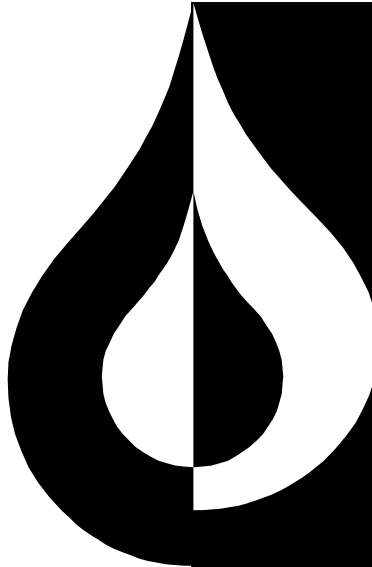


ATTITUDES AND BEHAVIORS ON WATER CONSERVATION IN TEXAS



**Final DRAFT research report prepared for the
Texas Water Development Board
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Introduction

Water and the ecosystem goods and services it provides continue to fall under increasing pressures emanating from both a growing demand as well as changing supplies. The goods and services that water provides are critical to natural resource and economic sustainability, ultimately driving quality of life for all Texans. These recognitions are well documented within the plans that Texas has implemented for the management of this finite resource and includes recommendations that all tools available be employed to sustain water resources for beneficial use.

Conservation, one of the most cost-effective tools we have in meeting the growing demand for water, is a crucial component to its overall management. The 2007 State Water Plan indicates that conservation accounts for nearly 23 percent of the projected additional water supply needed in 2060, which is enough to supply half of the current annual municipal use in Texas (TWDB, 2007).

Water conservation can be achieved across a broad spectrum of best management practices throughout municipal, industrial and agricultural users. Determining the appropriate suite of these practices falls largely upon water providers (i.e., Water Utility Districts, Irrigation Districts, etc.) and, concomitantly, water consumers (i.e., municipalities, industries, agricultural-based users, etc.). Understanding the perceptions, interest, knowledge, attitudes, experience, current behaviors, and behavioral intentions of water planners, water providers and water users in regard to water conservation activities is of utmost importance to the development of applicable policy and sustainable water conservation management programs.

Tuerff-Davis Environmedia, Inc. (2004) conducted a statewide market study in 2004, and reported that 87 percent of those surveyed said they were more likely to conserve water after learning about conservation. These findings, along with other primers, resulted in the inclusion of public awareness and education as conservation strategies in the 2006 Regional Water Plans. Though recognized as a valuable resource, water conservation efforts often remain underutilized, and, thus are not necessarily prevalent in the greater public's awareness. Success in water conservation depends on the level of stakeholder involvement, commitment, and awareness.

The purpose of the this research program was to determine the perceptions, interest, knowledge, attitudes, experience, current behaviors, and behavioral intentions of water consumers with respect to water conservation. The study focused on: (1) awareness, willingness, and ability to implement strategies; (2) economic, technical, and sociological considerations affecting decisions to engage in conservation activities; (3) solutions available to real and/or perceived barriers for implementing conservation; and, (4) actions by TWDB or local entities that could be implemented to facilitate adoption of conservation activities.

Through the development of the Water Conservation Implementation Task Force's Best Management Practices Guide, the State of Texas is seeking an effective implementation of water conservation practices to assist in securing future water resources required by the State. The results of this project provide valid and scientifically-based information on current and future water conservation attitudes and behaviors. The results provide a vision of what water constituents see as viable

approaches to water conservation within the State of Texas.

Methodology

Data for this study were collected from a random sample of individuals located in nine of the sixteen regional water planning areas across Texas. The nine regional water planning areas included:

- Region C
- Region E
- Region H
- Region I
- Region J
- Region K
- Region L
- Region O
- Region P

Region P – the only regional water planning area that did not recommend water conservation as a water management strategy in the 2007 State Water Plan – was purposely selected at the outset of the project. The additional eight regional water planning areas were selected upon empirical analyses of telephone interviews with executive committee members from each of the remaining fifteen regional water planning groups. The telephone interviews were designed to identify and provide insights into the water conservation attitudes and behaviors of the planning groups. In addition, the interviews allowed the researchers to ascertain a broad overview of the executive committee members’ perceived attitudes and behaviors of the water suppliers within their regions, as well as the perceived willingness of the water customers to accept and participate in water conservation activities. The selected regions were deemed to be broadly representative of perceived conservation attitudes and behaviors of water providers and water customers across the State of Texas.

During the summer of 2008, a survey questionnaire was mailed to a randomly selected sample of 8,768 households drawn from the nine regional water planning areas. A cover letter explaining the purpose of the study and an addressed postage-paid return envelope accompanied the questionnaire. The cover letter stated that the questionnaire was to be completed by the adult in the household who most recently celebrated his or her birthday. Approximately four weeks after the initial mailing, a second wave of surveys was mailed. Then, approximately four weeks after the second mailing, a third and final wave was mailed.

The survey instrument, organized as a self-completion booklet, contained 44 questions and required approximately 40 minutes to complete. After three mailings, 2,110 surveys were completed and returned (see Table 1).

Table 1

Distribution of survey respondents overall and by regional water planning area

	Surveys mailed	Surveys returned
Overall	8,768	2,110
Regional water planning area		
Region C	993	222
Region E	932	206
Region H	987	236
Region I	995	231
Region J	885	230
Region K	993	291
Region L	997	227
Region O	990	230
Region P	996	224
Unable to determine (UTD)		13

Analyses¹

Selected sample characteristics

Selected individual and household characteristics of the survey respondents that were included in the analyses were: **age, sex, race, years of formal education, household income, number of household residents and source of water.** Age was measured in years. The age of respondents ranged between 18 and 99; the average age was 59.77. Sex was dummy coded (0 = female; 1 = male). Fifty eight percent of respondents were female, while 42% were male. Race was dummy coded (0 = non-white; 1 = white). Seventy seven percent of the sample was white, while 23% was non-white. Years of formal education was measured by asking respondents to circle a response between “6” and “25 or more.” One male individual wrote on the survey that he completed 2 years of formal education, which therefore was the lowest number of years. Twenty five respondents indicated that they completed 25 or more years of formal education. The modal category was 14. Household income was assessed using the 14 categories which ranged from 1 = under \$9,999 to 14 = \$130,000 or more. The modal income category was 6 (\$50,000 to \$59,999). Number of household residents was measured by asking respondents how many people (including the respondent) lived at the residence. Responses ranged from 1 to 9. The mean number of household residents was 2.33. And, source of water was dummy coded (0 = well; 1 = water provider). The source of water for 76% of respondents was water provider. The source of water for 24% of respondents was well water.

¹ The 13 respondents who were not identified with a water planning region were excluded from all analyses.

Household water conservation practices

Overall, as shown in Table 2, roughly three in four respondents (76.3%; 1,413 of 1,853) claimed that they or members of their household employed any water conservation practices. Approximately 18% of respondents asserted that neither they nor members of their household employed any water conservation practices, while almost 6% did not know if they did or did not.

An examination by sampled water planning areas showed that Region E (the Far West Texas Planning Group) had the highest percentage (85.1%) of respondents who reported employing any water conservation practice at the household level. Conversely, of the sampled water planning areas, Region I (East Texas Planning Group) had the lowest percentage of respondents who reported employing any water conservation practice at the household level (64.3%).

Table 2

Household members employ any water conservation practice

	Yes	No	Don't know	n
	percent			
Overall	76.3	17.9	5.8	1,853
Region				
C	77.1	15.4	7.5	201
E	85.1	11.7	3.2	188
H	76.0	19.7	4.3	208
I	64.3	27.1	8.5	199
J	83.0	15.0	2.0	200
K	80.5	16.1	3.4	267
L	76.7	16.8	6.4	202
O	72.5	15.5	12.0	200
P	69.7	24.5	5.9	188

Multivariate analysis of whether or not household members employ any water conservation practices

Logistic regression was used to analyze the differences in employment of water conservation practices among regions and the selected individual and household characteristics.² Multivariate odds ratios are reported in Table 3.

