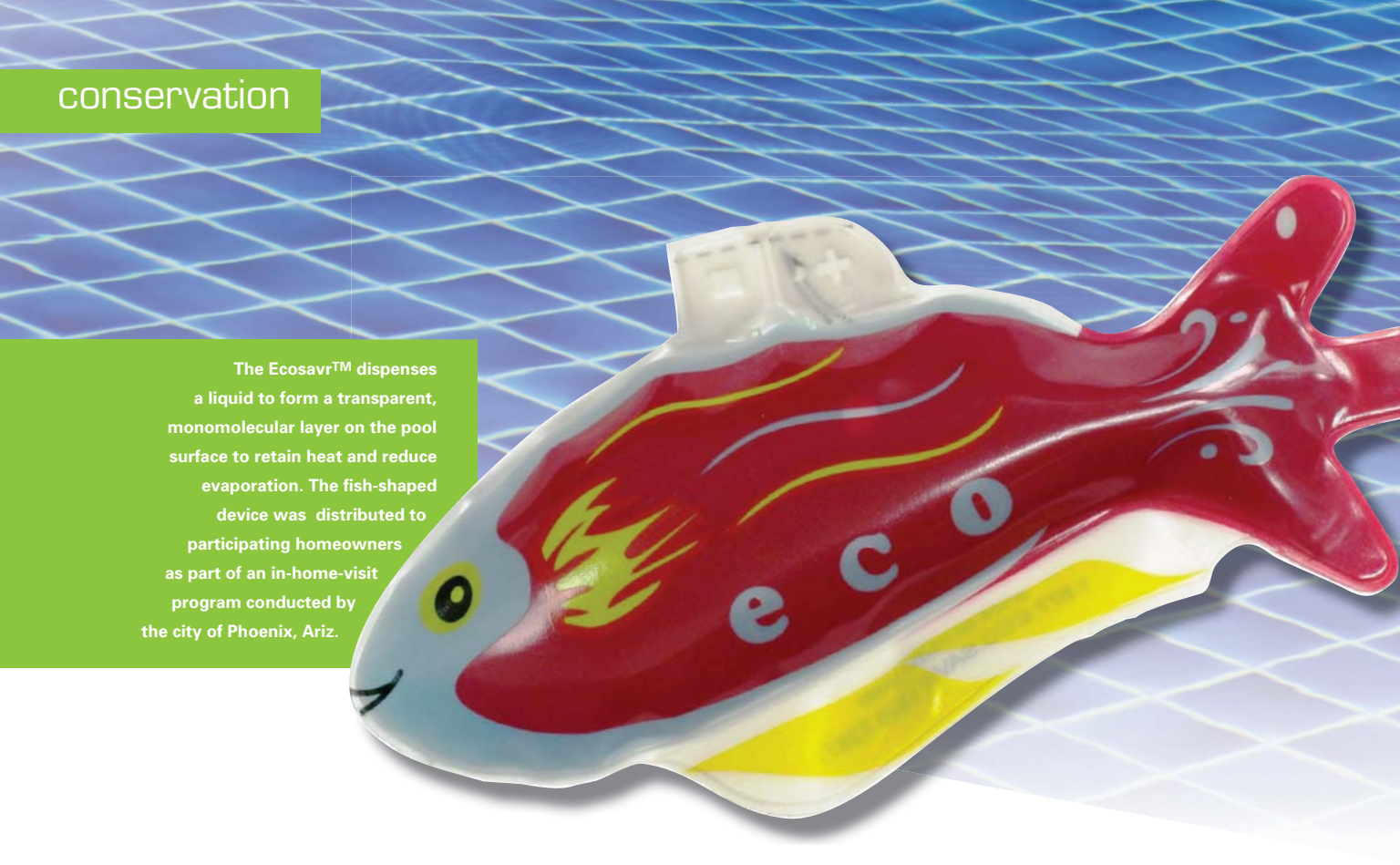


The Ecosavr™ dispenses a liquid to form a transparent, monomolecular layer on the pool surface to retain heat and reduce evaporation. The fish-shaped device was distributed to participating homeowners as part of an in-home-visit program conducted by the city of Phoenix, Ariz.

ANNETTE HUMM KEEN, DAVID KEEN, GUY E. FRANCIS, AND ADAM WOLFF

High-contact, hands-on outreach program changes customers' water use behavior

A CUSTOMER OUTREACH PROGRAM FEATURING IN-HOME VISITS HELPS FOSTER WATER CONSERVATION AND CHANGE WASTEFUL HABITS.

