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# Assessing Water Use in WaterSense-Labeled Homes and Quantifying the Savings

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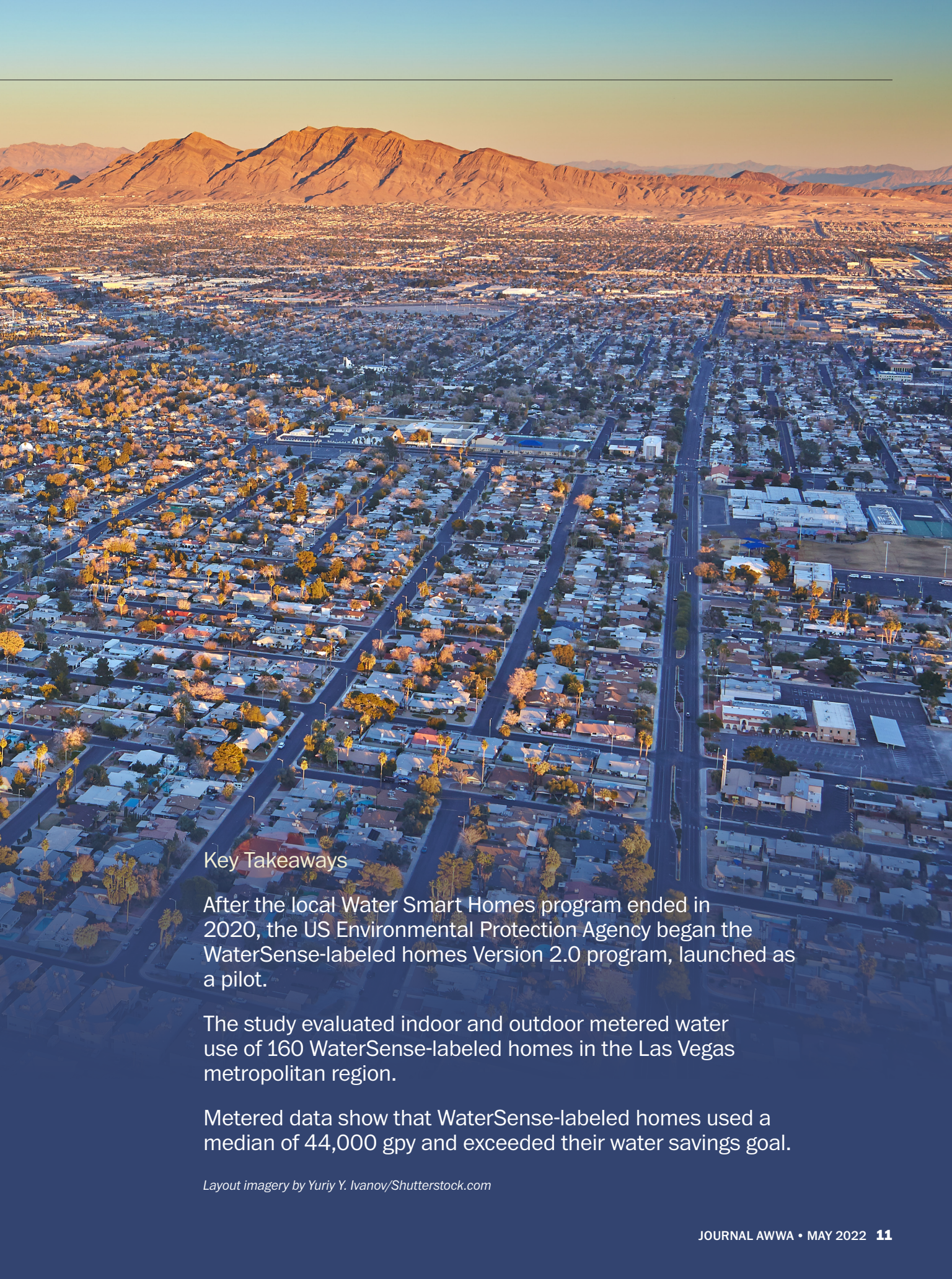

## Key Takeaways

After the local Water Smart Homes program ended in 2020, the US Environmental Protection Agency began the WaterSense-labeled homes Version 2.0 program, launched as a pilot.

