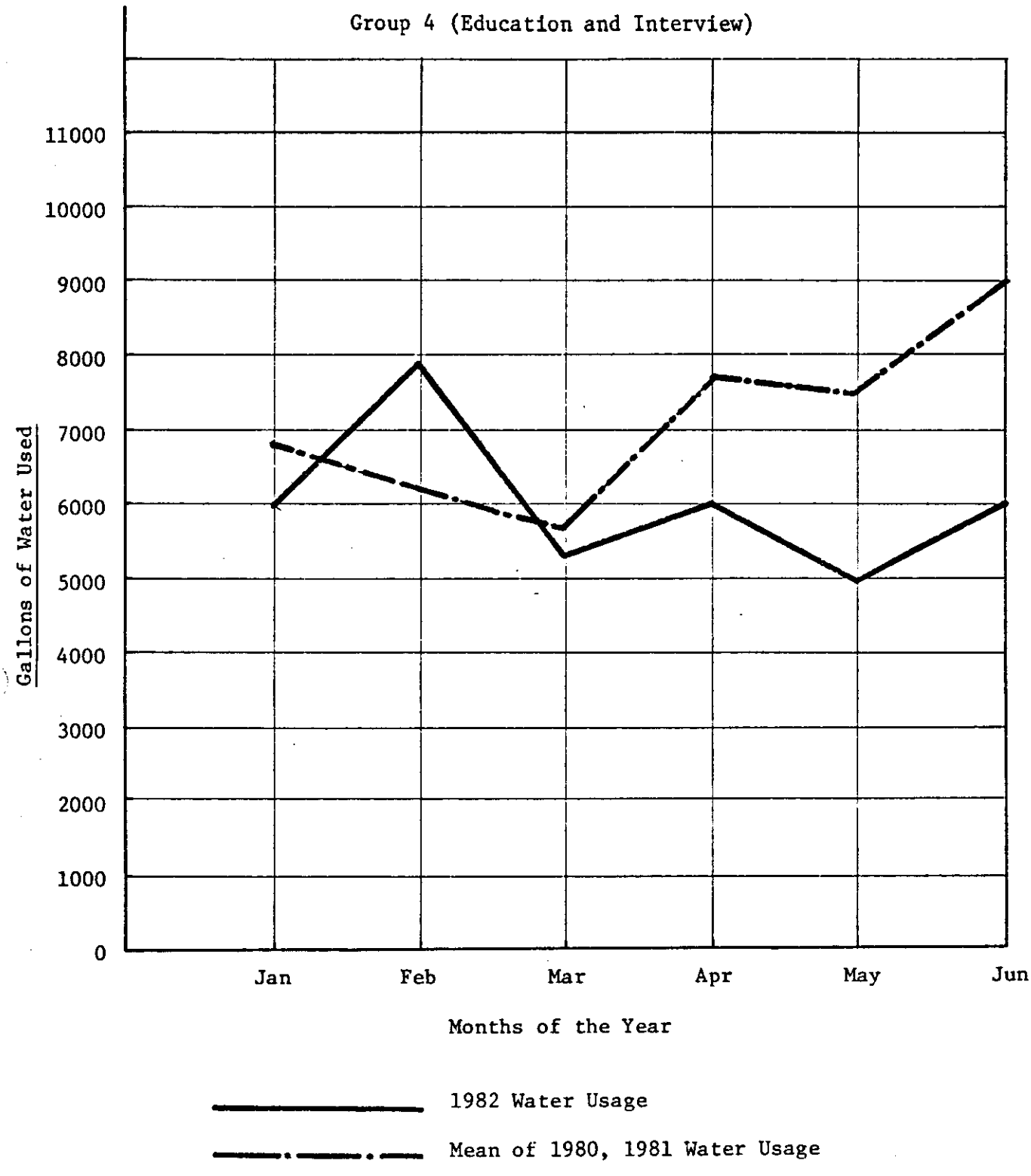

FIGURE 4. Mean Monthly Water Use - Group Four

Group 5 (No contact)