The city of Phoenix, Ariz., conducted a pilot program examining ways to promote indoor and outdoor water savings among single-family households. BBC Research & Consulting (BBC) of Denver, Colo., conducted in-home visits with residential customers in 36 homes in August and September 2007. The purpose of the visits was to better understand how customers perceive and use water, test acceptance of personalized water conservation tips and technologies, gauge water use behaviors, and gather preliminary evidence on what effect such visits might have on single-family water use.

KEY FEATURE OF PILOT PROGRAM WAS THE IN-HOME VISIT

Participants in the pilot program were selected from approximately 650 Phoenix single-family homes that BBC had surveyed in 2006 as part of a study for the city of Phoenix and the Arizona Municipal Water Users Association in Phoenix. In the original survey, homes were randomly selected and residents were interviewed by telephone to obtain economic, demographic, attitudinal, and behavioral information relevant to water use. Homes were classified according to six landscape categories:

The front yard of a visited home shows a mixed landscape of grass and desert plantings that is fairly typical of single-family homes in the Phoenix, Ariz., area.

- predominantly grass landscape with pool,
- mixed landscape with pool,
- predominantly grass-free landscape with pool,
- predominantly grass landscape with no pool,
- mixed landscape with no pool, or
- predominantly grass-free landscape with no pool.

Mixed landscapes often had desert landscaping in the front yard and grass in the backyard. Landscapes with no grass varied from lush desert vegetation to homes with rock front- and backyards with little other landscaping.

Pilot program targeted high-volume users. Most of the households selected for the in-home visit pilot program were chosen because they were high-volume water users in 2006 relative to other homes in their particular market segment. A water use model developed in part from information obtained in the original survey identified households in each landscape category whose 2006 use was substantially higher than predicted.

Selected residential customers received a letter from the city, informing them that they had been randomly chosen to participate in a water delivery study. In landscape categories with limited response from the highest users, letters were also sent to households that were more moderate water users. A total of 150 households were contacted. Up to three followup phone calls were made to each home that received a letter to determine the household's willingness to participate. Households were not informed that the visits concerned water conservation before the in-home visit. The 36 homes ultimately visited represented roughly 25% of the contacted homes that agreed to participate in the pilot. As shown in the map on page 40, visited households were distributed throughout the city of Phoenix.

In-home visits offered guides, water-conserving devices. Visits took place in August and September 2007 and were closely monitored throughout the process. Some in-home visits were conducted in Spanish for speakers who preferred Spanish. BBC staff spent on average one hour in each home, discussing conservation ideas and the household's water use.

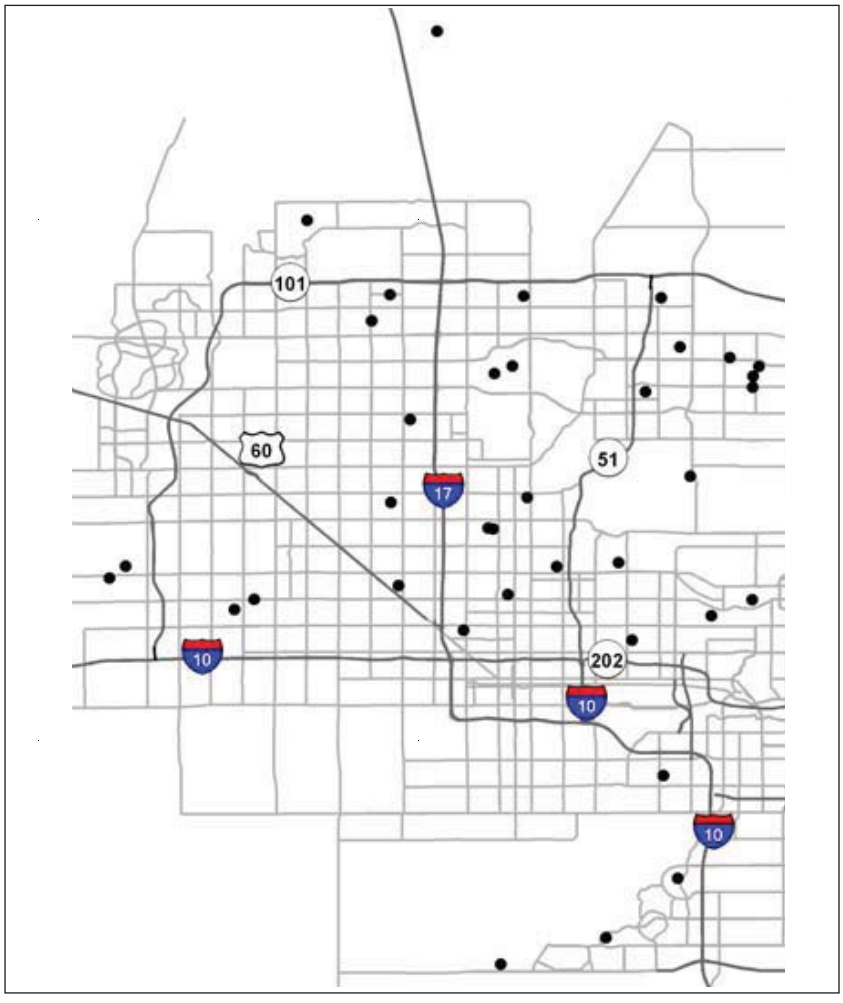
During the visit, homeowners were offered free of charge