An odds ratio (θ) is e (natural logarithm) raised to the power of “b” (the metric logit coefficient); θ refers to the effect of a one-unit change in X on the odds of Y. It has a “times as likely” interpretation and θ can equal any nonnegative number. When X and Y are independent, θ equals 1. A value of 1 generally serves as a baseline for comparison. Odds ratios on either side of 1 reflect certain types of associations. An odds ratio greater than 1 ($1 < \theta < \infty$) indicates a positive association, while an odds ratio less than 1 ($0 < \theta < 1$) denotes a negative association. Values of θ farther from 1 in either direction designate stronger levels of association (Agresti 1996, Liao 1994).

As shown in Table 3:

- Respondents from Region H, Region I, Region K, and Region P were less likely than their counterparts from Region E to employ any water conservation practices.

- White respondents were more likely than their non-white counterparts to employ any water conservation practice.
- Respondents with higher levels of formal education were more likely than those respondents with lower levels of formal education to employ any water conservation practice.

Table 3

Logistic regression of “household members employ any water conservation practices” (n = 1,345)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	0.56
Region H	0.39 **
Region I	0.28 ***
Region J	0.54
Region K	0.50 *
Region L	0.60
Region O	0.65
Region P	0.32 ***
Age	1.01
Sex (0 = female)	0.80
Race (0 = non-white)	1.79 **
Years of education	1.11 ***
Household income	1.00
No. of household residents	1.09
Source of water (0 = well)	0.71

* p < 0.05; ** p < 0.01; *** p < 0.001.

² Respondents who did not know if they or members of their household employed any water conservation practices were excluded from all multivariate analyses.

Impression of water supply in Texas

Survey respondents were asked to report their impression of the water supply in Texas. As shown in Table 4, approximately seven in ten respondents (68.2%) believed that “Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.” Slightly more than one-tenth of the sample (11.8%) believed that “Texas has enough water to meet the current and future needs of its citizens.” One in every five respondents (20.0%) believed that “Texas does not have enough water to meet the current or future needs of its citizens.”

Table 4

Impression of water supply in Texas
(n = 1,957)

Impression of water supply in Texas	Percent in agreement
Texas has enough water to meet the current and future needs of its citizens.	11.8
Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	68.2
Texas does not have enough water to meet the current or future needs of its citizens.	20.0

Selected water conservation practices

Survey respondents were presented with a list of sixteen water conservation practices that they or members of their household may or may not employ. The sixteen practices included:

1. Water landscaping less
2. Adjust sprinkler schedules regularly
3. Sweep debris off driveways, patios, etc. rather than use a water hose
4. Use washing machine less or only with a full load
5. Repair leaks or drips
6. Take short showers (5 minutes or less)
7. Collect cold water for other uses while waiting for water to heat up
8. Use dishwasher less of only with a full load
9. Wash dishes by hand
10. Turn off water while brushing teeth or shaving
11. Redirect downspouts towards lawn/plants
12. Use Texas native or low water use plants in landscaping
13. Rainwater harvesting
14. Retrofit plumbing fixtures
15. Use water saving appliances
16. Other

Response categories included: “Yes,” “No,” and “Not Applicable.” For purposes of this report, respondents who selected “Not Applicable” were excluded for analyses.

As shown in Table 5, respondents were most likely to assert that they or members of their household repaired leaks or drips (97.5%). Also, as indicated, over nine in ten respondents claimed that they or members of their household: used dishwasher less or only with a full load (93.3%); swept debris off driveways, patios, etc. rather than use a

water hose (93.0%); and used washing machine less or only with a full load (90.5%). Less than three in ten respondents stated that they or members of their household harvested rainwater (29.9%) and collected cold water for other uses while waiting for water to heat up (27.8%).

Table 5

Selected household water conservation practices

Actions	Have you?	
	Yes	No
	<i>percent</i>	
Water landscaping less (n = 1,423)	82.6	17.4
Adjust sprinkler schedules regularly (n = 879)	80.3	19.7
Sweep debris off driveways, patios, etc. rather than use a water hose (n = 1,601)	92.9	7.1
Use washing machine less or only with a full load (n = 1,793)	90.5	9.5
Repair leaks or drips (n = 1,723)	97.4	2.6
Take short showers (5 minutes or less) (n = 1,755)	74.2	25.8
Collect cold water for other uses while waiting for water to heat up (n = 1,612)	27.4	72.6
Use dishwasher less or only with a full load (n = 1,256)	93.7	6.3
Wash dishes by hand (n = 1,730)	78.2	21.8
Turn off water while brushing teeth or shaving (n = 1,828)	83.5	16.5
Redirect downspouts towards lawn/plants (n = 1,127)	65.6	34.4
Use Texas native or low water use plants in landscaping (n = 1,382)	72.1	27.9
Rainwater harvesting (n = 1,434)	29.7	70.3
Retrofit plumbing fixtures (n = 1,311)	40.8	59.2
Use water saving appliances (n = 1,553)	67.9	32.1
Other (n = 50)	74.0	26.0

Bivariate results of impression of water supply in Texas by employment of selected water conservation practices

Chi-square (χ^2) tests were used to analyze the associations between respondents' impression of the water supply in Texas and each of the sixteen selected water conservation practices. Eight of the sixteen analyses reached statistical significance. The results of the statistical significant analyses are reported in Tables 6 through 13.

Table 6

Association of “impression of the water supply in Texas” and “water landscaping less” for all Regions
(n = 1,423)

		Water landscaping less	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	68.4%	31.6%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	83.3%	16.7%
	Texas does not have enough water to meet the current or future needs of its citizens	86.7%	13.3%

$\chi^2 = 22.87^{***}$
 $\Phi = 0.13$

Table 7

Association of “impression of the water supply in Texas” and “adjust sprinkler schedules regularly” for all Regions (n = 879)

		Adjust sprinkler schedules regularly	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	72.3%	27.7%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	79.9%	20.1%
	Texas does not have enough water to meet the current or future needs of its citizens	85.8%	14.2%

$\chi^2 = 7.32^*$
 $\Phi = 0.09$

Table 8

Association of “impression of the water supply in Texas” and “collect cold water for other uses while waiting for water to heat up” for all Regions (n = 1,612)

		Collect cold water for other uses while waiting for water to heat up	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	32.6%	67.4%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	25.2%	74.8%
	Texas does not have enough water to meet the current or future needs of its citizens	32.2%	67.8%

$\chi^2 = 8.84^*$
 $\Phi = 0.07$

Table 9

Association of “impression of the water supply in Texas” and “use dishwasher less or only with a full load” for all Regions (n = 1,256)

		Use dishwasher less or only with a full load	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	81.9%	18.1%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	95.1%	4.9%
	Texas does not have enough water to meet the current or future needs of its citizens	94.9%	5.1%

$\chi^2 = 33.50^{***}$
 $\Phi = 0.16$

Table 10

Association of “impression of the water supply in Texas” and “turn off water while brushing teeth or shaving” for all Regions (n = 1,828)

		Turn off water while brushing teeth or shaving	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	81.7%	18.3%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	81.9%	18.1%
	Texas does not have enough water to meet the current or future needs of its citizens	89.9%	10.1%

$\chi^2 = 13.48^{**}$
 $\Phi = 0.09$

Table 11

Association of “impression of the water supply in Texas” and “use Texas native or low water use plants in landscaping” for all Regions
(n = 1,382)

		Use Texas native or low water use plants in landscaping	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	64.3%	35.7%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	70.3%	29.7%
	Texas does not have enough water to meet the current or future needs of its citizens	81.1%	18.9%

$\chi^2 = 17.45^{***}$
 $\Phi = 0.11$

Table 12

Association of “impression of the water supply in Texas” and “rainwater harvesting” for all Regions
(n = 1,434)

		Rainwater harvesting	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	31.8%	68.2%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	27.7%	72.3%
	Texas does not have enough water to meet the current or future needs of its citizens	35.5%	64.5%

$\chi^2 = 6.85^*$
 $\Phi = 0.07$

Table 13

Association of “impression of the water supply in Texas” and “retrofit plumbing fixtures” for all Regions
(n = 1,311)

		Retrofit plumbing fixtures	
		Yes	No
Impression of the water supply in Texas	Texas has enough water to meet the current and future needs of its citizens.	48.5%	51.5%
	Texas has enough water to meet the current needs of its citizens, but it will be more difficult to meet future needs.	38.2%	61.8%
	Texas does not have enough water to meet the current or future needs of its citizens	45.8%	54.2%

$\chi^2 = 8.61^*$
 $\Phi = 0.08$

Summary – Tables 1 through 13

On the surface, it appears that a relatively large number of households across all water planning regions employed some “self-defined” water conservation practices (Table 2). On the upper end of the spectrum is Region E (Far West Texas Region) where over 85% of respondents indicated that active water conservation is taking place within their households. Conversely, in Region I, which is located in deep southeast Texas, just shy of 2/3 of respondents indicated employing water conservation practices within the household.