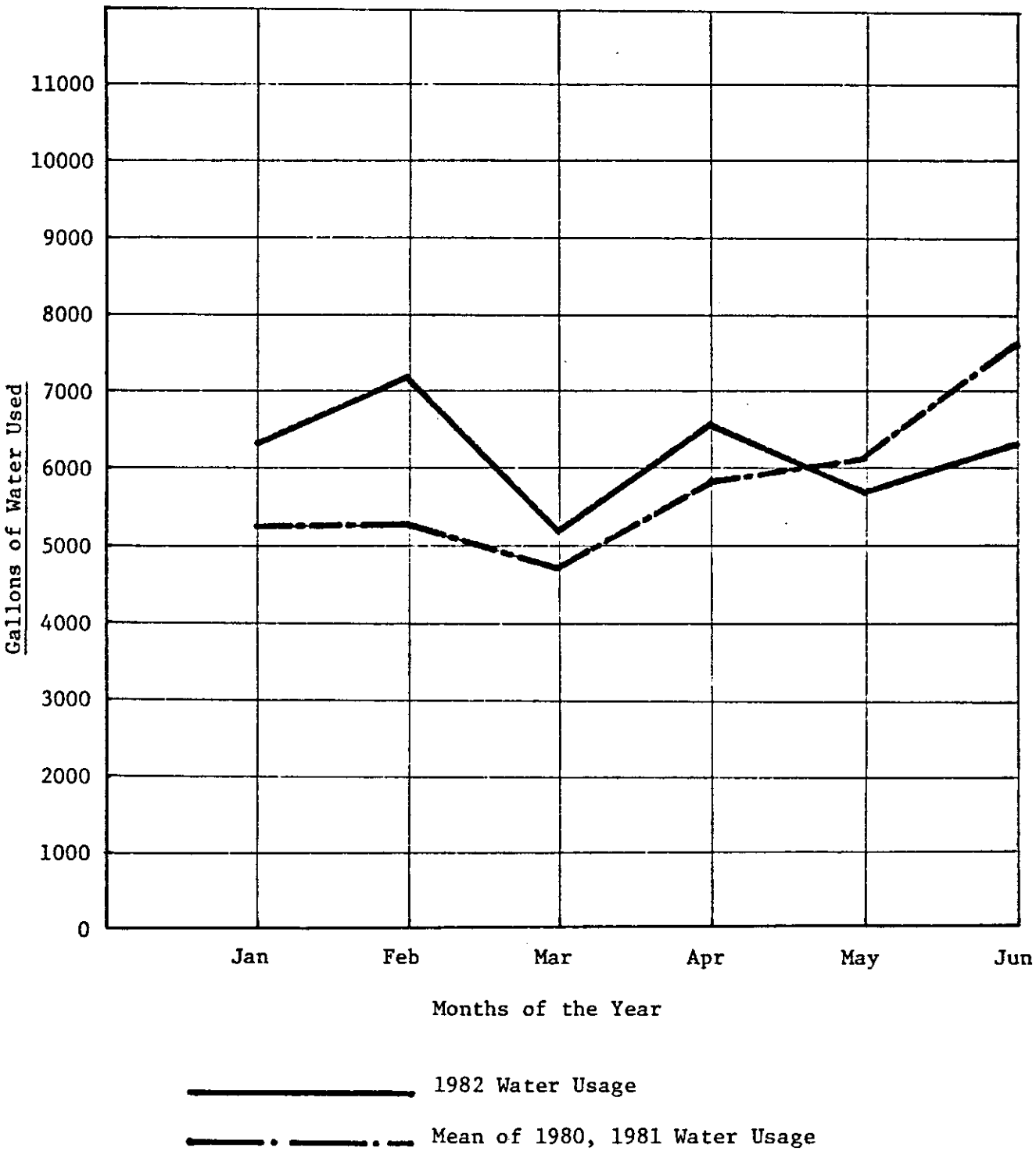

FIGURE 5. Mean Monthly Water Use - Group Five

Evaluation of Water Saving Devices

The second objective of this study was to obtain evaluation of the water conserving hardware from the families who have experienced using it.

General Response

The best testimony to the success of the installation is that no one asked us to remove the devices. All old plumbing fixtures remained the property of the owner but no one asked to have the old fixtures re-installed. No participant initiated a call or a letter to complain about the new devices. All remarks received were in response to inquiries by the researchers. The overall response to all devices was on the postive side. The majority of the participants did not perceive any difference between the old and the new fixtures. The most favorable reaction was for the shallow trap toilets. The device with the poorest acceptance was the flow-restrictor shower head. However, it should be pointed out that three (3) of the participants were using large volume shower heads prior to the test.

The use of shallow trap (3.5 gallons per flush) toilets in new construction and toilet replacement in remodeling is a foregone conclusion in the residential segment of the market. All of the major and many of the minor manufacturers in the United States have recently decided to manufacture only the water conserving toilet and thus comply with the many codes that require water conserving fixtures.

Specific Complaints

The consumer evaluation of the water conserving fixtures and hardware revealed only a few problems. Only one real complaint was received on the devices installed in the 15 homes. That one participant complained that the faucet flow restrictors caused excessive pressure in the pipes, more noise and

leaks, so they had to be taken off. This observation by the participant was for the most part imaginary.

A summary of the evaluation by participants following three (3) months of using the fixtures is shown in Table 13.

Toilets. Of the 13 families who had the shallow trap toilets installed, only one noted that they couldn't put as much toilet paper in it and three noted that occasionally solid matter did not flush adequately with one flush.

The new shallow trap toilet in one home replaced a very old toilet and as a result the participant remarked that the new toilet was too low.