- a variety of water-saving tips tailored to each home's characteristics;
- three guides providing additional tips on watering, plant selection, and other conservation ideas;
- an evapotranspiration (ET) controller for use with an automatic sprinkler system; and
- a fish-shaped device[1] that dispenses a liquid to form a transparent, monomolecular layer on a pool surface to reduce evaporation (offered to homeowners only if their home had a pool).

Following the visits, BBC attempted to contact the homes by telephone in October 2007 and November 2008 to assess the effect of the visits. Of the 36 participating homes, 32 were contacted at least once after the original visit; reasons for unsuccessful followup attempts included household relocation, changes to phone numbers, health issues and, in one case, death. The followup interviews provided information key to identifying changes in behavior relating to indoor and outdoor water use as well as any modifications to the home or changes in household occupants.

The balance of this article summarizes the effect of the in-home visits, including any changes in

- reported behavior of households related to water use;
- household appliances, fixtures, and other water-using characteristics of the home; and



Location of participating in-home-visit households in Phoenix, Ariz.

• recorded water use, based on an analysis of water use records provided by the city of Phoenix for the period 2006–08.

The first section summarizes the changes reported by households as part of the followup phone interviews. The second section analyzes changes in recorded water use, comparing water use for homes that were visited with use in other Phoenix single-family homes for 2006–08. An analysis of water use records facilitated an estimate of how strongly in-home visits affected water use during 2008.

MOST VISITED HOUSEHOLDS REPORTED CHANGES

Followup interviews with residents indicated that homeowners had been receptive to the visits and the water-saving ideas that were shared. In many cases, households appeared to have made earnest attempts to change behavior and conserve water. Only four of the homes that were successfully contacted in followup calls reported that no changes were made as a result of the in-home visit.

Households responded in a variety of ways to the visits. The greatest range of water-saving efforts occurred outdoors, although several indoor changes to reduce water use were also reported. Figure 1 shows the most common changes that homeowners said they made in the 14 months following the visits. The most common changes included reduced watering outdoors and locating and repairing leaks, both indoors and outdoors. Most leak repairs were the result of leaks found in irrigation systems, although leaks were also located and repaired in pools, hose bibs, faucets, and toilets. Several homes were able to locate and repair more than one leak during the year following the visit.

Reduced watering replaced overwatering habits for some participants. Several homeowners reported cutting back on outdoor watering with no negative effects on their plants. On more than one occasion, homeowners commented that they now believed that they had been overwatering before the visits. Reductions in watering were made through changes to the operation of automatic irrigation systems as well as reduced watering by hand.

Repairs to irrigation systems were the most common type of leak repair undertaken following the in-home visits. Several households hired professionals to inspect and service their sprinkler systems. In some cases, more than one inspection took place at the home between the in-home visit and the November 2008 followup phone call. Repairs included replacing broken or clogged sprinkler heads and fixing drip systems. One household stopped using its sprinkler system entirely until the leaks were located and fixed. Some homeowners commented that they would never have found the leak without the prompting of the in-home visits. In addition to fixing sprinkler and drip systems, several households identified and repaired leaks in hose bibs and hoses.