The study evaluated indoor and outdoor metered water use of 160 WaterSense-labeled homes in the Las Vegas metropolitan region.

Metered data show that WaterSense-labeled homes used a median of 44,000 gpy and exceeded their water savings goal.

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The US Environmental Protection Agency (EPA) launched the WaterSense program in 2006 to make it easy for consumers to identify high-performing, water-efficient products. In addition to offering a label for water-efficient products, WaterSense provides resources that help consumers save water. In 2009, WaterSense launched the WaterSense-labeled homes program, the first national certification for whole-house water efficiency. The Version 2.0 (V2) program, launched as a pilot in July 2020 and finalized in February 2021, represents a fundamentally new approach to the program's requirements.

Like the product labeling program, the WaterSense-labeled homes program is voluntary. It allows builders to identify high-performing, water-efficient homes and to communicate this to homebuyers via third-party certification. It also provides a set of requirements that can be used as a reference or template for efficiency on a whole-house level by utilities and communities as opposed to individual product rebates. While the WaterSense label is available to new and existing homes, most certification activity occurs in new construction, as is the case with many green building certifications. New construction also represents the best opportunity to achieve maximum potential savings for minimal incremental cost.

The study discussed in this article aims to quantify how WaterSense-labeled homes use water in real households by analyzing post-occupancy meter data. The benefits from this study include

- validating whether the program is working effectively and saving water,
- informing future improvements in the program and identifying potential shortcomings,
- quantifying and predicting the effect of both whole-house efficiency measures and individual technologies/end-use approaches to efficiency in real-world applications, and
- helping communities plan for growth as they balance the need to add housing with the desire to minimize infrastructure costs and demands on resources.

The study summarizes the data collected, compares the observed water use against modeled predictions and independent field data, offers several hypotheses about other factors that could be influencing the results, and highlights areas for future research. Our results show that while market and industry factors outside the certification are influencing water use and could be responsible for some of the savings that are observed, WaterSense-labeled homes had a median water use of 44,000 gpy and are reducing water use by at least 30%, the latter of which is the program's target.

## Water Smart Homes in Southern Nevada

The study area was entirely contained in the Southern Nevada Water Authority (SNWA) wholesale service territory. In 1991, seven local water and wastewater agencies formed SNWA to address water issues on a regional basis, rather than an individual water purveyor basis. As the wholesale water provider, SNWA is responsible for water treatment and delivery, acquiring and managing long-term water resources, and conservation incentive programs for Southern Nevada. Collectively, SNWA member agencies serve more than 2.2 million residents.

The Water Smart Homes program concept was drafted in 2004 through a partnership between SNWA and the Southern Nevada Home Builders Association (SNHBA). In the early 2000s, the Las Vegas Valley saw a boom in major new residential construction, and SNWA needed to address the water efficiency of new homes. Working with builders through the SNHBA partnership, SNWA developed a set of program criteria for homes to be considered Water Smart. The SNWA Board approved the Water Smart Homes program on Jan. 20, 2005, and KB Homes built the first Water Smart Home in May 2005.

The Water Smart Home program established requirements for essentially all elements of a home that use water, and a list of indoor and outdoor requirements was developed for participating builders. SNWA inspected 10% of completed homes, and the process of passing homes evolved over the years from a pass/fail model to a points-based model. Because of the high-efficiency toilet rebates offered by SNWA, builders faced only minimal incremental program costs to participate.

**The range of water use values across different data sets in the same or similar areas reinforces the variability of water consumption over time and across different housing types.**

Early consumption analysis of Water Smart Homes showed promising results, with a few caveats. In comparison with older homes built in the Las Vegas Valley (pre-2003 built homes), Water Smart Homes used an average of 94,000 gpy and saved approximately 90,000 gpy. Compared with homes built during the same time,

Water Smart Homes used approximately 20,000 gpy less. However, Water Smart Homes were generally built on smaller lots. When the lot sizes were normalized, Water Smart Homes used 35,000 gpy less than a home built before 2003 and about 3,000 gpy less than homes built at the same time.