Shower Heads. One of the 13 who received shower heads when asked what trouble they had with it, remarked that the shower water gets hot when the toilet is flushed. (Ths problem would also have occurred prior to the installation of the new shower head). Another remarked that the shower was uneven. Four (4) persons thought that it took more time to take a shower with the new device.

Faucet Flow Aerators. Two of the 15 to receive faucet aerators thought it took longer to get hot water when you first turned on the faucet. One person remarked that the water ran crooked (apparently a small piece of pipe scale or mineral partially clogged the opening). One person out of the 15 removed the faucet flow restrictors prior to completion of the test as stated earlier. That person lived very close to the standpipe so the pressure there should have exceeded the pressure and flow rate experienced by all but one other participants.

TABLE 13

PARTICIPANTS' EVALUATION OF WATER CONSERVING HARDWARE

Flow restrictor faucet aerators in all sinks max. flow 2.3 gpm	Flow restrictor shower heads max. flow 2.7 gpm	Shallow trap toilets (3.5 gal per flush	User Evaluation Response
3		3	1. "I like the new device better than the one it replaced."
		1	2. "I like the new devices somewhat better than the one it replaced."
1 3.6* Mean	3	3.38* Mean	3. "I did not like the new device at first but now I do."
9	4.09* Mean 5	7	4. "There doesn't seem to be any difference between the new device and the one it replaced."
2	1	1	6. "The new device has been a problem and I don't like it."

Water Management in the Family Unit

The third objective of the study was to conduct indepth interviews with selected families to identify changes in water use practices and key factors that affect water management decisions within the family unit. A total of 28 families were interviewed following the dissemination of water conservation education materials over a four month period. Fifteen of these families had also been using the water conserving hardware.

Water Management Decisions. Water use decisions were most often made by each individual within the family as related to the water use activities in which the individual was involved, i.e., length of shower, running water while brushing teeth, etc. When asked where the most water was wasted in the home 50 percent of the families indicated that bathing/showering was where the most water was wasted. No other use was mentioned by more than seven percent of the families. Outdoor usage or lawn watering was not mentioned as one of the wasteful uses.

Over half of the families reported having discussed water use as a family; only 43 percent acknowledged that any decision concerning water conservation was made. The case study interviews show that 46 percent of the families interviewed did not change any water use behavior. It further showed that an even larger percent (68%) of the families in Groups One, Two and Four had no future plans to reduce water use.

The interviews were conducted with the adult members of the family and they reported that decisions to conserve water were made by one or both of the adults. None of them mentioned that their children had made decisions to conserve water. In fact, it was common for parents to complain about the childrens' waste of water.

In most cases both the adult heads of the household stated that they were aware of the cost of the water each month, but only 39 percent knew the approximate number of gallons of water used. The wife in 70 percent of the families, the husband in 17 percent, and either husband or wife in the remaining families actually wrote the check to pay the water bill. Forty percent of the families reported that the cost of water was not an important item when working out the family budget. Thirty-nine percent of the families considered the cost of water when deciding where and when to use it. The cost of water in this district (and most other rural water districts in Oklahoma) is so low that there is not much potential for the cost of water to impact behavior in favor of conservation.

Changes in Water Use. Even though the case study interviews revealed that 64 percent of the families in Group One, Two, and Four made no conscious effort to change behavior to save water, the overall average of water usage showed that the groups did reduce the amount of water they used. No family in Group One (they did not receive any educational material) admitted that they changed any behavior in an effort to conserve water. Only those families in the groups that received the educational material (Groups Two and Four) acknowledged changing behavior to conserve water.

The behaviors the families selected to modify were, for the most part symbolic of at least an interest in water conservation. Of the 43 percent that made water conservation decisions over half of those decisions concerned the length of a shower. Many of those complaining of the waste in bathing and showering mentioned specifically that "the children" or "the boys" ran the shower too long. One-fourth of the water conservation decisions involved watering the garden, not the lawn. The remaining 25 percent of the water conservation decisions were scattered, covering such items as keeping drinking water in the refrigerator, and fixing dripping faucets. Another frequently

mentioned behavior change was not letting the water run when brushing one's teeth.

Considering that 54 percent of the case study families in Groups Two and Four mentioned changing behaviors and no one in Group One mentioned any behavior change for water conservation there is an indication that the mail-out materials had some impact. In the 54 percent of the families that made any behavior changes in water use inside the home, the wife was named as the person responsible for all but the individual use changes. The wife made changes in dishwashing operation in 35 percent of the families, in laundry 21 percent of the families, and in food preparation and clean-up in 18 percent of the families.

It was common for the persons who was being interviewed to say that they thought they were very aware of water conservation practices and were using them even before the study. Many of the older couples generally questioned why they were in the study because they used so little water. Many families with children felt they had good reason to be high water users but they thought they would be more conserving after the children left the nest.

