Saving Water With a Landscape Water Conservation Rebate Program

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Key Takeaways

In response to severe drought in the state of California, local, regional, and state water agencies implemented rebate programs to encourage reductions in water use.

The Valley Water Landscape Rebate Program encourages residents and businesses to convert high-water-use landscape to approved low-water-use landscape, and to retrofit existing irrigation equipment with approved high-efficiency irrigation equipment.

Significant and ongoing water savings can be achieved by rebate programs for turf removal, weather-based irrigation controllers, and high-efficiency sprinkler nozzles.

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California experienced the most severe drought in the past 1,200 years from 2012 to 2014 (Griffin & Anchukaitis 2014), and this drought continued until 2016. The state's water storage and distribution systems are critically dependent on the Sierra Nevada snowpack, which could decline by as much as 64% by the end of this century (Reich et al. 2018). On April 1, 2015, California's snowpack reached a startling 5% of normal, and in response, Governor Jerry Brown issued an executive order for the first ever statewide mandatory water use reductions (Executive Department, State of California 2015). The order included a requirement to replace 50 million ft^2 of turf with drought-tolerant landscapes to reduce water use in the urban sector.

The State of California and local and regional water agencies implemented this plan through rebate programs to incentivize property owners to replace turf. The agencies spent more than US$350 million on these rebate programs during the last two years of the drought (Knickmeyer 2016). As the programs were carried out by multiple agencies, they varied in implementation; however, they all essentially shared the same requirement regarding the removal of turf and typically offered between $0.50 and $4.00 per square foot for its removal.

Quantifying the water saved by these conservation programs allows for an assessment of their effectiveness and indicates areas to improve future programs. However, quantifying water savings may be challenged by a lack of sufficient years of postconversion data and the difficulty of obtaining and analyzing water billing data. For example, even though many programs conduct inspections after turf removal to ensure replacements aren't high-water-use species, the replacement species may require substantial irrigation in their early years to establish. Consequently, the full water savings related to turf removal may not be immediately realized.

Valley Water, a wholesale water supply and groundwater management agency in one of the state's largest urban centers (Silicon Valley), was in a unique position to conduct a conservation-based study, as it has had a long-standing turf removal rebate program since 2007. Valley Water's current version of the program, known as the Landscape Rebate Program, has operated since 2010, creating a unique opportunity to examine long-term water savings. This examination also offered the chance to quantify savings from irrigation equipment rebates, as they were offered in Valley Water's program. In this study, the water savings associated with four elements of Valley Water's Landscape Rebate Program were assessed: the replacement of turf with low-water-use species, automatic timer–based controllers with weather-based irrigation controllers, and conventional sprinkler nozzles with high-efficiency nozzles, both independent of and in conjunction with sprinkler bodies.

Focusing on single-family homes, Valley Water's largest rebate program participant type, data were obtained from 10 retailers through a voluntary research partnership. Water savings were determined as the difference between pre- and postrebate participation water use. Water billing data are based on meters that measure both indoor and outdoor water use cumulatively, so an assumption here is that measured water savings are a result of changes in outdoor water use because of participation in the rebate program. During the period of this study, 2010–2016, the region experienced drought conditions during the periods from 2006 to 2010 and 2012 to 2016.

Valley Water's Landscape Rebate Program

The Valley Water Landscape Rebate Program is designed to encourage residents and businesses to convert high-water-use landscape to approved low-water-use landscape, as well as to retrofit existing irrigation equipment with approved high-efficiency irrigation equipment. The program involves pre- and postinspections (typically onsite) to ensure that requirements are met. The program also offers educational and technical assistance for meeting requirements via a hotline, plus videos and educational resources that are available online. The program offers rebate types in two categories.