Code was implemented in 2004 across all jurisdictions that prohibited front yard landscaping. Follow-up research tracked older homes and revealed significant decreases in water use due to landscape and fixture changes as well as some increase in water use of Water Smart Homes and other newer built homes. The latter is likely attributable to newer homes developing their backyards over time. The older and newer homes, though, continued to be significantly different.

From 2005 through 2020, approximately 17,000 Water Smart homes were completed. In 2019, Assembly Bill 163 required all new single-family residential construction after Jan. 1, 2020, to include WaterSense-labeled toilets and fixtures. These new requirements, along with the deployment of the EPA WaterSense-labeled homes V2 program, led to the termination of the SNWA program in June 2020.

## The V2 Program and Pilot Study

The sunsetting of Water Smart Homes created both a need and an opportunity. Builder participants in the Water Smart program sought new recognition for their homes, many of which had already been marketed and sold as featuring Water Smart certification. Simultaneously, WaterSense had proposed new requirements as V2 in an April 2019 draft and sought an opportunity to test this approach.

Previous versions of WaterSense-labeled homes included a variety of prescriptive, design, and professional requirements. V2 requires only a short prescriptive checklist intended to ensure homes meet homeowner expectations, including WaterSense-labeled plumbing products and an inspection for leaks, and an efficiency requirement that homes use 30% less than typical new construction based on national standards and norms. These changes were intended to increase coordination with the existing green building industry while also increasing flexibility without sacrificing water savings.

In July 2020, WaterSense and the Residential Energy Services Network (RESNET), an approved Home Certification Organization (HCO) for WaterSense-labeled homes, launched the V2 pilot test in Las Vegas. The pilot allowed homes to earn the WaterSense label by

- meeting all requirements in the draft mandatory checklist and
- demonstrating they met the WaterSense efficiency requirement (30% savings compared with typical new construction) by achieving a $HERS_{H2O}$ (https://bit.ly/HERSh20) score of 70 or less.

RESNET's $HERS_{H2O}$ program uses 2020 ANSI/RESNET/ICC 850, *Standard Calculation and Labeling of the Water Use Performance of One- and Two-Family Dwellings Using the Water Rating Index* (Standard 850) to estimate a home's water use relative to a reference case. A rating of zero indicates net-zero water use, while a rating of 100 indicates the home is equal to the reference (typical new construction). A rating of 70 indicates a home uses 70% of the water predicted for the reference, meaning there is a 30% savings. EPA has evaluated and approved the standard for use in the WaterSense-labeled homes program.

**Lot size has a clear impact on overall consumption, with smaller lots using less water due to lower outdoor water demand.**

On the basis of positive feedback from the pilot, WaterSense finalized V2 in February 2021 with minimal changes. From the launch of the pilot in July 2020 to March 2021, 568 homes in the Las Vegas area received the WaterSense label.

## V2 Pilot Study Findings

### Data Collection

V2 also changed the way WaterSense receives information about labeled homes. The new reporting process allows WaterSense to gather a range of information from HCOs. Table 1 summarizes the information WaterSense receives via quarterly reports. In addition to the information collected from HCOs, the three water purveyors serving the homes—the Las Vegas Valley Water District, the City of Henderson, and the City of North Las Vegas—were asked for water use data.

Because of the seasonal nature of water usage, it is important to consider a full year of water use. To make the data set large and robust (across a large variety of homes), homes with at least nine months of metered water consumption were also added to the final data set, with similar months doubled where necessary to estimate annual consumption. This approach recognizes seasonal water use patterns and provides a reasonably accurate estimate of water use on the basis of available observed consumption. Table 2 summarizes which months were doubled (if

### Information Considered in WaterSense Labeling

| Home Characteristics | Indoor Products/System | Outdoor Products and Services/System | Rating Information |
|---|---|---|---|
| Location | Toilets—*gpf* | Size of the installed landscape—*ft²* | $HERS_{H2O}$ rating (1–100 scale) |
| Size—*conditioned ft²* | Lavatory and kitchen faucets—*gpm* | Size of unimproved area/ estimates for future landscaped area—*ft²* | Predicted indoor/outdoor annual consumption of the rated home (the home as built) |
| Bedrooms—*n* | Showerheads—*gpm* | Presence of automatic irrigation system | Predicted indoor/outdoor annual consumption of the reference home (the standard's definition of a typical home of the same size and location) |
| Stories—*n* | Clothes washers (IWF, capacity) | Controller technology (clock timer versus smart controller) | |
| Lot size—*ft²* | Dishwashers (WF, standard versus compact) | Flow rate/capacity of irrigation systems | |
| | Water softeners | Commissioning/auditing of irrigation systems | |
| | Hot water distribution systems (run length and insulation of pipes) | | |