Use of liquid pool cover. As part of the original visits, each household with a pool was offered a liquid-dispensing pool cover designed to save energy and conserve water. The fish-shaped cover contains a transparent liquid that spreads across the surface of the pool to help retain heat and reduce evaporation. Depending on pool size, three to six fish were offered to each home with a pool. Of the 19 homes offered covers, 18 accepted them. The second followup phone call in November 2008 yielded the following findings.

• Ten homes had used at least one cover, and five homes had used all of them.

• Four participants believed that the covers were effective at reducing evaporation from pools.

• One homeowner had purchased additional covers.

However, several of the participants who had used the covers felt that they were not effective. Some of the homeowners who had accepted the covers reported that they still intended to use them but had not yet done so for various reasons.

Installation of ET controllers significantly reduced water use for some households. As part of the original in-home visits, residents were offered a free ET controller to install as part of an automatic irrigation system. Controllers were historically based ET controllers using weather data. Of the 30 homes offered a controller, 20 accepted. Reasons for not accepting a controller included lack of an automatic sprinkler system, a similar or near-new controller already in use, or skepticism about the controller's effectiveness.

At the time of the November 2008 followup, four homes had installed new ET controllers since the original in-home visit. In three of these cases, residents had installed the controller that they had been given during the visit; in the last case, the homeowners had decided to purchase their own controller. These four homes were among those showing the greatest reduction in water use between 2006 and 2008, reducing their use by an average of 29%, compared with an average 18% reduction for all homes participating in the in-home visit program. This greater reduction may be attributable in part to other changes that these individual households made.

Changes to pools and spas extended beyond use of pool covers. In addition to the use of the liquid pool covers, several homes took more substantial measures to reduce water loss through pools and spas. One household chose to drain the pool and have it resurfaced following detection of a leak. Another homeowner identified and repaired a leak in the pool's auto-fill system. Two households stopped using a summertime aboveground pool completely, and two other homeowners reported that they no longer used their spa.

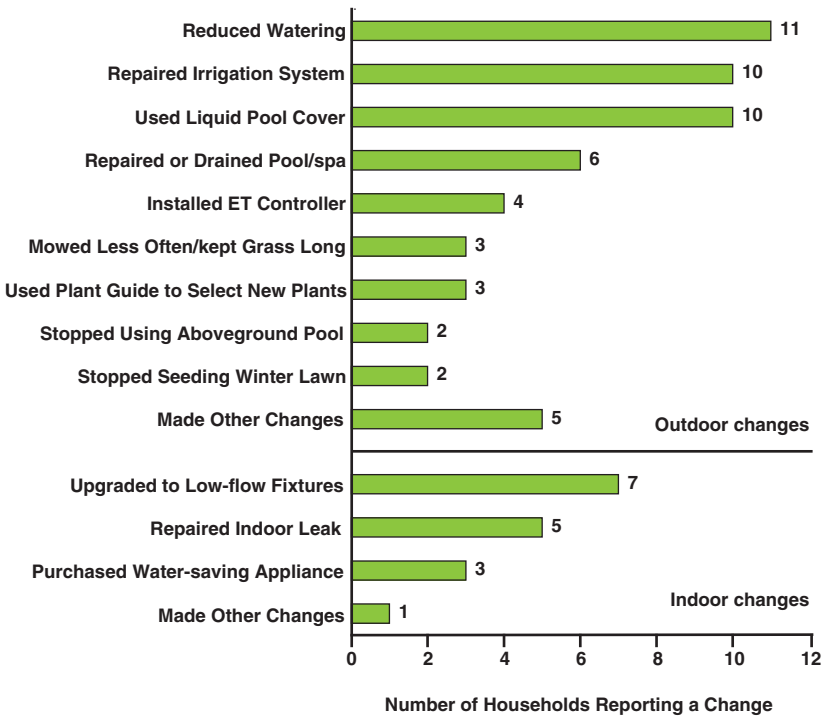
Several participants reported making changes in how they maintained their lawn. Three homeowners reported either mowing less often or keeping grass 2.5 in. in length in response to suggestions made during the in-home visits. In addition, some program participants reported that they now determined when to water their lawns by using the "footprint test," i.e., if blades of grass do not spring back up three or four minutes after being stepped on, it's time to water. Two households decided to discontinue seeding a winter lawn, and another homeowner removed an area of grass that had been difficult to maintain.

Many participants made good use of literature provided. During the in-home visits, households were offered print materials consisting of a watering guide, a guide with simple conservation tips, and a guide to plant selection. These materials were accepted by the majority of households. Several homeowners subsequently reported reading the guides, although some stated that they found the guides confusing. At least three participants had used the plant guide as an aid in selecting plants.