Landscape Conversion

Landscape conversion consists of replacing turf or pool areas to a landscape of low-water-use species in conjunction with a form of non-overhead irrigation, such as drip irrigation or hand-watering. In this study, all subjects converted live (green) turf areas only. Replacing a live lawn with a low-water-use landscape was required for this rebate program during the study period. Starting in 2015, replacement of dead (brown) lawns was also permitted for the rebate program; these sites were not included in the study, though, because they would confound estimates of water savings. The species selected for planting in the conversion area had to be selected from Valley Water's list of qualifying plants, which was adapted from the Water Use Classification of Landscape Species (WUCOLS IV) plant list.

Equipment Rebates

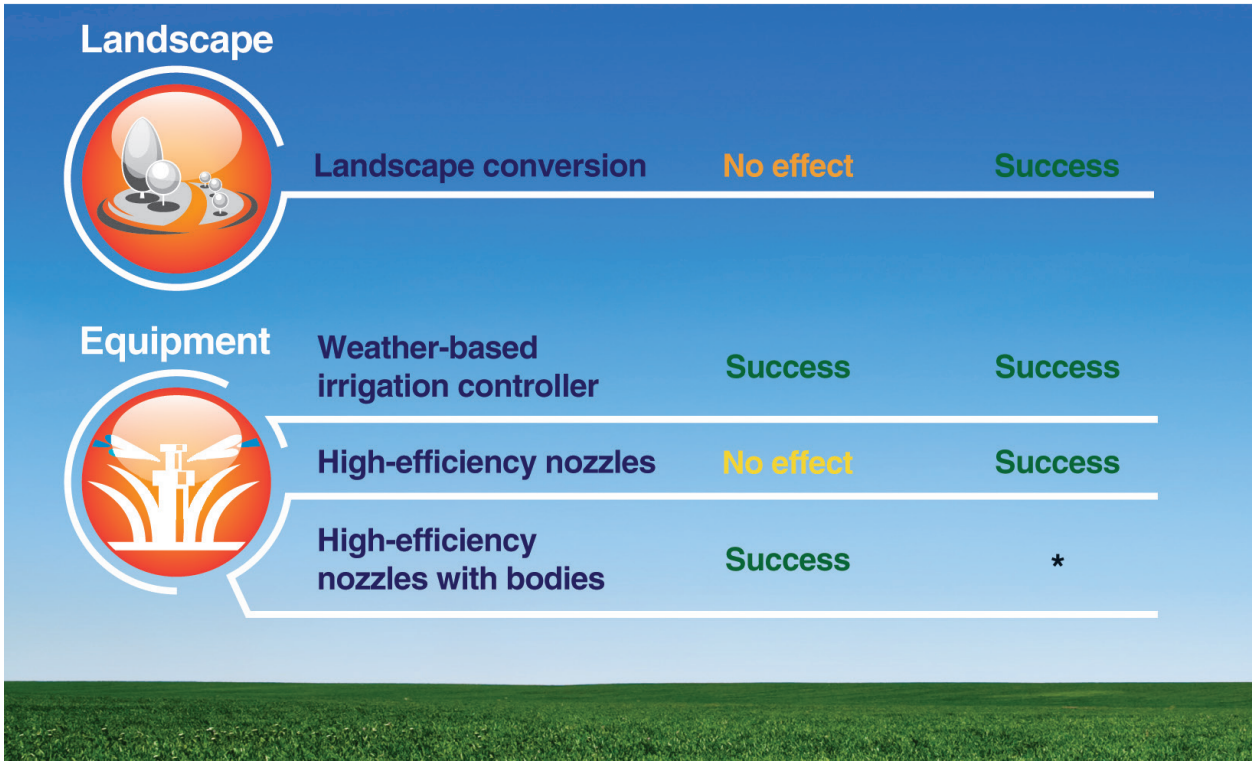
There were three types of equipment (from the Valley Water qualifying list) available for program participants to receive a rebate.