IWF—integrated water factor, WF—water factor

**Table 1**

### Strategy for Estimating Use of Missing Months

| Missing Month | Month Used as Estimate |
|---|---|
| November | October |
| December | January if available, February if not |
| January | February |

**Table 2**

### Water Consumption and Ratings of WaterSense-Labeled Homes

| Source | Mean | Median | Range |
|---|---|---|---|
| Rating[a] | 58 | 59 | 38–70 |
| Metered annual consumption—*1,000 gal* | 53 | 44 | 3–279 |

[a]The Standard 850/$HERS_{H2O}$ rating is dimensionless, with lower values indicating lower water use/higher efficiency. A rating of 0 would equal net-zero water use; a rating of 100 would indicate features and water use equal to the standard's defined reference home.

**Table 3**

needed) for an annual estimate. The resulting data set includes annual water use estimates of 160 homes for October 2020 through September 2021.

#### Water Consumption and Features in WaterSense-Labeled Homes

WaterSense-labeled homes used a median of 44,000 gpy and an average of 53,000 gpy during the study period (Table 3). On the basis of previous results for Water Smart homes, this represents extremely low water consumption for the area. As is often the case with water use, the data represents a strikingly large amount of variability on both extremes. Further analysis of the features and characteristics of the homes that influence water use as well as comparing the observed usage against the Standard 850 model outputs and independent field data provides additional insight.

As discussed, homes certified to WaterSense using RESNET's $HERS_{H2O}$/Standard 850 need a rating of 70 or less. While homes were only required to achieve a rating of 70, the average rating was 58 (equal to a water savings of 42%). Only one home in the data set achieved the minimum rating of 70, and only four homes received ratings higher than 67. From conversations with the builder, this could indicate a desire for a buffer from the target. When presented with a target of 70, builders may be reluctant to aim for it, knowing they may just miss it and end up ineligible for the certification.

To achieve a rating of 70 or lower, homes need to include a variety of product and design features (verified by

a RESNET HERS$_{H2O}$ rater) that the Standard 850 model determines are likely to result in a savings of 30%. The Standard 850 model adjusts water consumption predictions on the basis of the following inputs:

- Rated product efficiency for plumbing products and appliances
- Size and location of home and lot
  - Estimated occupancy based on the number of bedrooms
- Run length and insulation of hot water distribution system
- Size of irrigated area
- Irrigation technology used (automatic irrigation, WaterSense-labeled irrigation controller)
- Flow rate intensity of an automatic irrigation system

Plumbing products and appliances as well as the outdoor attributes (the last three items in the list) all use defined values in the reference home regardless of the rated home's features or design; e.g., the reference home will always have 1.6-gpf toilets regardless of the toilets installed/used in the rated home.

Standard 850 is an asset-based rating system, so only the home's physical attributes are used in the model. For example, demographic information such as the age or income of the occupants has been shown to have predictive value on water use, but the standard views them as inappropriate for an asset-based rating. Likewise, it is unlikely WaterSense would want to include such attributes as potential criteria for the WaterSense-labeled homes program.

### Characteristics and Features of WaterSense-Labeled Homes

Table 4 describes the size of WaterSense-labeled homes and their lots. Tables 5 and 6 provide the indoor and outdoor design and product features, respectively. Photo 1 shows a bathroom in a WaterSense-labeled home.