> In many cases, households appeared to have made earnest attempts to change behavior and conserve water.

Indoor leaks were also found and repaired. Although more leaks were discovered outdoors, several homeowners reported locating and repair-

FIGURE 1 Changes reported during followup visits



Source: BBC Research & Consulting

ET—evapotranspiration

ing indoor leaks. These included a leaking toilet float valve, leaking faucets, and one major plumbing leak in a bathroom. In several cases, locating and repairing the leak provided the impetus for installing a new low-flow fixture.

Several interviewees reported upgrading fixtures or installing new appliances. Followup contact showed that seven households had replaced a showerhead or a dripping faucet with a low-flow fixture. Three homeowners who had purchased new water-saving appliances reported that as a result of the in-home visits, they had taken water efficiency into account when considering an appliance purchase. One resident reported replacing both toilets with high-efficiency versions and a bathtub with a shower unit.

One household reported making additional changes affecting water use. Outdoors, less common changes included using mulch in beds, installing a pond filter, and refilling the spa less frequently. Indoors, the only other change reported was taking shorter showers.

RECORDS HELPED ASCERTAIN EFFECT OF IN-HOME VISITS ON WATER USE

Phoenix water use records for 2006–08 were examined to compare water use for visited homes with nonvisited Phoenix single-family households. The approaches used to compare changes in water consumption included

- the absolute change in average daily water use between 2006 and 2008 for homes that were visited and those that were not,
- the percentage change in annual water use between 2006 and 2008 for homes that were visited and those that were not,
- the percentage of households whose annual water use declined from 2006 to 2008 for homes that were visited and those that were not, and
- the change in water use over time for homes that were visited, compared with other single-family homes.

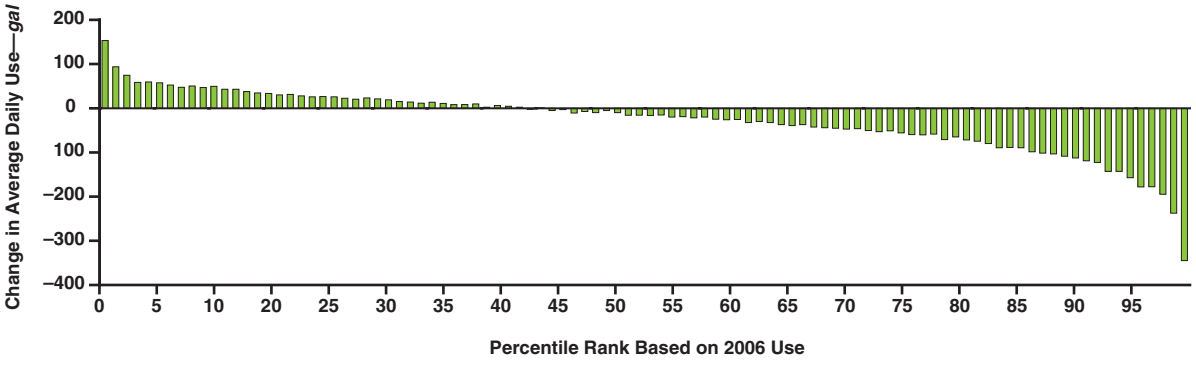
The greatest range of water-saving efforts occurred outdoors, although several indoor changes to reduce water use were also reported.

Analysis considered numerous factors affecting changes in water use. Analysis of changes in use for homes participating in the in-home visits must take place in the context of changing use for all single-family homes. Average water use for single-family homes in Phoenix changes from year to year because of weather. Longer-term factors influencing average use include the amount and type of new development, changing landscape types, and the prevalence of pools and spas. In recent years, Phoenix has seen a general decline in average single-family water use.

In addition, there is an important statistical relationship between a household's level of water use in one year and its use in subsequent years. Homes with higher use in any one year tend, on average, to exhibit slightly decreased use in following years, whereas homes with lower use in any one year tend subsequently to exhibit slightly increased use, on average. This phenomenon of regression to the mean is common in many years, both in periods when overall use for single-family homes is increasing and in periods when it is decreasing.