- **Smart controller.** Participants could replace a conventional automatic irrigation controller with a weather-based irrigation controller with a rain sensor that sets and adjusts water application in response to changes in the weather. These controllers are programmed to calculate plant irrigation on the basis of weather parameters, typically measured on site. Termed as "weather-based," "smart," or "evapotranspiration" (ET) and collectively referred to in the irrigation industry as smart water application technology (known as SWAT), these controllers are eligible for a rebate if they contain or are installed in conjunction with onsite rain sensors, also known as rain shutoff devices.
- **High-efficiency nozzles.** Participants could replace conventional nozzles with high-efficiency nozzles.
- **High-efficiency nozzles with sprinkler bodies.** Participants could convert conventional nozzles and sprinkler bodies to high-efficiency nozzles and sprinkler bodies with pressure regulation and/or check valves.

Water Savings From Rebate Program Participation

The rebate programs were successful for saving water overall. When looking at the water savings year over year, some rebate types were only marginally successful in the first year after conversion, but all rebate types were ultimately successful (Figure 1).

Valley Water Landscape Rebate Program Success



*Analyzed only the first year

Figure 1

Landscape Conversion

After analyzing data from the survey periods, the water savings for landscape conversion were found to be marginal the first year after conversion and statistically significant beginning in the second year after conversion. Significant water savings were not achieved during the first year, probably because new plants need more water to become established. As shown in Figure 2, the average water savings increased incrementally each year after conversion.

Plant water use is expected to decrease with maturity and eventually stabilize. Thus, the water savings for landscape conversion may plateau after a certain number of years, corresponding with the time needed for the new landscape to fully establish and for maintenance practices to normalize. Further study would be needed to determine how many years the savings would continue to increase. Annual average landscape conversion savings were up to 48 gal/ft²/year (during the fifth year after conversion), and on average 31 gal/ft²/year for years two through five when savings were significant. In comparison, other studies show savings between 23.5 and 60.9 gal/ft²/year in California (A&N Technical Services Inc. et al. 2018), 36.3 gal/ft²/year in Southern California (Metropolitan 2019), and 24.6 gal/ft²/year in Moulton Niguel, Calif. (Tull et al. 2016).

Equipment Conversion

Smart controllers offered significant water savings for each postconversion year examined in this study, and were on average 9.0 gal/ft²/year. Similar to landscape conversion, the average water savings for smart controllers incrementally increased each year following conversion (Figure 3). While the volume of smart controller savings depends on landscape area, smart controllers had greater savings per unit (on average 30,070 gal/unit/year) compared with high-efficiency nozzles in this study.

Controlled experiments have shown water savings of 40%–70% when using smart controllers, but large real-world studies have shown savings less than 10%

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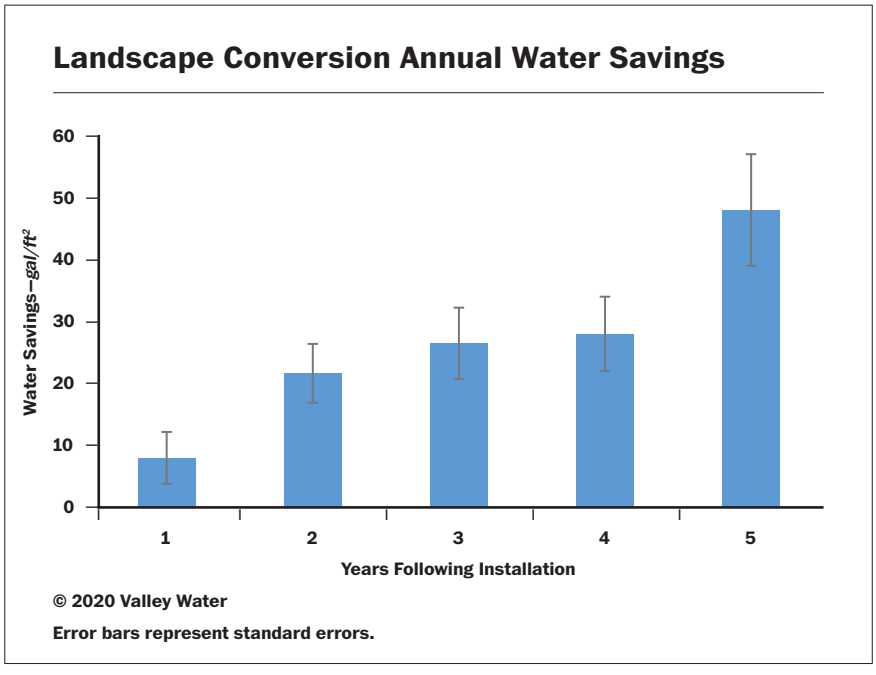