New homes may or may not include appliances such as dishwashers and clothes washers, and they are not required

**Size of WaterSense-Labeled Homes**

| Parameter | Mean | Median | Range |
|---|---|---|---|
| Conditioned area—*ft*$^2$ | 2,103 | 2,089 | 1,157–3,430 |
| Bedrooms—*n* | 3.7 | 3.5 | 2–5 |
| Lot area—*ft*$^2$ | 4,182 | 3,871 | 1,725–8,166 |
| Estimated occupants—*n* | 3.1 | 3 | 2.2–3.8 |

**Table 4**

**Indoor Features of WaterSense-Labeled Homes**

| Feature | Mean | Median | Range |
|---|---|---|---|
| Toilets—*gpf* | 1.28 | 1.28 | 1.28[a] |
| Showerheads—*gpm* | 1.7 | 1.75 | 1.3–1.75 |
| Lavatory faucets—*gpm* | 1.2 | 1.2 | 1.2–1.5 |
| Kitchen faucets—*gpm* | 1.5 | 1.5 | 1–1.5 |
| Dishwashers (WF) | 3.3 | 3.3 | 3.3[a] |
| Clothes washers (IWF) | 4.3 | 4.3 | 4.3[a] |
| Hot water piping[b]—*ft* | 63 | 59 | 31–90 |

IWF—integrated water factor, WF—water factor

[a]Feature category did not exhibit any variability.

[b]All hot water piping was insulated.

**Table 5**

This bathroom shows typical indoor features of a WaterSense-labeled home. *Photo credit: Jim Doyle/ Applied Photography LLC, provided courtesy of KB Home*

**Photo 1**

A WaterSense-labeled home includes an installed front landscape. *Photo credit: Jim Doyle/Applied Photography LLC, provided courtesy of KB Home*

**Photo 2**

to earn the WaterSense label. Most homes in the data set (135 out of 160) included these features, either included by the builder or sold as an add-on in the final price of the home and installed at delivery. This could be an indication of competition in the market or the market prevalence of first-time homebuyers who are less likely than existing homebuyers to bring appliances from a previous home.

Homes are required to have their front landscape installed before receiving a Standard 850 rating (as seen in Photo 2). However, builders often deliver homes with temporary stabilization (such as straw mulch) in the side and back, allowing the homeowners to finish the landscape post-delivery. The Standard 850 rating also includes an estimate for the size of the landscape that will likely be installed in the future. This is provided in Table 6 as the "estimated future/uninstalled landscape." The "installed landscape at delivery" indicates whatever landscape was installed by the builder before delivery to the homeowner.

Standard 850 also includes a measure of irrigation flow rate intensity called the Residential Irrigation Capacity Index (RICI). The RICI method was developed by SNWA and tested against a national data set of homes from The Water Research Foundation's *Residential End Uses of Water* report (DeOreo 2016). Standard 850 allows raters to use RICI as an adjustment factor in landscapes. Lower flow rates correspond to lower RICI scores, and adjustments are applied from a baseline of 5. For example, a RICI score of 1 indicates an irrigation system that flows at 80% lower intensity than a typical irrigation system. All homes included in the data set used RICI in their rating and feature minimal desert-style landscaping with drip irrigation. As a result, the RICI scores were predictably low.

All homes in the data set included automatic irrigation, which is not required for the Standard 850 rating or the WaterSense certification but is typical for the market. All homes also received a credit for having a certified professional from a WaterSense-labeled certification program audit the irrigation system after installation. Standard 850 has an optional credit for using a WaterSense-labeled irrigation controller, but none of the homes in the data set used this option.

### Actual and Predicted Usage

Comparing the observed usage against both predicted use and independent field data also helps answer the core question of how much water the labeled homes are saving and if the predictions are reliable. Table 7 summarizes the metered consumption as well as Standard 850's prediction for the rated and reference homes.

As expected, the observed values have a wider range of results than either of the modeled values. As Figure 1 illustrates, though, there is a clear relationship between the rated home's prediction and observed water use. Despite this high degree of variability in observed water use, Standard 850 is performing well in identifying homes that will ultimately use less water.

The median predicted consumption was 76,000 gpy

**Outdoor Features of WaterSense-Labeled Homes**

| Feature | Mean | Median | Range |
|---|---|---|---|
| Installed landscape at delivery—$ft^2$ | 1,110 | 1,450 | 0–4,485 |
| Estimated future/ uninstalled landscape—$ft^2$ | 509 | 346 | 0–2,672 |
| Residential Irrigation Capacity index | 0.8 | 0.75 | 0.2–2.9 |

**Table 6**

compared with median observed consumption of 44,000 gpy. Possible reasons for this discrepancy are discussed in greater in the following sections.