It is interesting, in comparison, to see that Region P, the only region that did not consider water conservation as a strategy for meeting future needs still had just shy of 70% of all respondents conducting some form(s) of water conservation within their households. Inclusion of water conservation as a strategy to meet future needs is not recognized primarily due to a limited expectation of population increase for the region over the planning horizon (~1% by 2060). Region J and Region L, the Edwards Plateau and South Central Texas regions, respectively, have recently experienced several cycles of severe drought (see Figure 1). This has increased water management awareness and the need to conserve water by water providers and other sources within these regions.

Table 4 indicates that there is a relatively high concern by the respondents related to future availability of water resources. Most respondents indicate that Texas has sufficient water resources to meet current needs, but they are concerned regarding the ability to meet future needs. It is also apparent that respondents are actively working towards some level of water conservation. Outside of rainwater

harvesting, collection of cold water for later used while awaiting hot water and retrofit of plumbing, 65% or greater of all respondents are applying multiple water conservation practices.

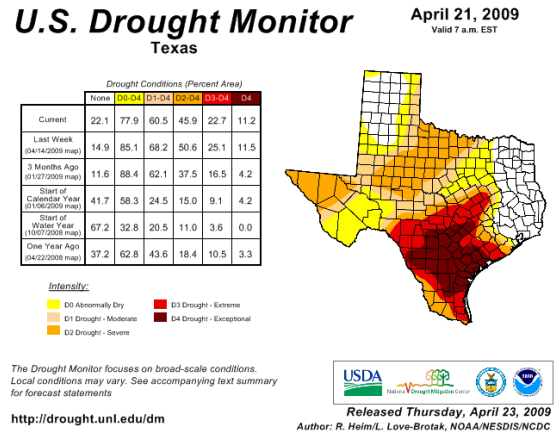


Figure 1

Beliefs preventing household from conserving water

Survey respondents were presented with a list of six reasons that may or may not prevent them or members of their household from conserving water.

The six reasons included:

1. Don't know if household conservation efforts are effective
2. Don't think my household is wasting water
3. Residential users do not use enough water to make a difference
4. I don't know how to conserve water
5. I have the right to use any amount of water I choose
6. Other

Respondents were instructed to circle all that applied. If a respondent circled other, then he/she was asked to specify a reason.

As shown in Table 14, the number one belief preventing households from conserving water reported by the survey respondents is "don't think my household is wasting water." Two of every three respondents (66.0%) did not think that their household is wasting water. The second most frequently occurring reason was "other" (19.0%), followed by "don't know if household conservation efforts are effective" (10.2%). Approximately five percent of respondents claimed that they "don't know how to conserve water," while roughly the same percentage of respondents (4.7%) believed that "residential users do not use enough water to make a difference." Approximately four percent of survey respondents asserted they have the right to use any amount of water that they choose to use.

Table 14

Beliefs preventing household from conserving water
(n = 1,625)

Belief	Yes	No
	percent	
Don't know if household conservation efforts are effective.	10.2	89.9
Don't think my household is wasting water.	66.0	34.0
Residential users do not use enough water to make a difference.	4.7	95.3
I don't know how to conserve water.	5.1	94.9
I have the right to use any amount of water I choose.	4.1	95.9
Other	19.0	81.0

Beliefs preventing household from conserving water by whether or not household members employ any water conservation practices

An examination of beliefs preventing household from conserving water by whether or not household members employ any conservation practices revealed similar findings (see Tables 15 and 16). As shown in Tables 15 and 16, regardless of whether or not households employ any water conservation practices, over six in ten individuals did not think that their household is wasting water.

Table 15

Beliefs preventing household from conserving water
(household members employ any water conservation practices; n = 1,303)

Belief	Yes	No
	percent	
Don't know if household conservation efforts are effective.	9.4	90.6
Don't think my household is wasting water.	65.1	34.9
Residential users do not use enough water to make a difference.	3.6	96.4
I don't know how to conserve water.	4.3	95.7
I have the right to use any amount of water I choose.	2.8	97.2
Other	20.1	79.9

Table 16

Beliefs preventing household from conserving water
(household members do not employ any water conservation practices; n = 322)

Belief	Yes	No
	percent	
Don't know if household conservation efforts are effective.	13.0	87.0
Don't think my household is wasting water.	69.6	30.4
Residential users do not use enough water to make a difference.	9.3	90.7
I don't know how to conserve water.	8.4	91.6
I have the right to use any amount of water I choose.	9.3	90.7
Other	14.6	85.4

Multivariate analysis of don't think my household is wasting water

Logistic regression was used to analyze the differences in the “don't think my household is wasting water” belief – the one belief that the majority of survey respondents claimed is preventing their household from conserving water – among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 17.

As shown in Table 17:

- Respondents from Region C and Region P were more likely than their counterparts from Region E to believe that their household is not wasting water.
- Older respondents were more likely than younger respondents to believe that their household is not wasting water.
- Males were more likely than females to believe that their household is not wasting water.
- Respondents with fewer years of formal education were more likely than those with more years of formal education to believe that their household is not wasting water.
- Respondents whose source of water is from a well were more likely than those who use a water provider to believe that their household is not wasting water.

Table 17

Logistic regression of “don't think my household is wasting water”
(n = 1,258)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.96 *
Region H	1.66
Region I	1.52
Region J	1.55
Region K	1.24
Region L	1.29
Region O	1.29
Region P	1.93 *
Age	1.03 ***
Sex (0 = female)	1.32 *
Race (0 = non-white)	0.90
Years of education	0.96 *
Household income	1.00
No. of household residents	0.92
Source of water (0 = well)	0.87 *
Employ any conservation practices (1 = yes)	0.86

* p < 0.05; *** p < 0.001.

Summary – Tables 14 through 17

This section provided some interesting results across regions and demographics related to beliefs preventing households from conserving water. These results are quite telling regarding areas where active programs might be implemented to dispel myths and misperceptions regarding water conservation.

The results indicate that 2/3 of all respondents believed that they were not wasting water within their household. The question must be posed as to the reality of these beliefs; are these findings a function of current and ongoing water conservation programs within households across regions or an indication of ignorance regarding methods and means that water can be wasted? It is important to understand that “ignorance” is not utilized in a derogatory means, but instead is defined as “the state or fact of being ignorant; lack of knowledge, learning, information, etc.” If, in fact, these households are employing some efforts to conserve water, what educational methods or outreach programs need to be developed to further educate and influence behaviors that can increase, beyond current levels, effectiveness of water conservation to meet regional strategies? The question that needs to be addressed is “if a majority of water users feel they are currently employing ‘effective’ water conservation practices, are educational methods/outreach programs encouraging water conservation being aimed at an audience that is not receptive because they feel they are not wasting water?”

Scenarios that would motivate household to conserve water

Survey respondents were presented with a list of eleven scenarios that may or may not motivate them or members of their household to conserve water.

The eleven reasons included:

1. Severe drought
2. Substantial increase in water bill
3. Reduced rates for reduced water use
4. Free low-flow device(s)
5. Vanishing wildlife habitats
6. Growing number of endangered species
7. Pollution of freshwater from over pumping
8. Disappearing wetlands
9. Reduced agricultural yields
10. Mandatory regulations
11. Other

Respondents were instructed to circle all that applied. If a respondent circled other, then he/she was asked to specify a reason.

As shown in Table 18, the scenario that would most likely motivate households to conserve water is “severe drought.” Excluding the “Other” category, of the remaining nine scenarios, respondents were least likely to agree that a “growing number of endangered species” would motivate them to conserve water.