Figure 2

(Dukes 2012). This may be because smart controllers can be programmed incorrectly, causing over-irrigation (Bijoor et al. 2014, Pittenger et al. 2005). In addition, they cannot reduce the irrigation rate unless sprinklers irrigate uniformly.

A reason that the percentage of savings reported in this study may be higher than other studies could be because of the requirement that smart controllers be installed with rain sensors. These devices increase the likelihood of success by eliminating watering during periods of rainfall.

There were also significant water savings during the first year after conversion for high-efficiency nozzles with bodies (1,661 gal/unit/year).

Surprisingly, the water savings for high-efficiency nozzles without bodies were not significant in the first year after conversion, but they were significant thereafter (on average 1,242 gal/unit/year). This may be because landscapers or households that install high-efficiency nozzles may not be aware of how to properly adjust the scheduling for the new nozzles during their first year. Recipients should be provided information or assistance to adjust their irrigation run times after conversion to achieve the immediate savings that would be expected for high-efficiency nozzles. Once significant savings were achieved in the second year for high-efficiency nozzles, the savings did not significantly differ from high-efficiency nozzles with bodies, suggesting that there are not additional savings to be achieved by adding sprinkler bodies to the high-efficiency nozzle rebate.

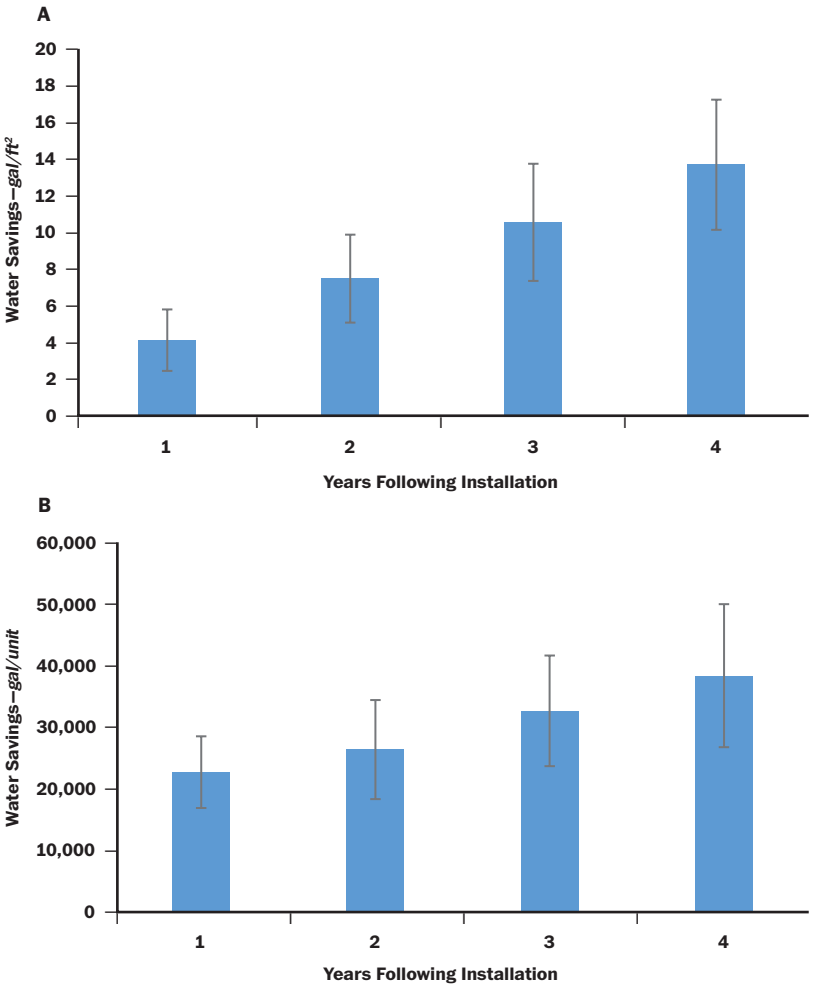
Household Water Use in Drought

Average water use of the retailers' total single-family household sector was compared with average water use of program participants. Since participation in the rebate programs is low (less than 0.5% of retailers' total home customer base), the average home use was not expected to be affected by rebate program participation. Average home water use decreased during the study period in response to the 2012–2016 drought, and many county residents stopped irrigating their lawns to conserve water. In fact, there was a local "brown is the new green" media campaign during the time that encouraged people to conserve by cutting back on landscape irrigation.

Average home use was not appropriate as an experimental control in this study given the differences in pre-installation water use between the program participants and average home water use. Average home water use is expected to rebound in the years following this study, but participant water use may remain lower, which could be tested in a future study.

Interestingly, pre-installation water use differed between average homes and program participants for each type of rebate. Landscape conversion

Weather-Based Irrigation Controller Annual Water Savings in Gallons Per Square Foot (A) and Gallons Per Unit (B)



Error bars represent standard errors.

Figure 3

participants had lower pre-installation water use than average residents, demonstrating that landscape conversion programs may be popular with households that already conserve more water than others in their service area. For equipment rebates, preconversion water usage was higher for participants than it was for average residents—this suggests that decisions about equipment rebates may be financially driven, as these users are, on average, spending more on their water bills than others in their service areas.