### Establishing Baseline Water Use

In addition to how homes use water relative to the standard's prediction, it's also important to establish a reasonable baseline from independent field data. Several potential sources for this baseline value are summarized in Table 8. In addition to data from previous studies (Dieter et al. 2018, DeOreo 2016), information was obtained from Flume real-time monitoring devices for the greater Las Vegas area over the study period.

The range of water use values across different data sets in the same or similar areas reinforces the variability of water consumption over time and across different housing types. The lowest average water usage on the list, found in Water Smart homes built in 2008–2009, are (like WaterSense-labeled homes) specifically designed for efficiency and can be expected to use less water. The highest values, those from real-time water monitoring devices, could also be explained as they represent a self-selected user group who have installed these devices. Homeowners with higher water bills/consumption might be more motivated to use such devices. WaterSense-labeled homes exhibited lower consumption than any of the potential baselines, with an average value of 53,000 and median value of 44,000 gpy.

Among the available data sets, the SNWA data set for homes built in 2008–2009 is the most appropriate baseline for this pilot study. This data set is conservative relative to the intended WaterSense baseline given the substantial voluntary and mandatory conservation efforts undertaken in the region over the past 20 years. However, it provides a reasonable estimate of what a typical new home would consume in the market and is the best available field data in this instance.

**Metered Water Use Versus Modeled Predictions**

| Water Use | Mean | Median | Range |
|---|---|---|---|
| Actual metered consumption—*1,000 gpy* | 53 | 44 | 3–279 |
| Reference home, modeled water use—*gpy* | 133 | 132 | 95–201 |
| Rated home, modeled water use—*1,000 gpy* | 76 | 76 | 55–112 |

**Table 7**

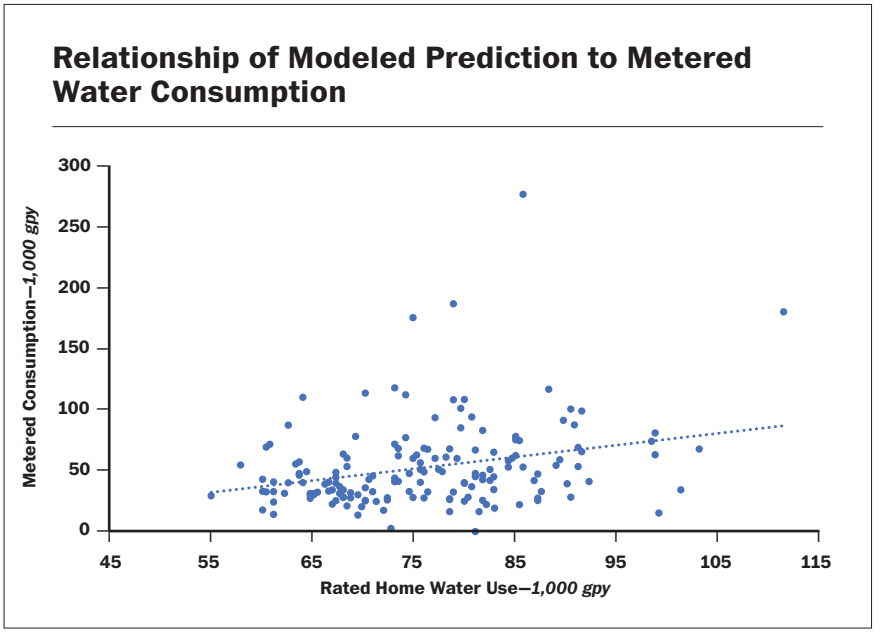


**Figure 1**

Using a baseline of 97,000 gpy, WaterSense-labeled homes used 45.4% less water on the basis of an average consumption of 53,000 gpy, or 55.6% less based on median consumption of 44,000 gpy. This exceeds both the Standard 850 predicted reductions and the WaterSense efficiency requirement of 30%.

## Influences on Water Use

While the results clearly show that WaterSense-labeled homes are saving water as intended, the study also offers several hypotheses about what external factors could be influencing water use outside of the product and design choices made to obtain the certification, as well as how likely they are to change water usage patterns over time.