Table 18

Scenarios that would motivate household to conserve water
(n = 1,698)

Scenario	Yes	No
	<i>percent</i>	
Sever drought	81.0	19.0
Substantial increase in water bill	53.6	46.4
Reduced water rates for reduced water use	43.0	57.0
Free low-flow device(s)	28.9	71.1
Vanishing wildlife habitats	37.8	62.2
Growing number of endangered species	26.0	74.0
Pollution of freshwater from over pumping	51.3	48.7
Disappearing wetlands	33.7	66.3
Reduced agricultural yields	39.5	60.5
Mandatory regulations	44.0	56.0
Other	9.0	91.0

Scenarios that would motivate households to conserve water by whether or not household members employ any water conservation practices

An examination of scenarios that would motivate households to conserve water by whether or not household members employ any conservation practices revealed similar findings (see Tables 19 and 20). As shown in Tables 19 and 20, regardless of whether or not households employ any water conservation practices, the scenario that would most likely motivate households to conserve water is “severe drought.” Excluding the “Other” category, of the remaining nine scenarios, respondents were least likely to agree that a “growing number of endangered species” would motivate them to conserve water.

Table 19

Scenarios that would motivate household to conserve water
(household members employ any water conservation practices; n = 1,377)

Scenario	Yes	No
	percent	
Sever drought	81.7	18.3
Substantial increase in water bill	54.2	45.8
Reduced water rates for reduced water use	44.4	55.6
Free low-flow device(s)	31.0	69.0
Vanishing wildlife habitats	40.2	59.8
Growing number of endangered species	28.3	71.7
Pollution of freshwater from over pumping	54.4	45.6
Disappearing wetlands	36.6	63.4
Reduced agricultural yields	42.6	57.4
Mandatory regulations	45.9	54.1
Other	9.7	90.3

Table 20

Scenarios that would motivate household to conserve water
(household members do not employ any water conservation practices; n = 321)

Scenario	Yes	No
	percent	
Sever drought	77.9	22.1
Substantial increase in water bill	51.1	48.9
Reduced water rates for reduced water use	37.1	62.9
Free low-flow device(s)	19.7	80.3
Vanishing wildlife habitats	27.7	72.3
Growing number of endangered species	16.2	83.8
Pollution of freshwater from over pumping	38.1	61.9
Disappearing wetlands	21.5	78.5
Reduced agricultural yields	26.3	73.8
Mandatory regulations	35.8	64.2
Other	5.6	94.4

Summary – Tables 18 through 20

Outside of climate-induced (severe drought) awareness of the finite nature of water, the most likely means of impacting water conservation is related to economic or regulatory drivers. As an example, some municipalities are addressing this through a sliding scale for the cost of water based upon consumption. For example, College Station, Texas, currently has a sliding scale ranging from \$2.22/1000 gal (0-10,000 gallons utilized) to \$4.86/1000 gal (26,000+ gallons utilized).

Associated with this and other more proactive economic drivers, water conservation educational programs could potentially provide opportunities for mostly urban communities that illustrate the connectivity between rural and urban regions and address how most of the water resources utilized within the urban/suburban setting are generated from the rural landscapes surrounding these communities. Implementing educational and outreach programs that focus understanding on the connectivity between rural and urban ecosystems and how water resources utilized in the urban areas are often generated from surrounding, rural ecosystems. Providing this understanding could provide a basis for urban and rural communities working together, not as competitors, to develop synergistic programs within regions (landscapes) to actively conserve water resources for both rural and urban systems.

Multivariate analysis of severe drought

Logistic regression was used to analyze the differences in the “severe drought” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 21.

As shown in Table 21:

- Respondents from Region C and Region I were more likely than their counterparts from Region E to report that a severe drought would motivate their household to conserve water.
- White respondents were more likely than non-white respondents to report that a severe drought would motivate their household to conserve water.
- Respondents with higher incomes were more likely than those with lower incomes to indicate that a severe drought would motivate their household to conserve water.
- Respondents whose source of water is from a well were more likely than those who use a water provider to report that a severe drought would motivate their household to conserve water.

Table 21

Logistic regression of “severe drought”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	2.11 *
Region H	1.38
Region I	2.11 *
Region J	1.44
Region K	1.20
Region L	1.34
Region O	1.14
Region P	1.24
Age	1.01
Sex (0 = female)	0.85
Race (0 = non-white)	2.13 ***
Years of education	0.97
Household income	1.09 ***
No. of household residents	1.00
Source of water (0 = well)	0.60 *
Employ any conservation practices (1 = yes)	1.03

* p < 0.05; *** p < 0.001.

Multivariate analysis of substantial increase in water bill

Logistic regression was used to analyze the differences in the “substantial increase in water bill” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 22.

As shown in Table 22:

- Respondents from Region C, Region I, and Region O were more likely than their counterparts from Region E to report that a substantial increase in water bill would motivate their household to conserve water.
- Respondents in households with greater numbers of residents were more likely than those in households with fewer residents to report that a substantial increase in water bill would motivate their household to conserve water.
- Respondents whose source of water is a water provider were more likely than those who use a water well to report that a substantial increase in water bill would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that a substantial increase in water bill would motivate their household to conserve water.

Table 22

Logistic regression of “substantial increase in water bill”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	2.10 **
Region H	1.60
Region I	1.98 *
Region J	1.39
Region K	1.32
Region L	1.33
Region O	1.86 *
Region P	1.48
Age	0.99
Sex (0 = female)	1.04
Race (0 = non-white)	1.21
Years of education	1.02
Household income	1.01
No. of household residents	1.14 *
Source of water (0 = well)	13.24 ***
Employ any conservation practices (1 = yes)	1.48 *

* p < 0.05; ** p < 0.01; *** p < 0.001.

Multivariate analysis of reduced rates for reduced water use

Logistic regression was used to analyze the differences in the “reduced rates for reduced water use” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 23.

As shown in Table 23:

- Younger respondents were more likely than older respondents to report that reduced rates for reduced water use would motivate their household to conserve water.
- Females were more likely than males to indicate that reduced rates for reduced water use would motivate their household to conserve water.
- Respondents whose source of water is a water provider were more likely than those who use a water well to report that reduced rates for reduced water use would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that reduced rates for reduced water use would motivate their household to conserve water.

Table 23

Logistic regression of “reduced rates for reduced water use”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.23
Region H	1.30
Region I	1.29
Region J	1.39
Region K	1.32
Region L	1.04
Region O	0.99
Region P	1.03
Age	0.98 ***
Sex (0 = female)	0.71 **
Race (0 = non-white)	0.83
Years of education	1.02
Household income	1.00
No. of household residents	1.03
Source of water (0 = well)	7.58 ***
Employ any conservation practices (1 = yes)	1.87 ***

** p < 0.01; *** p < 0.001.

Multivariate analysis of free low-flow device(s)

Logistic regression was used to analyze the differences in the “free low-flow device(s)” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 24.

As shown in Table 24:

- Younger respondents were more likely than older respondents to report that free low-flow device(s) would motivate their household to conserve water.
- Females were more likely than males to indicate that free low-flow device(s) would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that free low-flow device(s) would motivate their household to conserve water.
- Respondents whose source of water is a water provider were more likely than those who use a water well to report that free low-flow device(s) would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that free low-flow device(s) would motivate their household to conserve water.

Table 24

Logistic regression of “free low-flow device(s)”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.01
Region H	0.90
Region I	0.86
Region J	0.84
Region K	0.75
Region L	0.87
Region O	0.84
Region P	0.95
Age	0.98 **
Sex (0 = female)	0.65 **
Race (0 = non-white)	0.95
Years of education	1.07 **
Household income	1.00
No. of household residents	1.06
Source of water (0 = well)	1.46 *
Employ any conservation practices (1 = yes)	1.83 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Multivariate analysis of vanishing wildlife habitats

Logistic regression was used to analyze the differences in the “vanishing wildlife habitats” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 25.

As shown in Table 25:

- Younger respondents were more likely than older respondents to report that vanishing wildlife habitats would motivate their household to conserve water.
- Females were more likely than males to indicate that vanishing wildlife habitats would motivate their household to conserve water.
- White respondents were more likely than non-white respondents to report that vanishing wildlife habitats would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that vanishing wildlife habitats would motivate their household to conserve water.
- Respondents whose source of water is from a well were more likely than those who use a water provider to report that vanishing wildlife habitats would motivate their household to conserve water.

- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that vanishing wildlife habitats would motivate their household to conserve water.