Regulation and Policy Aspects

The indepth interviews conducted with Groups One, Two, and Four sought to find out how the families involved in the study felt about several water policy issues. Although 28 families were interviewed, not every family could or would answer every question. Table 14 shows the responses of those families that did answer the questions.

It is significant that two-thirds of the members surveyed did not feel that there water district had any problems. Those respondents who felt there was a problem most often mentioned the lack of adequate pressure at certain times. The mail-out educational materials identified local problems and described local operation of their water district. Because the water district used in this

TABLE 14

RESPONSES TO QUESTIONS ON WATER POLICY ISSUES

A. Do you think there is a water problem in Oklahoma?

Yes 61% No 39%

B. Do you think there is a water problem in your Rural Water District?

Yes 36% No 64%

C. How important is it for you to try to conserve water on a scale of 1 to 5?

very important	1	2	3	4	5	very unimportant
	32%	49%	19%	0%	0%	

D. You are now charged for water on a decreasing block rate. That means you pay less per gallon when you use a larger number of gallons.

a. Do you think this is a fair way to charge for water?

Yes 41% No 56% Undecided 3%

b. Do you think this method or rate of charging encourages or discourages the use of water?

Encourages 86% Discourages 3% Don't know 11%

E. Do you think everyone should have the right to use as much water as they are willing to pay for?

Yes 46% No 43% Undecided 11%

F. Do you think that water rates should be high enough to allow the district to take in some excess funds that could be used for future maintenance or expansion of the system?

Yes 68% No 29% Yes, but on maintenance only 3%

TABLE 14 (cont.)

G. Which of the methods of charging for water do you think would be best for a rural water district?

a. Charge rates high enough to make it possible to accumulate some excess funds that can be used for maintenance of the system and later expansion. 69%

b. Keep rates at an absolute minimum then when major maintenance and expansion are needed the district should do which of the following:

1. borrow from the state 0%
2. borrow from the federal government 4%
3. sell bonds 23%

c. Undecided 4%

H. Which method would you prefer if your water district needed to encourage the members to conserve water?

a. Require that all members install water saving devices in their homes. 19%

b. Charge more for water during summer months to discourage the use of water for lawn watering, car washing, etc. 15%

c. Conduct an educational program to encourage members to reduce the amount of water they use by changing water use behavior. 54%

d. A combination of the above 12%

I. Do you have any plans for trying to reduce the amount of water that you use in the future? Yes 32% No 68%

J. Since the water district has reached near capacity for its existing equipment, do you think that all homes that connect to the water

TABLE 14 (cont.)

district in the future should be required to have water saving devices installed prior to receiving service?

Yes 78.5% No 14.3% Undecided 7.2%

This question was asked of only those in the hardware groups 3 months after they had the devices installed in their homes.

study is rather small, problems are generally communicated to the users by a phone call from the manager. This personal touch keeps the communication of problems quite low-key and for the most part trouble free.

The respondents were much more conscious of water problems at the state level. Two-thirds of the members felt that Oklahoma had water problems. The problem most often mentioned was the unequal water availability in western verses eastern parts of the state. Other problems listed were those problems associated with growth and drought. No respondent mentioned any environmental problem or made any comment about any critical problems related to water.

All respondents thought that water conservation was "important" to "very important". However, no relationship was found between the respondents' use of water and their attitudes about the importance of water conservation.

It was a surprise that the majority of the respondents felt that the decreasing block rate was unfair because this has been the traditional rate structure since the beginning of the water district operation. Because over three-fourths of the respondents realize that the decreasing block rate does not encourage conservation, a rate change that would encourage conservation would not be out of order and would not necessarily meet with total resistance. In fact, it could be seen by the membership of the district as a step toward fairness.

The nearly even split in responses on water rights in Question E indicated that the idea of limiting or rationing water would be acceptable to at least the majority of the membership. It also indicated that the majority of users did not accept visible water waste.

The vast majority (70 percent) of the respondents accept the "pay as you go" idea on rate collection (Question G). It is ironic that while the state legislature was discussing the state support of water projects, not one respondent in this study favored borrowing money from the state government and only four percent favored borrowing from the federal government.

Evaluation of Educational Materials

When educational materials were received they were seen by the following family members:

wife only	19%
husband only	19%
both husband and wife	46%
everyone in the family	8%
wife and children	4%
children only	4%

The ideas in the materials were discussed in 74% of the families that received them. In only 21 percent of the homes did the respondents acknowledge that any of the materials influenced the way they used water. Only nine percent of the respondents said any of the materials affected them negatively in any way. The concern of those persons was the amount of money and effort it took to send so many items out. They noted that some of the materials repeated many of the same conservation suggestions. The shotgun approach of sending many different items in the mailings was an effort to have something for everyone in the family. The posters, stickers and coloring books were aimed at various age children. In Groups Two and Four 18 percent of the test families had no children. In 50 percent of the remaining families with children, the parents said the materials had no effect on the children's water usage. Seventeen percent of the parents thought the materials did have some effect but they weren't sure which materials caused that effect. In those cases when asked, "What effect do you think the materials had?", the parents thought the children didn't use as much water while bathing, showering or brushing their teeth. The water conservation reminder stickers and the coloring books were thought to be

the most effective in 17 percent of the families and an additional 11 percent thought only the stickers were the most effective reminder to change the childrens' water use habits.