Any attempt to determine the effect of in-home visits on water use must take into account the fact

FIGURE 2 Absolute change in average daily water use between 2006 and 2008 for single-family homes in Phoenix, Ariz., by percentile rank of use in 2006



Source: BBC Research & Consulting from Phoenix Water Services Department water use data

that most of the households visited were above-average users. To account for this aspect, households that received in-home visits were compared with similar high-water-use households. First each home's percentile rank of use in 2006 (based on average gallons per day) was calculated, and then the visited homes were compared with all single-family homes in the same or similar percentiles in 2006.

Figure 2 shows the relationship between percentile rank of use in 2006 and the change in use between 2006 and 2008 for all Phoenix single-family homes. Homes that had the highest use in 2006 (e.g., ≥ 90th percentile) showed the greatest reductions in water use by 2008. Homes ranking under the 35th percentile in 2006 use had increased their water use by 2008.

Even in the context of overall reductions in average use during 2006–08 and accounting for the expected declines in use for above-average users, the analysis indicated that the in-home visits were effective in reducing water use. Phoenix water use records showed that, on average, homes receiving visits recorded a greater reduction in use than would be expected for similar homes over the same time period (explained in detail subsequently).

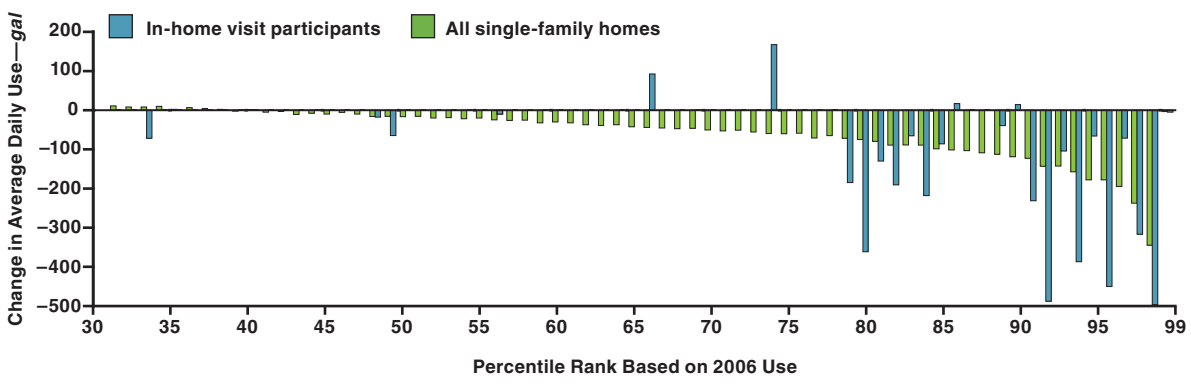
Absolute change in participants' water use between 2006 and 2008 was greater than expected. Figure 3 shows the absolute change in use (based on average gallons per day in 2006 and 2008) for homes that were visited and for all single-family homes. Homes are grouped according to their percentile rank in 2006; each bar represents the average change for homes in that percentile. Most households that were visited were high users in 2006 who might be expected to record lower use in subsequent years; however, the decline in use for many of these homes was even greater than might be expected. As noted previously, most of the visited homes had been high users compared with other homes in their landscape category, although some of the homes (e.g., those with little grass or no pool) had low average use compared with all Phoenix households.

Percentage change in annual water use between 2006 and 2008 was examined for all homes visited. A comparison of the percentage change in annual water use between 2006 and 2008 for all single-family homes in Phoenix and those participating in the program showed that overall, homes that were visited used 18% less water in 2008 than in 2006. As with absolute use, homes that were high users in 2006 tended to record a greater percentage decline in use than homes that were low users. Therefore, the level of water use in 2006 was considered when comparing visited and nonvisited homes. Figure 4 summarizes this analysis.

> The program underscored the value and benefits that could accrue to a high-contact, hands-on water conservation initiative and enhanced public education tools.

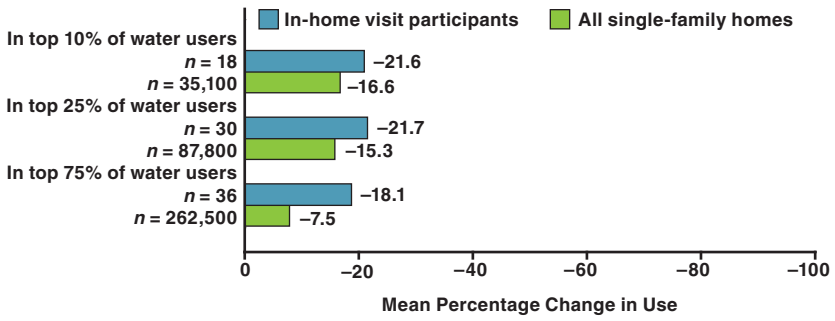
- Of the homes visited, 50% (18) were among the top 10% of water users in 2006. By 2008, these households had reduced their use by an average of 22%, compared with an average reduction of 17% for all other single-family homes in the top 10% of 2006 water users.
- Nearly all of the homes visited (30) were in the top 25% of water users in 2006. By 2008, these households had cut their water use by 22%, compared with a reduction of 16% for all other single-