Table 25

Logistic regression of “vanishing wildlife habitats”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.19
Region H	0.71
Region I	0.78
Region J	1.11
Region K	0.97
Region L	0.63
Region O	0.65
Region P	0.64
Age	0.99 **
Sex (0 = female)	0.59 ***
Race (0 = non-white)	1.49 *
Years of education	1.05 *
Household income	1.01
No. of household residents	1.10
Source of water (0 = well)	0.61 **
Employ any conservation practices (1 = yes)	1.56 **

* p < 0.05; ** p < 0.01; *** p < 0.001.

Multivariate analysis of growing number of endangered species

Logistic regression was used to analyze the differences in the “growing number of endangered species” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 26.

As shown in Table 26:

- Respondents from Region O and Region P were less likely than their counterparts from Region E to report that a growing number of endangered species would motivate their household to conserve water.
- Younger respondents were more likely than older respondents to report that a growing number of endangered species would motivate their household to conserve water.
- Females were more likely than males to indicate that a growing number of endangered species would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that a growing number of endangered species would motivate their household to conserve water.

- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that a growing number of endangered species would motivate their household to conserve water.

Table 26

Logistic regression of “growing number of endangered species”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	0.93
Region H	0.67
Region I	0.83
Region J	0.84
Region K	0.69
Region L	0.59
Region O	0.51 *
Region P	0.52 *
Age	0.98 ***
Sex (0 = female)	0.47 ***
Race (0 = non-white)	1.20
Years of education	1.05 *
Household income	1.00
No. of household residents	1.07
Source of water (0 = well)	0.77
Employ any conservation practices (1 = yes)	1.96 ***

* p < 0.05; *** p < 0.001.

Multivariate analysis of pollution of freshwater from over pumping

Logistic regression was used to analyze the differences in the “pollution of freshwater from over pumping” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 27.

As shown in Table 27:

- Younger respondents were more likely than older respondents to report that pollution of freshwater from over pumping would motivate their household to conserve water.
- Females were more likely than males to indicate that pollution of freshwater from over pumping would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that pollution of freshwater from over pumping would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that pollution of freshwater from over pumping would motivate their household to conserve water.

Table 27

Logistic regression of “pollution of freshwater from over pumping”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.14
Region H	1.47
Region I	0.83
Region J	1.40
Region K	0.89
Region L	0.77
Region O	0.93
Region P	0.89
Age	0.99 **
Sex (0 = female)	0.72 **
Race (0 = non-white)	1.22
Years of education	1.04 *
Household income	1.00
No. of household residents	1.08
Source of water (0 = well)	0.77
Employ any conservation practices (1 = yes)	2.01 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Multivariate analysis of disappearing wetlands

Logistic regression was used to analyze the differences in the “disappearing wetlands” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 28.

As shown in Table 28:

- Respondents from Region L, Region O, and Region P were less likely than their counterparts from Region E to report that disappearing wetlands would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that disappearing wetlands would motivate their household to conserve water.
- Respondents in households with greater numbers of residents were more likely than those in households with fewer residents to report that disappearing wetlands would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that disappearing wetlands would motivate their household to conserve water.

Table 28

Logistic regression of “disappearing wetlands”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	0.77
Region H	0.69
Region I	0.80
Region J	0.80
Region K	0.96
Region L	0.56 *
Region O	0.59 *
Region P	0.57 *
Age	0.99
Sex (0 = female)	0.64
Race (0 = non-white)	1.23
Years of education	1.05 *
Household income	1.01
No. of household residents	1.13 *
Source of water (0 = well)	0.82
Employ any conservation practices (1 = yes)	1.93 ***

* p < 0.05; *** p < 0.001.

Multivariate analysis of reduced agricultural yields

Logistic regression was used to analyze the differences in the “reduced agricultural yields” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 29.

As shown in Table 29:

- Females were more likely than males to indicate that reduced agricultural yields would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that reduced agricultural yields would motivate their household to conserve water.

Table 29

Logistic regression of “reduced agricultural yields”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.12
Region H	0.84
Region I	0.80
Region J	1.07
Region K	1.11
Region L	0.84
Region O	1.15
Region P	0.72
Age	0.99
Sex (0 = female)	0.71 **
Race (0 = non-white)	1.31
Years of education	1.02
Household income	1.01
No. of household residents	1.06
Source of water (0 = well)	0.76
Employ any conservation practices (1 = yes)	1.80 ***

** p < 0.01; *** p < 0.001.

Multivariate analysis of mandatory regulations

Logistic regression was used to analyze the differences in the “mandatory regulations” scenario that may or may not motivate households to conserve water among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 30.

As shown in Table 30:

- Younger respondents were more likely than older respondents to report that mandatory regulations would motivate their household to conserve water.
- Females were more likely than males to indicate that mandatory regulations would motivate their household to conserve water.
- Non-white respondents were more likely than white respondents to report that mandatory regulations would motivate their household to conserve water.
- Higher educated respondents were more likely than lower educated respondents to claim that mandatory regulations would motivate their household to conserve water.
- Respondents with higher incomes were more likely than those with lower incomes to indicate that mandatory regulations would motivate their household to conserve water.

- Respondents whose source of water is a water provider were more likely than those who use a water well to report that mandatory regulations would motivate their household to conserve water.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to indicate that mandatory regulations would motivate their household to conserve water.

Table 30

Logistic regression of “mandatory regulations”
(n = 1,314)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.50
Region H	1.09
Region I	1.03
Region J	1.16
Region K	1.05
Region L	0.84
Region O	1.38
Region P	1.14
Age	0.99 *
Sex (0 = female)	0.75 *
Race (0 = non-white)	0.71 *
Years of education	1.07 ***
Household income	1.07 ***
No. of household residents	1.08
Source of water (0 = well)	2.33 ***
Employ any conservation practices (1 = yes)	1.49 **

* p < 0.05; ** p < 0.01; *** p < 0.001.

Summary – Tables 21 through 30

To further illustrate the potential of economic/regulatory impacts on water conservation, Table 22 indicates that water users utilizing water providers (not on individual water wells) would be a receptive audience to further outreach as they would be most impacted by significant increases in cost for water services. The same could be said for this group of water users regarding a willingness to increase water conservation if water prices were reduced when these efforts were implemented (Table 23).

For those individuals indicating that active water conservation is ongoing in the household, it appears that making available “free low-flow device(s)” could potentially increase their water conservation practices within the household (Table 24). Furthermore, the potential for increased regulation on water use to maintain sustainable water resources provides a educational opportunity to inform how conservation may be able to reduce more authoritative approaches to meeting future water needs.

In comparison, there was interest in other ecosystem goods/services that may influence household conservation such as loss of wildlife habitat, impacts on endangered species, water quality, etc. One interesting result of this survey is the fact that younger people are more inclined to accept water conservation as a means to maintain healthy ecosystems. This provides an opportunity in the development of K-12 educational programs that teach the connectivity of ecosystems and illustrates that healthy watersheds provide multiple benefits in the maintenance of wildlife and water resources. Similar responses could be incorporated for different age groups that illustrate the

benefits of water conservation on the maintenance of endangered species.

Also within the realm of ecosystem goods and services, the results of the survey indicate another audience that may be influenced through appropriate educational and outreach programs that focus on the interrelationship between pollution and over-pumping. Tying water conservation to water quality programs could, according to these results, influence segments that are not currently employing any water conservation programs within the household (Table 27). Similar impacts could be targeted towards certain demographics that are influenced by the loss of wetlands.

Table 29 provides some interesting results. It appears that female respondents connect water use and agriculture with food prices. Again, this provides an opportunity to educate on the connectivity and interactions across ecosystems within regions and how water conservation within urban communities can actually impact stable food production.

Overall, this section of results indicates that a coordinated approach to water conservation education across multiple demographics and targeted to these segments could further influence water conservation programs within the regions sampled.

Multivariate analysis of perceptions and attitudes concerning water conservation and conservation practices

Ordinary least squares (OLS) regression was used to analyze five statements dealing with perceptions and attitudes concerning water conservation and conservation practices. The five statements were:

1. I think about the way I use water around the house and try to save water whenever possible.
2. I am concerned about the issue of residential water use in Texas.
3. People should be entitled to use as much water as they like.
4. Careless water users should pay more for water.
5. Only a substantial increase in the price of water would change my current level of use.

Responses to these five items were coded as: (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; and, (5) strongly agree.

Region, age, sex, race, years of formal education, household income, number of residents in the household, source of water, and employment of any water conservation practices were the independent variables.