The responses to the question, "Which of the materials on water conservation were most helpful to you and your family?", are shown in Table 15.

TABLE 15

EDUCATIONAL MATERIALS CONSIDERED MOST HELPFUL

Item	Percent
The computer printout graph of water use comparison	39.3
The list of water quantities used for various activities	17.8
The EPA Water Wheel on conservation tips	14.3
The stickers for reminders concerning water conservation (AWWA)	7.1
The information on the Rural Water District Operation	7.1
The childrens' coloring books (Ok. Water Resources Board)	3.6
The leak repair diagrams	3.6
The Virginia Water Conservation Primer	3.6
None	3.6

The individualized water use graph sent to the water user was by far the most helpful information sent.

As an evaluation of the educational program, 36.4 percent of the respondents had no further suggestions when or how this program could be made more effective if used with other rural water districts. Eighteen (18) percent of the respondents thought water conservation should be taught beginning in the grade schools and that units on water conservation should be taught at all levels of school. The most perceptive respondents were in a group of fourteen percent of the families that voiced opinions like

"Education programs won't make much of an impact when water rates are so cheap", "Get down to dollars and cents", and "Charge more for water". The information about their water district and the personalized water use graph prompted some persons to suggest that reminders should be put in the monthly bills of high users suggesting that, You should check for leaks, you have used more water this month than normal", or "You have used much more than the normal amount of water this month; is there some reason for the increased usage?". Other suggestions included that the annual meetings of the water district membership include a talk on water conservation.

The evaluation of the educational program also asked if the respondent would recommend that an educational program such as the one they have been involved with should be made available to all of the members of the water district. Over 90 percent of the respondents said they would recommend this.

The least successful portion of the mail-out educational program concerned the flow restrictors. Only fifteen (15) percent of the persons that received the flow restrictor washer, included in one of the mailings, installed the device.

The Water Watcher Gram mail-out also included diagrams of how to repair three different faucets and a toilet tank. It asked that the families check for leaks. Seventy-two (72) percent said they did check for leaks and 62 percent said they found a leak. All but one person fixed the leaks they found; only nine percent said they used the materials sent to them to fix the leak.

If conservation is a policy goal of the water supplier then the reduction in water use by the groups which received the educational materials (Groups, Two,

Three and Four) has demonstrated the success of the mail-out program. These educational programs could be conducted along with monthly bill mailings at minimal additional cost. No water district should expect wide-spread installation of flow restrictors and other devices received in the mail; however, installation of devices and leak detection and repair is best handled on a personal basis where the device is installed for the user.

Cost Effectiveness of Conservation

Water conservation campaigns by water suppliers usually cause a reduction in cash flow without an accompanying reduction in operational costs. The Rural Water District studied is a one-family operation. Employee costs are stable. No treatment is done to the water. There is no alternate source of supply other than the district's four (4) shallow wells (approximately 47' deep). No water is purchased from other suppliers. While the district is still paying back its Farmer's Home Administration construction loan the district is in good sound financial condition. The current rates have been in effect since the district started operation in 1973. The water rates are not the lowest in the county nor are they the highest. The rate for water is as follows:

First 2,000 gallons	$9.00 minimum charge
Next 2,000 gallons	1.50/1000 gallons
Next 2,000 gallons	1.00/1000 gallons
Next 4,000 gallons	.75/1000 gallons
All over 10,000 gallons	.50/1000 gallons

Operational expense for the district is quite stable except for repair work and electrical pumping costs. The Water District charter directs that the district operate on a non-profit basis for the benefit of the members.

Mean water usage for the 233 meters over the last two years is approximately 7500 gallons per meter. In 1980 an average of 1,797,500 gallons of water per month was used by the district members. The peak water consumption by the district members was in July 1981 when 3,205,000 gallons were used.

As far as the district operation is concerned conservation of water by the members decreases electrical pumping charges and reduces the need for system expansion. If all members had the same reduction as Group Two only, approximately $600 could be saved in electrical pumping charges. No salary or treatment charges would be reduced by any conservation effort.

The cost of water saving devices was as follows:

Fixture	Material and Fixture Cost
Shallow trap toilet w/seat	80.00
Flow restrictor shower head	8.00
Flow restrictor faucet aerators	2.00
Lavatory faucets	22.00
Kitchen faucets	29.00

The average home of this project was retrofitted at a cost of approximately $350 materials and labor. Considering the homes were all in a rural area and the installation charges included plumbers travel time to and from the shop in Stillwater, the average installation cost per home was approximately $250. There was approximately $100 installation difference between the houses

with 1 bath and the homes with 2 baths. The survey of the plumbing at the start of the project revealed a wide variance in the condition of the existing plumbing. The plumbers had a real mixture of conditions to work with; there were no typical installations since none of the volunteers lived in new homes (the homes were from 5 to 50 years old).