FIGURE 3 Absolute change in average daily water use between 2006 and 2008 by percentile rank of use in 2006



Source: BBC Research & Consulting from Phoenix Water Services Department water use data

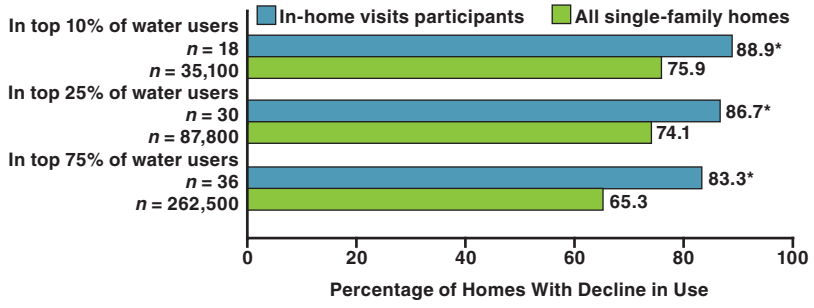
FIGURE 4 Percentage change in use between 2006 and 2008 for in-home visit households and all single-family homes



Source: BBC Research & Consulting from Phoenix Water Services Department water use data

n—*number of homes*

FIGURE 5 Percentage of homes with a decline in use between 2006 and 2008 for in-home visit households and all single-family homes

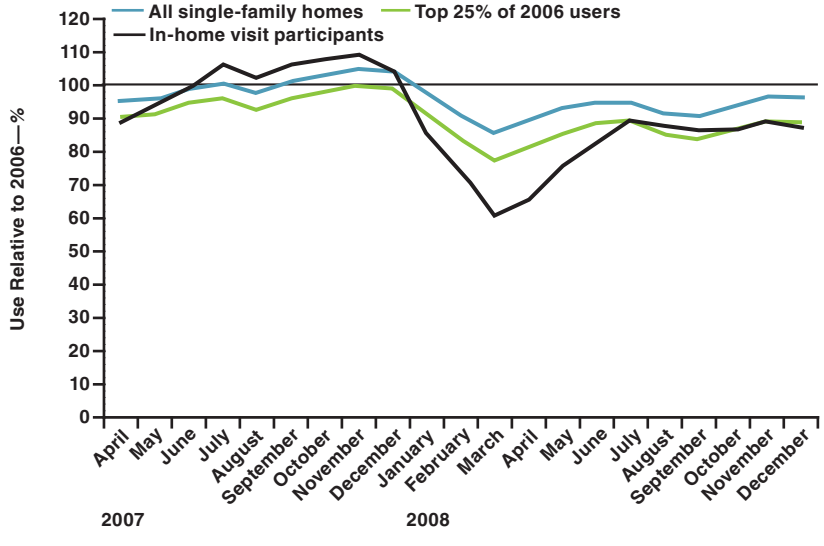


Source: BBC Research & Consulting from Phoenix Water Services Department water use data

n—*number of homes*

**Difference between homes that were visited and all single-family homes in terms of the percentage of homes recording a decline in use is statistically significant at the 90% confidence level.*

FIGURE 6 Average water use in 2007 and 2008 relative to 2006 use (four-month moving average)*



Source: BBC Research & Consulting from Phoenix Water Services Department water use data

**Use indicated in each month is the average for that month and the preceding three months.*

family homes in the top 25% of users in 2006.

Even when participating homes that were not among the highest users in 2006 are included in the analysis, the percentage reduction in use in 2008 was higher than the reduction for other single-family homes with similar or higher use levels in 2006.

Examining the percentage of homes whose water use declined from 2006 to 2008 offered another way to assess the effectiveness of in-home visits. Households participating in the home-visit program were more likely to record a drop in use between 2006 and 2008 than other similar homes in Phoenix. Figure 5 categorizes households by water use in 2006 and shows the percentage whose consumption declined between 2006 and 2008. About 89% of in-home-visit participants who were in the top 10% of water users in 2006 had decreased their water use by 2008, compared with 76% of other Phoenix single-family homes that were in the top 10% in 2006 (a statistically significant difference).