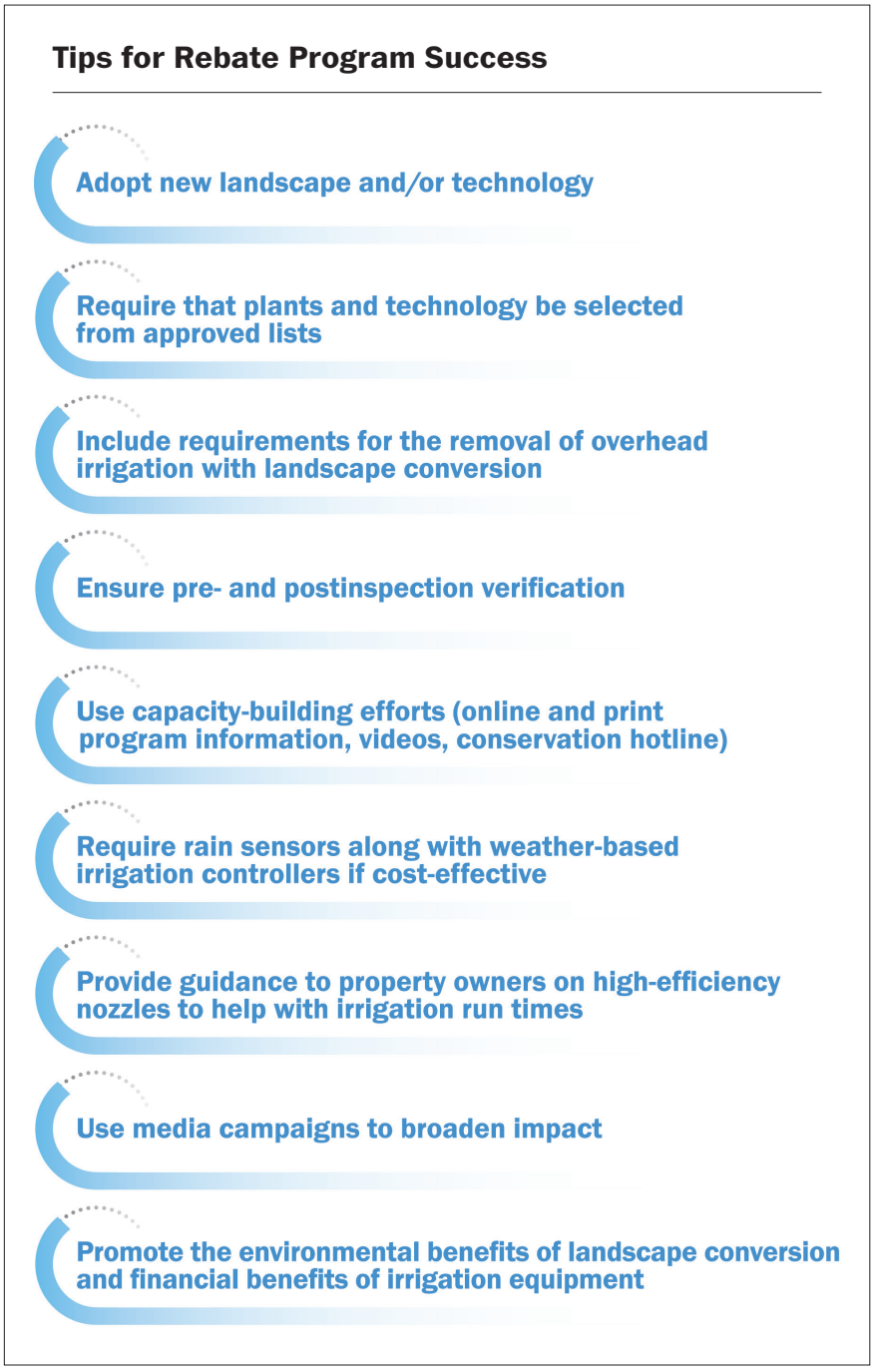


Figure 4

Study Implications

This study shows that significant and ongoing water savings can be achieved by rebate programs for turf removal, weather-based irrigation controllers, and high-efficiency nozzles. Rebates for sprinkler bodies along with high-efficiency nozzles also result in water savings, although not significantly greater savings than high-efficiency nozzles alone. For turf removal rebates, savings are significant and continue to increase after the new landscape is established during the first year.

Beyond the adoption of new landscape and technology, several factors can contribute to a rebate program's success (Figure 4). This includes having stringent requirements that plants and technology be selected from approved lists, requiring non-overhead irrigation, and conducting pre- and postinspection verifications. Requiring rain sensors may increase savings from weather-based irrigation controllers, but the cost feasibility should be explored. Other factors that contribute to program success include capacity-building efforts, such as having inspectors provide program and educational information onsite; establishing a conservation hotline to provide participants with program assistance; and providing detailed

online program information, educational outreach, and instructional videos.