Considering the entire membership of the water district the average meter registers water usage of 7500 gallons per month. The group means of the percent of change in water use for the four test months are shown in Table 16.

TABLE 16

MEAN PERCENT CHANGE IN WATER USE
DURING TEST PERIOD: MARCH - JUNE 1982

Group	% change in March-June 1982 compared to the same months usage in 80 and 81
One (Hardware only)	-12.3%
Two (Hardware and education)	-22.8%
Three (Education only)	-10.75%
Four (Education and interview)	-23.8%
Five (No contact)	+ 1.75%

The average monthly cost of water for each group is shown in Table 16.

TABLE 17

MEAN WATER USE AND COST PER MONTH
FOR MARCH - JUNE 82

Group	Gallons	Cost
One	4734	$12.73
Two	8395	15.80
Three	7170	14.88
Four	7551	15.16
Five	6000	14.00

Group Five is used as the control group. If the families in Groups One - Four had not received the educational materials and devices it can be assumed that their water use would have been comparable to Group Five - that it would have increased by 1.75 percent. When this percentage increase is applied the cost savings as a result of devices and education would be as shown in Table 18.

TABLE 18

MONTHLY COST SAVINGS FROM REDUCED WATER USE

Group	Proposed Usage (Gallons)	Cost	Monthly Cost Difference Table 18 less Table 17
One	5,504	$13.50	$0.77
Two	11,119	17.56	2.48
Three	8,194	15.64	0.76
Four	10,135	17.06	1.90
Five	6,000	14.00	----

At this water rate the simple payback time for the $350 initial cost of the conservation devices for Group Two, not including interest, inflation etc., is over 11 years. Simply put, if water rates remain the same, it does not make economic sense to install water conservation devices for the consumer who would hire a plumbing contractor to remove working fixtures from the house and replace them. However, if the toilet is malfunctioning and the consumer would have to hire a plumber anyway, then the replacement of existing fixtures with water conserving fixtures could be repaid by savings in water costs in approximately six years. The do-it-yourself-replacement of flow-restrictor faucet areators and shower heads is economic now because of the reduction of hot water usage.

The only way then to justify the retrofit cost of water conserving fixtures is on a do-it-yourself basis with a three year simple payback. If water prices remain as low as they are at present, then all conservation efforts are very difficult to explain to the consumer.

SECTION V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This investigation of the effectiveness of the use of water conserving hardware and water conservation education in reducing the quantity of water used by members of a rural water district produced the following findings:

1. The quantity of water used was reduced in all the test groups with the largest percent decrease occurring in the group that received both the water conserving hardware and the educational materials. The second largest percent decrease occurred in the group that received water conservation education materials only. Water use increased during March and April for the group that received no contact and then decreased slightly in May and June.
2. The group which received no contact was found to be significantly different from the group which received education and the group which received education and hardware in terms of reduction in water use for two of the four months of the study.
3. The overall response of users to the water conserving hardware and devices was positive with users not perceiving any major differences between the old and the new fixtures. The most favorable reaction was for the shallow trap toilets.
4. In nearly half of the homes, the educational materials were seen by both the husband and wife. Water management decisions are most often made by these adult heads of household. In this study it was the wife who made most of the decisions about water use for laundry, food preparation and clean-up.

Although children may make some decisions about water use for their personal hygiene, the parents frequently function to establish criteria to guide the behavior of children.

5. The majority of families indicated that they felt the most water was wasted in bathing and showering. Over half of the conscious decisions to reduce household water consumption were related to bathing/showering activity.
6. The individualized water use graph was by far the most helpful educational material, as evaluated by the users. The second most helpful material was the list of quantities of water used for various activities and the third was the EPA Water Wheel with conservation tips.
7. The present low rates being charged for water had very little effect on decisions related to the quantity of water used by the respondents.
8. The decreasing block rate was viewed as unfair by a majority of the respondents. About two-thirds of the respondents thought that water rates should be high enough to allow the district to take in some excess funds that could be used for future maintenance or expansion of the system.
9. The simple payback period (not including the effects of inflation, interest etc.) for the initial cost of replacing existing hardware with new water conserving hardware is over 11 years.

Conclusions

The major conclusions from this study are:

1. A combination of water conserving hardware and water conservation education produces the greatest reduction in water consumption.
2. The reduction in water use that can be brought about by the installation of

water conserving hardware can be expected to be less for households that are already low users than for households that are average to higher users.