Changes in use over time were also tracked. BBC examined how water use changed month by month following the home visits in August and September 2007. Phoenix water use records suggest that the effect of the in-home visits on residential water use was not constant over time but was greatest in early 2008.

Figure 6 shows how water use in homes that received visits varied in 2007 and 2008, relative to their water consumption in 2006. Although use in early 2008 was lower than for the same period in 2006 for all single-family homes and in particular for the highest users, the drop in use for the visited homes was significantly greater. Given that these households were among the highest users in 2006, this reduction in use relative to other homes during early 2008 is considerable both in percentage and absolute terms. Some of the households participating in the

TABLE 1 Estimated water savings in 2008 for homes that were visited

Savings	Estimated Water Savings—*gal*
Per household	
Daily savings	37
Annual savings	13,505
Total of all households	
Daily savings	1,332
Annual savings	486,180

Source: BBC Research & Consulting from Phoenix Water Services Department water use data

program recorded water use in the early months of 2008 that was less than half of their use in 2006.

The drop in use for all single-family homes may be explained in part by the wetter-than-average conditions in Phoenix during late 2007 and early 2008. Nevertheless, the fact that the reduction in use was much greater for homes that were visited suggests that these homeowners' irrigation habits may have been more responsive to weather conditions. It is also possible that the effect of conservation ideas was greatest when the memory of the in-home visits was still fresh in participants' minds. By late 2008, water use for participating households relative to 2006 was similar to that of the top 25% of all single-family users in 2006.

Analysis included estimate of water conserved as a result of in-home visits. On the basis of the evidence for additional reductions in water use resulting from the in-home visits, the total savings that could be attributed to the visits was estimated by comparing the percentage change in use between 2006 and 2008 for each participating household with the average percentage change in use for all homes in the same percentile class. This analysis indicated that homes receiving visits reduced their water use on average by an additional 4% beyond reductions seen in similar households. This corresponded to an average saving of 37 gpd per household or roughly 13,500 gal each year. The total savings in water as a result of visits to all 36 households was nearly 500,000 gal in 2008. Table 1 summarizes the estimated savings in 2008 attributable to the in-home visits. The city of Phoenix plans to continue to track and evaluate water use for the 36 households visited. Continued analysis could help determine whether the reductions in water use achieved through the in-home-visit pilot program hold up over time.

IN-HOME-VISIT PROGRAM PAID OFF FOR HOMEOWNERS AND CITY ALIKE

In addition to the reduced water consumption and increased conservation demonstrated by most participants, the in-home-visit program yielded other findings.

- In many cases, the program spotlighted the deficiencies in the average customer's knowledge of water use, particularly outdoor use.
- The program demonstrated the high levels of customer acceptance and response to city-driven outreach efforts.
- The program underscored the value and benefits that could accrue to a high-contact, hands-on water conservation initiative and enhanced public education tools.

Because of the success of the in-home visits, the city of Phoenix will strengthen its outreach efforts to high-volume water users through a new high-contact, water audit program. A team of water auditors will be specially trained to conduct in-home visits focused on detecting leaks and reducing outdoor water use. The city is adding a similar one-on-one outreach to its drought-response plan. In addition, BBC has assisted the city of Phoenix in launching a new water resources and conservation website that focuses on customers and incorporates the valuable insights gleaned from the in-home visits and subsequent program analysis.

ACKNOWLEDGMENT

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ABOUT THE AUTHORS

Annette Humm Keen *(to whom correspondence should be addressed) is a senior consultant with BBC Research & Consulting, 3773 Cherry Creek North Dr., Ste. 850, Denver, CO 80209; hummkeen@bbcresearch.com. She has a bachelor's degree from St. John's University in Queens, N.Y., and a master's degree in landscape architecture from Harvard University, Cambridge, Mass. She has 20 years of experience integrating water conservation and social marketing communications campaigns. In addition to helping the city of Phoenix enhance its water conservation efforts, she has conducted water conservation and marketing assignments for utilities in Colorado, Wyoming, and California. David Keen is managing director of BBC Research & Consulting. Guy E. Francis is an associate and Adam Wolff is a research associate with the firm.*

FOOTNOTES

[1]Ecosavr™, Flexible Solutions Ltd., Victoria, B.C.

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