The multivariate OLS regression models are reported in Tables 31 through 35. A summary of Tables 31 through 35 appears on pages 35 and 36.

Table 31

OLS regression of “I think about the way I use water around the house and try to save water whenever possible”
(n = 1,243)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	-0.12
Region H	-0.20 *
Region I	-0.21 *
Region J	-0.13
Region K	-0.20 **
Region L	-0.10
Region O	-0.19 *
Region P	-0.08
Age	0.01 **
Sex (0 = female)	-0.05
Race (0 = non-white)	-0.11 *
Years of education	0.00
Household income	-0.02 **
No. of household residents	-0.00
Source of water (0 = well)	-0.02
Employ any conservation practices (1 = yes)	0.62 ***
Constant	3.83 ***
Adjusted R ²	0.15 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 32

OLS regression of “I am concerned about the issue of residential water use in Texas”
(n = 1,243)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	-0.13
Region H	-0.28 **
Region I	-0.27 **
Region J	-0.09
Region K	-0.05
Region L	-0.07
Region O	-0.02
Region P	0.01
Age	0.01 ***
Sex (0 = female)	-0.02
Race (0 = non-white)	-0.04
Years of education	0.01
Household income	0.00
No. of household residents	-0.01
Source of water (0 = well)	-0.01
Employ any conservation practices (1 = yes)	0.52 ***
Constant	3.51 ***
Adjusted R^2	0.11 ***

** p < 0.01; *** p < 0.001.

Table 33

OLS regression of “people should be entitled to use as much water as they like”
(n = 1,243)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.09
Region H	0.42 **
Region I	0.36 **
Region J	0.08
Region K	0.08
Region L	0.05
Region O	0.13
Region P	0.38 **
Age	-0.01 *
Sex (0 = female)	0.01
Race (0 = non-white)	-0.17 *
Years of education	-0.03 *
Household income	-0.01
No. of household residents	-0.02
Source of water (0 = well)	-0.11
Employ any conservation practices (1 = yes)	-0.61 ***
Constant	3.74 ***
Adjusted R^2	0.10 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 34

OLS regression of “careless water users should pay more for water”
(n = 1,243)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.21
Region H	-0.17
Region I	-0.11
Region J	0.11
Region K	-0.02
Region L	0.00
Region O	0.19
Region P	0.02
Age	0.00
Sex (0 = female)	0.21 **
Race (0 = non-white)	-0.15
Years of education	0.02 *
Household income	-0.01
No. of household residents	-0.02
Source of water (0 = well)	0.01
Employ any conservation practices (1 = yes)	0.36 ***
Constant	3.28 ***
Adjusted R^2	0.04 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 35

OLS regression of “only a substantial increase in the price of water would change my current level of use”
(n = 1,243)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.08
Region H	0.38 **
Region I	0.13
Region J	0.02
Region K	0.08
Region L	0.10
Region O	0.18
Region P	0.24
Age	0.01 **
Sex (0 = female)	-0.02
Race (0 = non-white)	-0.03
Years of education	-0.02
Household income	0.02
No. of household residents	0.04
Source of water (0 = well)	0.24 **
Employ any conservation practices (1 = yes)	-0.27 **
Constant	2.65 ***
Adjusted R^2	0.03 ***

** p < 0.01; *** p < 0.001.

Summary – Tables 31 through 35

Number of household residents

- Failed to reach statistical significance.

Regional water planning area

When compared to respondents in Region E:

- Respondents in Region H were less likely to (a) think about the way they use water around the house and try to save water whenever possible, and (b) be concerned about the issue of residential water use in Texas. Conversely, these same respondents were more likely to agree that (a) people should be entitled to use as much water as they like, and (b) only a substantial increase in the price of water would change their current level of use.
- Respondents in Region I were less likely to (a) think about the way they use water around the house and try to save water whenever possible, and (b) be concerned about the issue of residential water use in Texas. Conversely, respondents in this region were more likely to agree that people should be entitled to use as much water as they like.
- Respondents in Region K and Region O were less likely to think about the way they use water around the house and try to save water whenever possible.
- Respondents in Region H and Region I are less likely than respondents in Region E to be concerned about the issue of residential water use in Texas.

- Respondents in Region P were more likely to agree that people should be entitled to use as much water as they like.

Age

- Older respondents were more likely than younger respondents to (a) think about the way they use water and try to save water whenever possible, (b) be concerned about the issue of residential water use in Texas, and (c) agree that only a substantial increase in the price of water would change their current level of use. Older respondents were also more likely to disagree that people should be entitled to use as much water as they like.

Sex

- Males were more likely than females to agree that careless water users should pay more for water.

Race

- White respondents were less likely than non-white respondents to think about the way they use water and try to save water whenever possible. Concomitantly, white respondents were less likely than non-white respondents to agree that people should be entitled to use as much water as they like.

Years of formal education

- Respondents with more years of formal education were more likely than those with fewer years of formal education to disagree that people should be entitled to use as much

water as they like. At the same time, respondents with more years of formal education were more likely to agree that careless water users should pay more for water.

Household income

- Respondents with higher household incomes were less likely than those with lower household incomes to think about the way they use water and try to save water whenever possible.

Source of water

- Respondents whose source of water is a water provider were more likely than those who use a water well to agree that only a substantial increase in the price of water would change their current level of use.

Employ any conservation practices

- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to (a) think about the way they use water and try to save water whenever possible, (b) be concerned about the issue of residential water use in Texas, and (c) agree that careless water users should pay more for water. These same respondents were less likely to agree that (a) people should be entitled to use as much water as they like, and (b) only a substantial increase in the price of water would change their current level of use.

In regions that are currently less likely to experience significant water shortage, there is an opportunity to increase educational programs to explain how watersheds across the state are connected and the impacts within other portions of Texas' watersheds can/will have impacts on persons where the stress may not be directly located. For example, the two largest metropolises in Texas (DFW & Greater Houston) share a common bond, the Trinity River. Impacts in the Trinity influence both upstream and downstream water sustainability. It is important to point out within planning that the regional approach is necessary, but should not be constrained and expect that regional plans do not impact other regions and their activities.

The age category is critical here. Focused efforts within the younger demographics could have a higher degree of impact on overall water conservation than that targeted to older populations that may be less receptive or are already practicing water conservation. Development of education and outreach programs need to be targeted to those demographics that are likely not practicing significant water conservation practices. The umbrella approach to outreach may not be reaching the population where behavior change would most likely occur.

Multivariate analysis of perceptions and attitudes concerning water supply and shortages

Ordinary least squares (OLS) regression was used to analyze five statements dealing with perceptions and attitudes concerning water supply and shortages. The five statements were:

1. The water shortage in Texas is overrated.
2. The water shortage is not a problem in my area of Texas.
3. The water shortage in Texas is only a temporary issue rather than a chronic problem.
4. The government has done all it can to address the current water issues in Texas.
5. The government is doing all it can to address future water issues in Texas.

Responses to these five items were coded as: (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; and, (5) strongly agree.

Region, age, sex, race, years of formal education, household income, number of residents in the household, source of water, and employment of any water conservation practices were the independent variables.

The multivariate OLS regression models are reported in Tables 36 through 40. A summary of Tables 36 through 40 appears on pages 40 and 41.