3. Water conserving hardware can be installed without reducing the comfort or changing the lifestyle of the users.
4. Although less than half of the families interviewed at the end of the study acknowledged having made conscious decisions to conserve water, the actual water consumed had decreased significantly in three of the four test groups.
5. Programs designed to change behavior so as to reduce household water consumption should be directed primarily toward the adult who has primary responsibility for laundry, food preparation, clean-up and supervision of childrens' personal hygiene. However, this individual should be encouraged to involve all family members in the water use decision making process.
6. Consumers' interest in water conservation can be increased by providing them with information about their own water use over time relative to that of the average use for the district as a whole.
7. Just mailing out faucet flow restrictors is not an effective means of encouraging conservation. The detection of water leaks and the installation of water conserving devices is best handled on a personal basis where the devices are installed for the user.
8. The present water rates in many rural water districts in Oklahoma are so low that there is little potential for the cost of water to impact behavior in favor of conservation.
9. If the water rates remain at their present low levels, it is not economically viable to install new shallow trap toilets or flow restricting faucets and shower heads if the user has to hire a plumber to do the installation. The

only way to justify the cost of retrofitting with water conserving hardware is on a do-it-yourself or replacement basis with a three year simple payback.

Recommendations

1. Water district boards which have a policy goal of reducing water consumption should initiate a water conservation education program. A minimal cost program can be designed to accompany the mailing of monthly bills. The educational materials are most effective when they contain personalized information about the consumers' actual water use.
2. Water conservation should be included in the schools, beginning with the elementary schools and following through all grades.
3. Water conservation education materials designed to change water use behavior around the house should include information for all family members but be most heavily directed toward the adult(s) who are responsible for laundry, food preparation, clean-up and supervision of personal hygiene of the children.
4. If conservation is to be encouraged, users should be made aware of problems within the district related to supply, pollution, treatment, distribution, etc.
5. The water use of the persons in all five groups of this study should be monitored for an additional six to eight months in order to assess the long term as well as the short term effects of hardware and education.
6. Water district boards can insist on conservation by requiring the installation of conserving devices in the homes, businesses and institutions served by the water supply entities. The example of an enabling ordinance,

like the one shown below, is recommended as a water conserving approach that can have the force of law. Enforcement of problem situations then can be shifted to the law enforcement agencies in much the same manner as traffic enforcement, i.e. a misdemeanor with its accompanying citations. Many states and municipalities having water problems have adopted similar approaches to "day in and day out" water conservation in order to reduce operation costs, reduce peak demand and avoid large capital expenditures. The enforcement aspect of the ordinance is optional and could be enacted when and if there is a problem in compliance.

Sample Enabling Ordinance and Regulation

The first step is for the water district board to request that the county government enact enabling ordianances which would require or allow the water supplying public entities to write water conservation measures and establish those regulations as county ordinances with penalties for violation. The following is an example of the form that an enabling ordinance might take.

Section A. Public hearing: Adoption and enforcement by ordinance or resolution:

Notwithstanding any other provision of the law to the contrary, any public entity which supplies water at retail for the benefit of the inhabitants therein may by ordinance or resolution adopted by a majority of the members of the governing body thereof after holding a public hearing upon notice thereof and making appropriate findings of necessity therefore, adopt and enforce a water conservation program to reduce the quantity used by the inhabitants therein for the purpose of conserving the supplies of such entity. Such ordin-

nance or resolution may specifically require the installation of water-saving devices which are designed to reduce water consumption.

The ordinance or resolution may also limit times water may be used and quantity of water that may be used by any user of the water supply. Irrigation of crops on farms and the watering of livestock shall not be controlled by the above ordinances or resolutions.

Section B. Effective date of ordinance: Publication

Any ordinance or resolution adopted pursuant to Section A is effective upon adoption. Within 10 days after its adoption, the ordinance or resolution shall be published pursuant to the Code in full in a newspaper of general circulation which is printed, published, and circulated in the district. If there is no such newspaper the ordinance or resolution shall be posted within 10 days after its adoption in three public places within the district.

Section C. Violation as misdemeanor

From and after the publication or posting of any ordinance or resolution pursuant to Section B, violation of a requirement of a water conservation program adopted pursuant to Section B is a misdemeanor. Upon conviction thereof such person shall be punished by a fine not exceeding $100.

The second step is for a rural water board to enact a regulation concerning the installation of water conservation devices. A sample of this type of regulation is shown below.

Section 1.1

After January 1, 1983 no new water meters will be set and no water provided to serve any dwelling, motel, apartment, office building, retail store, restaurant, or other commercial use structure in which tank-type water closets are used unless the water closet uses no more than an average of 3.5 gallons of

water per flush, or that structure has been supplied water from (insert name of the water supply entity) prior to December 31, 1982.

Table A lists the maximum amount of water that can flow through any bathing type shower head, lavatory or kitchen faucets in any of the structures listed above. Institutional and commercial kitchens are exempted from the requirements of this ordinance.