Property owners need guidance to determine proper irrigation practices after landscape changes, including setting optimal irrigation rates. On the basis of this study's findings, it is recommended that recipients of high-efficiency nozzle rebates be provided with information or assistance to adjust their irrigation run times after conversion to help achieve expected savings.

> **When looking at the water savings year over year, some rebate types were only marginally successful in the first year after conversion, but all rebate types were ultimately successful.**

This study shows that nonparticipating single-family residents also conserved water during an ongoing drought, likely because of conservation messaging. However, these savings are expected to be short-term, as lawn irrigation should rebound after the drought.

Participants of turf rebates may be motivated by environmental ideology, so advertising for these programs with environmental messaging may be effective. For equipment rebates, messaging may be more effective if it demonstrates potential financial savings.

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AWWA Resources

- **Drought and Supply Limits Drive Sustainability Initiatives. West A. 2018. *Opflow.* 44:3:10. https://doi.org/10.5991/OPF.2018.44.0026**
- **Leveraging the Power of Rebates: The Difference Is in the Breakage. Goetz MK. 2014. *Journal AWWA.* 106:1:32. https://doi.org/10.5942/jawwa.2014.106.0007**
- **M52 *Water Conservation Programs,* 2nd ed. AWWA Catalog No. 30052-2E.**
- **Water Conservation. www.awwa.org/Resources-Tools/Resource-Topics/Water-Conservation.**

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