Table 36

OLS regression of “the water shortage in Texas is overrated”
(n = 1,271)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.22 *
Region H	0.28 **
Region I	0.34 **
Region J	0.04
Region K	0.06
Region L	0.09
Region O	-0.03
Region P	0.40 ***
Age	0.00
Sex (0 = female)	0.16 **
Race (0 = non-white)	-0.23 ***
Years of education	-0.04 ***
Household income	-0.02 *
No. of household residents	0.00
Source of water (0 = well)	0.02
Employ any conservation practices (1 = yes)	-0.33 ***
Constant	3.31 ***
Adjusted R ²	0.11 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 37

OLS regression of “the water shortage is not a problem in my area of Texas”
(n = 1,271)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.41 **
Region H	1.00 ***
Region I	1.12 ***
Region J	0.14
Region K	0.30 *
Region L	0.11
Region O	-0.20
Region P	0.89 ***
Age	0.00
Sex (0 = female)	0.13 *
Race (0 = non-white)	-0.08
Years of education	-0.03 **
Household income	-0.02
No. of household residents	-0.02
Source of water (0 = well)	0.03
Employ any conservation practices (1 = yes)	-0.33 ***
Constant	3.20 ***
Adjusted R^2	0.18 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 38

OLS regression of “the water shortage in Texas is only a temporary issue rather than a chronic problem”
(n = 1,271)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	0.32 **
Region H	0.49 ***
Region I	0.49 ***
Region J	0.16
Region K	0.15
Region L	0.18
Region O	-0.06
Region P	0.38 ***
Age	0.00
Sex (0 = female)	0.07
Race (0 = non-white)	-0.16 *
Years of education	-0.04 ***
Household income	-0.02 *
No. of household residents	0.01
Source of water (0 = well)	0.06
Employ any conservation practices (1 = yes)	-0.40 ***
Constant	2.86 ***
Adjusted R^2	0.13 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 39

OLS regression of “the government has done all it can to address the current water issues in Texas”
(n = 1,271)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	-0.11
Region H	0.14
Region I	0.07
Region J	-0.01
Region K	-0.00
Region L	-0.16
Region O	0.04
Region P	0.13
Age	0.00
Sex (0 = female)	-0.05
Race (0 = non-white)	-0.12 *
Years of education	-0.03 **
Household income	-0.00
No. of household residents	0.01
Source of water (0 = well)	0.01
Employ any conservation practices (1 = yes)	-0.19 **
Constant	2.69 ***
Adjusted R^2	0.04 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 40

OLS regression of “the government is doing all it can to address future water issues in Texas”
(n = 1,271)

Variables	Model
Regional water planning area (0 = Region E)	
Region C	-0.11
Region H	0.06
Region I	0.11
Region J	-0.12
Region K	-0.10
Region L	-0.08
Region O	-0.07
Region P	0.17
Age	0.00
Sex (0 = female)	-0.09
Race (0 = non-white)	-0.14 *
Years of education	-0.03 ***
Household income	-0.01
No. of household residents	0.01
Source of water (0 = well)	0.05
Employ any conservation practices (1 = yes)	-0.19 **
Constant	3.05 ***
Adjusted R^2	0.06 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Summary – Tables 36 through 40

Age

- Failed to reach statistical significance.

Number of household residents

- Failed to reach statistical significance.

Source of water

- Failed to reach statistical significance.

Regional water planning area

When compared to respondents in Region E:

- Respondents in Region C, Region H, Region I, and Region P were more likely to agree that the water shortage in Texas is (a) overrated, (b) not a problem in their area, and (c) only a temporary issue rather than a chronic problem.
- Respondents in Region K were more likely to agree that the water shortage is not a problem in their area.

Sex

- Males were more likely than females to agree that the water shortage in Texas is (a) overrated, and (b) not a problem in their area of Texas.

Race

- Whites were more likely than non-whites to disagree that (a) the water shortage in Texas is overrated, (b) the water shortage in Texas is only a temporary issue rather than a chronic problem, (c) the government has done all it can to address the current water issues in Texas, and (d) the government is doing all it can to address future water issues in Texas.

Years of formal education

- Respondents with higher levels of education were more likely than those with lower levels of education to disagree with all five statements.

Household income

- Respondents with higher household incomes were more likely than those with lower household incomes to disagree that the water shortage in Texas is (a) overrated, and (b) only a temporary issue rather than a chronic problem.

Employ any conservation practice

- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to disagree with all five statements.

Sources where household members receive information on water conservation and water saving tips

Survey respondents were presented with a list of nineteen items that may or may not be sources from which members of their household receive information on water conservation and water saving tips.

The nineteen reasons included:

1. Newspaper articles
2. Newspaper advertisements
3. Magazine/trade publications
4. Magazine/trade advertisements
5. Direct mail
6. Chamber or civic publications
7. Utility bill/water bill insert
8. Radio news stories
9. Radio commercials
10. Television news stories
11. Television commercials
12. Government access television
13. Websites/internet
14. Flyers/brochures
15. Events
16. E-mail messages
17. Hotline
18. Word of mouth
19. Other

Respondents were instructed to circle all that applied. If a respondent circled other, then he/she was asked to specify a reason.

As shown in Table 41, the number one source from which household members receive information on water conservation and water saving tips is “newspaper articles” (55.9%). The second most frequently reported source is “television news stories” (49.6%).

Table 41

Source where household members receive information on water conservation and water saving tips

Information source	Yes	No
	<i>percent</i>	
Newspaper articles	55.9	44.1
Newspaper advertisements	7.8	92.2
Magazine/trade publications	18.7	81.3
Magazine/trade advertisements	5.9	94.1
Direct mail	12.8	87.2
Chamber or civic publications	6.5	93.5
Utility bill/water bill insert	29.9	70.1
Radio news stories	17.7	82.3
Radio commercials	6.7	93.3
Television news stories	49.6	50.4
Television commercials	18.4	81.6
Government access television	1.8	98.2
Website/internet	14.7	85.3
Flyers/brochures	9.1	90.9
Events	4.1	95.9
E-mail messages	2.9	97.1
Hotline	0.6	99.4
Word of mouth	24.5	75.5
Other	5.9	94.1

Sources where household members receive information on water conservation and water saving tips by whether or not household members employ any water conservation practices

An examination of sources from which members of their household receive information on water conservation and water saving tips revealed a similar pattern (see Tables 42 and 43).

Table 42

Source where household members receive information on water conservation and water saving tips
(household members employ any water conservation practices; n = 1,324)

Information source	Yes	No
	percent	
Newspaper articles	59.3	40.7
Newspaper advertisements	8.8	91.2
Magazine/trade publications	21.5	78.5
Magazine/trade advertisements	6.6	93.4
Direct mail	13.1	86.9
Chamber or civic publications	7.1	92.9
Utility bill/water bill insert	31.2	68.8
Radio news stories	19.0	81.0
Radio commercials	7.4	92.6
Television news stories	52.3	47.7
Television commercials	19.8	80.2
Government access television	2.0	98.0
Website/internet	16.2	83.8
Flyers/brochures	10.2	89.8
Events	4.9	95.1
E-mail messages	3.3	96.7
Hotline	0.6	99.4
Word of mouth	26.8	73.2
Other	6.7	93.3

Table 43

Source where household members receive information on water conservation and water saving tips
(household members do not employ any water conservation practices; n = 299)

Information source	Yes	No
	percent	
Newspaper articles	40.8	59.2
Newspaper advertisements	3.7	96.3
Magazine/trade publications	6.4	93.6
Magazine/trade advertisements	2.3	97.7
Direct mail	11.4	88.6
Chamber or civic publications	3.7	96.3
Utility bill/water bill insert	24.4	75.6
Radio news stories	12.0	88.0
Radio commercials	3.7	96.3
Television news stories	37.5	62.5
Television commercials	12.0	88.0
Government access television	0.7	99.3
Website/internet	8.0	92.0
Flyers/brochures	4.0	96.0
Events	0.7	99.3
E-mail messages	1.0	99.0
Hotline	0.3	99.7
Word of mouth	14.0	86.0
Other	2.0	98.0

Multivariate analysis of newspaper articles as source from which household members receive information on water conservation and water saving tips

Logistic regression was used to analyze the differences in newspaper articles as a source from which household members receive information on water conservation and water saving tips among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 44.

As shown in Table 44:

- Older respondents were more likely than younger respondents to list newspaper articles as a source where their household members receive information on water conservation and water saving tips.
- Whites were more likely than non-whites to list newspaper articles as a source where their household members receive information on water conservation and water saving tips.
- Respondents with more years of formal education were more likely than those with fewer years of formal education to list newspaper articles as a source where their household members receive information on water conservation and water saving tips.

- Respondents with higher incomes were more likely than those with lower incomes to list newspaper articles as a source where their household members receive information on water conservation and water saving tips.
- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to list newspaper articles as a source where their household members receive information on water conservation and water saving tips.

Table 44

Logistic regression of “newspaper articles”
(n = 1,268)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	0.73
Region H	0.66
Region I	0.69
Region J	1.37
Region K	0.86
Region L	1.10
Region O	1.50
Region P	1.14
Age	1.02 ***
Sex (0 = female)	0.91
Race (0 = non-white)	1.67 **
Years of education	1.07 **
Household income	1.08 ***
No. of household residents	0.97
Source of water (0 = well)	0.78
Employ any conservation practices (1 = yes)	1.75 ***

** p < 0.01; *** p < 0.001.

Multivariate analysis of television news stories as source from which household members receive information on water conservation and water saving tips

Logistic regression was used to analyze the differences in television news stories as a source from which household members receive information on water conservation and water saving tips among regions, the selected individual and household characteristics, and households that do or do not employ any water conservation practices. Multivariate odds ratios are reported in Table 45.