TABLE A

Appliance Plumbing Fixture	Test Pressure	Maximum Flow Rate
Showerheads	20-45 psig	2.75 gpm
	45-60 psig	3.00 gpm
Lavatory faucets or Sink faucets	20-60 psig	2.75 gpm

In the event the inlet pressure to any dwelling is in excess of 60 psig a pressure reducing valve shall be installed and set so that the meter outlets pressure does not exceed 60 psig.

Section 1.2 - Inspection

Inspection for compliance of the structures covered by this ordinance or resolution is the responsibility of the water supply entity. Fixtures and devices deemed to have complied with the ordinance or resolution shall be contained on a list of water conserving fixtures as is periodically compiled and published by the state Water Resources Board of the Board of Health. The installation of approved water conserving fixtures that comply with this ordinance or resolution is a condition of water service or supply.

Section 1.3 - Assistance

(Insert the name of the water supply entity) will provide instruction diagrams and assistance to aid the owners of any structure presently being served water to equip and install water conserving devices on that structure. Devices which modify existing water closets to meet the maximum of 3.5 gallons per flush with acceptable performance may be installed in the structures of those being supplied water by (insert the name of the water supply center) prior to December 31, 1982 until such time that those existing fixtures require extensive maintenance or operational service. The (insert the name of the water supply entity) may offer a grant or a loan to expedite the installation of the water conserving devices throughout the district.

Section 1.4 - Exemptions

The requirement of the Section 1.1 shall be applicable to all new structures and new additions to those structures. Section 1.1 shall also be applicableto those existing structures if the requirements will not require substantial modification of the existing plumbing system. The board of (insert name of water supply entity) may allow the use of water closets that require more water per flush than required in Section 1.1 or devices that exceed the usage stated in Table A only when in the opinion of the board the existing configuration of the building drainage system requires a greater quantity of water to adequately flush the system or when an adequate supply of water closets or devices is not available within a reasonable time.

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APPENDIX A

LIST OF EDUCATIONAL MATERIAL

The following mailings were made (a copy of each item is included in the Appendix B):

All "Water Watcher-Gram" were developed by the research team and were simple xerox reproduced letters that focused on a particular subject each mailing. All pamphlets, booklets, posters, stickers and the like included in the mailings were purchased from various water control or supply organizations.

Initial contact letters and invitation to participate

Mailout #1 - Introduction

a. buff colored fold out that described the operation of the Rural Water District.

b. Oklahoma Water Resources Board childrens' coloring book

c. an EPA fold out on the water clean-up campaign

Mailout #2 - Conservation

a. EPA "Water Wheel" a guide to home water conservation

b. Water Watcher-gram #1

Mailout #3 - Devices

a. Water Watcher-gram #2 (water flow control devices). An explanation of devices available in the Stillwater area along with the cost.

b. Penn State brochure by William Sharpe "Saving Money with Home Water Conservation Devices"

c. a graph (computer print-out sheet) showing the family's water use for the last 4 years as compared to the mean water use of 135 similar users within the district

d. list of manufacturers of water saving devices

Mailout #4 - Leaks

a. toilet tank leak detector pill (provided by Fluidmaster, Inc.)

b. pamphlet "Be a Leak Seeker" by the American Water Works Association

c. Water Watcher-Gram "Stop Those Leaks", a five page explanation with diagrams on 1. How to read a meter
2. How to fix 3 different types of faucets
3. How to fix common toilet leaks

Mailout #5 - Inside Water Use

a. a sheet of self-adhesive stickers on water conservation (American Water Works Association)

b. Water Watcher-Gram "Easy Ways to Reduce Water Use at Home". Lists approximate use of water for various residential uses

c. Commonwealth of Virginia Water Control Board booklet "Water Conservation Primer"

d. "Water Conservation at Home" published by American Water Works Association

e. "It Pays to be a Water Watcher" published by the Oklahoma Water Resources Board

Mailout #6 - Outside Water Use

a. Water Watcher-Gram "Great Outdoors" with instructions on how to water bermuda grass and drought resistant trees and shrubs

b. OSU Extension Facts #1655 "Lawn, Garden and Small Plot Irrigation"

c. OSU Extension Facts #1511 "Trickle Irrigation for Lawns, Gardens and Small Orchards"

d. OSU Extension Facts #6005 "Mulching Garden Soils"

e. "Stretch Your Water Mileage", Water Research Institute

f. "40 Saving Ways with Irrigation Water"

g. "By the Dawn's Early Light" published by the American Water Works Association

Mailout #7

a. follow-up thank-you letter

b. EPA "The Environment Supports Life - Consider the Connection"

c. EPA, March 1977, "Is Your Drinking Water Safe?"

d. "Water Conservation Checklist for the Home", published by the U.S. Dept. of Agriculture, #1192

e. a one page 4 question evaluation sheet