As shown in Table 45:

- Respondents from Region J, Region K, Region L, and Region O were more likely than their counterparts from Region E to list television news stories as a source where their household members receive information on water conservation and water saving tips.
- Respondents with more years of formal education were more likely than those with fewer years of formal education to list television news stories as a source where their household members receive information on water conservation and water saving tips.
- Respondents in households with fewer numbers of residents were more likely than those in households with a greater numbers of residents to list television news stories as a source where their household members receive information on water conservation and water saving tips.

- Respondents who employ any water conservation practice were more likely than their counterparts who do not employ conservation practices to list television news stories as a source where their household members receive information on water conservation and water saving tips.

Table 45

Logistic regression of “television news stories” (n = 1,268)

Variables	Odds ratios
Regional water planning area (0 = Region E)	
Region C	1.53
Region H	1.56
Region I	1.31
Region J	1.69 *
Region K	1.79 *
Region L	2.19 **
Region O	1.93 *
Region P	1.60
Age	1.01
Sex (0 = female)	1.12
Race (0 = non-white)	0.91
Years of education	0.95 *
Household income	1.03
No. of household residents	0.89 *
Source of water (0 = well)	0.86
Employ any conservation practices (1 = yes)	1.76 ***

* p < 0.05; ** p < 0.01; *** p < 0.001.

Summary – Tables 41 through 45

Based upon the demographics represented in the current study, it is expected that most respondents generate their information regarding water conservation from newspapers and or television programming. One potential opportunity here is the possibility to engage the popular media outlets with the scientific community to communicate the impacts of conservation within the popular media. Conversely, it is necessary to get the scientific community into a position that they can provide materials to media outlets in a meaningful way (non-technical).

DRAFT

Survey Respondents whose Source of Water is a Water Provider

Bivariate results of water provider has passed mandatory water conservation ordinance(s) by whether or not respondents employ any water conservation practice

At the overall level, a chi-square (χ^2) test was used to analyze the association between the passage of mandatory water conservation ordinances and whether or not respondents employed any water conservation practices. As reported in Table 46, respondents whose source of water is from a provider that has passed some type of mandatory water conservation ordinance were significantly more likely than those respondents whose provider has not passed a water conservation ordinance to employ some type of conservation practice. Approximately 91% of respondents whose water provider has passed mandatory water conservation ordinances do, in fact, employ some type of conservation practice (as opposed to the 78% of respondents whose water provider has not passed mandatory water conservation ordinances). It is important to note that roughly 9% of respondents whose water provider has passed mandatory water conservation ordinances DO NOT employ any water conservation practices.

Table 46

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for all Regions (n = 945)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	90.7%	9.3%
	No	78.0%	22.0%

$\chi^2 = 23.07***$
 $\Phi = 0.16$

NOTE: χ^2 has been corrected for continuity (Yates 1934).

The associations between the passage of mandatory water conservation ordinances and whether or not respondents employed any water conservation practices by water planning region are reported in Tables 47 through 55. Due to the small number of cases in certain cells, χ^2 tests of statistical significance were not conducted.

Table 48

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region E (n = 117)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	97.7%	2.3%
	No	83.8%	16.2%

Table 47

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region C (n = 114)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	89.2%	10.8%
	No	77.6%	22.4%

Table 49

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region H (n = 102)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	90.9%	9.1%
	No	80.0%	20.0%

Table 50

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region I (n = 85)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	85.7%	14.3%
	No	65.4%	34.6%

Table 52

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region K (n = 141)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	93.0%	7.0%
	No	79.8%	20.2%

Table 51

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region J (n = 105)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	88.9%	11.1%
	No	78.4%	21.6%

Table 53

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region L (n = 110)

		Employ any conservation practice	
		Yes	No
Water provider has passed mandatory water conservation ordinance(s)	Yes	88.5%	11.5%
	No	81.0%	19.0%

Table 54

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region O (n = 95)

Water provider has passed mandatory water conservation ordinance(s)	Employ any conservation practice		
		Yes	No
Yes	92.6%	7.4%	
No	83.8%	16.2%	

Table 55

Association of “water provider has passed mandatory water conservation ordinance(s)” and “employ any conservation practice” for Region P (n = 76)

Water provider has passed mandatory water conservation ordinance(s)	Employ any conservation practice		
		Yes	No
Yes	60.0%	40.0%	
No	73.2%	26.8%	

Survey Respondents whose Source of Water is a Water Provider

Bivariate results of water provider makes available voluntary water conservation program(s) by whether or not respondents employ any water conservation practice

At the overall level, a chi-square (χ^2) test was used to analyze the association between the availability of voluntary water conservation programs and whether or not respondents employed any water conservation practices. As reported in Table 56, respondents whose source of water is from a provider that makes available some type of voluntary water conservation program were significantly more likely than those respondents whose provider does not make available a voluntary water conservation program to employ some type of conservation practice. Approximately 91% of respondents whose water provider makes available some type of voluntary water conservation practices do, in fact, employ some type of conservation practice (as opposed to the 78% of respondents whose water provider does not make available some type of voluntary water conservation program).

Table 56

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for all Regions (n = 671)

Water provider makes available voluntary water conservation program(s)	Employ any conservation practice	
	Yes	No
Yes	90.5%	9.5%
No	78.2%	21.8%

$\chi^2 = 12.83^{***}$
 $\Phi = 0.14$

NOTE: χ^2 has been corrected for continuity (Yates 1934).

The associations between the availability of voluntary water conservation programs and whether or not respondents employed any water conservation practices by water planning region are reported in Tables 57 through 65. Due to the small number of cases in certain cells, χ^2 tests of statistical significance were not conducted.

Table 58

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region E
(n = 93)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	87.9%	12.1%
	No	90.0%	10.0%

Table 57

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region C
(n = 71)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	88.9%	11.1%
	No	79.5%	20.5%

Table 59

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region H
(n = 73)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	76.9%	23.1%
	No	76.7%	23.3%

Table 60

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region I
(n = 51)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	75.0%	25.0%
	No	66.0%	34.0%

Table 62

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region K
(n = 98)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	94.7%	5.3%
	No	78.3%	21.7%

Table 61

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region J
(n = 76)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	95.7%	4.3%
	No	79.2%	20.8%

Table 63

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region L
(n = 85)

		Employ any conservation practice	
		Yes	No
Water provider makes available voluntary water conservation program(s)	Yes	90.3%	9.7%
	No	83.3%	16.7%

Table 64

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region O
(n = 62)

Water provider makes available voluntary water conservation program(s)	Employ any conservation practice	
	Yes	No
	Yes	93.8%
No	80.4%	19.6%

Table 65

Association of “water provider makes available voluntary water conservation program(s)” and “employ any conservation practice” for Region P
(n = 62)

Water provider makes available voluntary water conservation program(s)	Employ any conservation practice	
	Yes	No
	Yes	100.0%
No	69.0%	31.0%

Concluding thoughts

It appears that there is a relatively good portion of respondents that recognize sustaining water through conservation is a valuable effort. There vast body of information regarding “water conservation” that demonstrates what can be done to conserve water; those practices that can be employed. What is lacking a more full understanding by more citizens, “that there may not be enough water to meet the future needs of the citizens of Texas without some effort to reduce utilization or development of new resources.” These findings also reveal that there are a significant number of Texas citizens who believe the water issues facing the State today are overrated. Even though there are a large number of citizens who are employing “some level” of water conservation, it appears there is room to increase conservation efforts or at least an understanding of the challenges facing the State into the future. If those who consider the problem as overrated more fully understood the impacts they could have on water resources, perhaps they might consider further voluntary actions that would conserve more water.

Last, it appears that there is a willingness within the population to conserve water; and that many could conceivably conserve more if the incentives were there. These incentives do not necessarily have to be economic in nature. Educating a larger component of the population that it is easier to voluntarily conserve water than to have more regulatory practices implemented such as higher cost and/or more regulation would be of great value for managing for future desires.

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