## Potential Sources and Values for Baseline Consumption

| Source | Scope | Study Period, Results, and Notes | Average Household Value *1,000 gpy* |
|---|---|---|---|
| DeOreo 2016 | National | Stock housing monitored, 2013–2014 | 146 |
| SNWA | Greater Las Vegas area | New homes built, 2000–2003 | 129 |
| SNWA | Greater Las Vegas area | New homes built, 2008–2009 | 97 |
| SNWA | Greater Las Vegas area | New Water Smart homes built, 2008–2009 | 94 |
| USGS daily withdrawal data[a] | Clark County, Nev. | Domestic withdrawal estimate for 2015 includes all homes/residential water use in the area | 124[b] |
| Flume real-time residential water use monitoring | Greater Las Vegas area | All Flume water monitoring device users in the area, Oct. 2020–Sept. 2021 | 196 |

SNWA—Southern Nevada Water Authority, USGS—US Geological Survey

[a]Dieter et al. 2018

[b]The USGS provides estimates in gallons per capita per day (gpcd). Value is calculated on the basis of the USGS estimate of 123 gpcd.

**Table 8**

### Occupancy

The number of occupants has been shown in a variety of field studies to have a strong influence on household water consumption and specifically on indoor water use. Standard 850 estimates occupancy using the equation below:

$$\textit{estimated occupants} = 1.09 + (0.54 \times \textit{number of bedrooms})$$

This formula is regressed from the US Energy Information Administration's Residential Energy Consumption Survey. Since it is impossible to know how many residents will occupy a home over the course of its life, it's reasonable to base an estimate on physical attributes with a clear and describable relationship to occupancy, such as the number of bedrooms. However, market trends and demographics will cause any given set of homes to be comparatively under- or over-occupied.

To test whether the standard accurately predicted occupancy in this case, homebuyer survey data from builders were used. These surveys include occupant data from the homebuyers of communities where the homes were sold. While not available for every home, the surveys were used to create an average for each community, resulting in a more granular estimate of occupancy during the study period.

Average occupancy from the standard's prediction was 3.1 people/household, while average occupancy estimated from the builder survey data was only 2.7 people/household. This indicates that the standard is likely overpredicting occupants for this specific set of homes by approximately 0.4 people/household.

### Outdoor Water Use

Outdoor water use can be a large portion of overall household water use, particularly in an arid climate like Las Vegas. Several factors for homes in the data set might have influenced outdoor water use over the study period or could influence it in future years of operation. While separate indoor and outdoor metered water usage data were not available, it's important to consider how these factors could be influencing overall water use patterns.

In newly installed landscapes as seen in Photo 3, outdoor water use is expected to be higher during the establishment period. This may have been augmented during the study period as virtually all (>99% and frequently 100%) of the area was in a state of drought for the entire 12-month period, according to the US Drought Monitor.

Another potential effect on outdoor water consumption are changes to the landscape post-occupancy. As discussed, homes are required to have the front landscaping installed, but builders often leave the back unfinished/unimproved. Standard 850 includes an estimate based on the reference home's outdoor water use prediction, the size of the lot, the footprint of the house, and the landscape already installed for this unimproved area.

To further investigate this potential influence, aerial photographs obtained for a subset of 56 homes by SNWA were reviewed from various points over the course of the study period. As Table 9 summarizes, the results confirm that unfinished portions of the landscape persist long after homeowners take possession of the homes. This could help explain why the model's prediction for water consumption in the rated home is higher than the metered consumption, since the model assumes more landscaping than what is present for at least a portion of the study period.

However, the Standard 850 estimates for future landscape tend to be small. With an average of just over 500 square feet, it's unlikely that finished landscapes will result in a large increase in water use for these homes. Additionally, of the homes that could be confirmed as having fully finished landscaping, more than half (24 out of 37) used vegetation similar to the front, with no turfgrass. Only two homes could clearly be identified as having turfgrass installed, and both had less than 500 square feet. Only one property had added a swimming pool. Though several properties featured what appeared to be artificial turf, this is difficult to confirm with aerial imagery.

From the data available, it seems clear that unfinished landscapes may be responsible for some of the discrepancy between the rated home's modeled water use and the metered consumption. It may also be reasonable to expect metered consumption in the homes to rise slightly as more landscape is installed. Given that many of the homes have already been fully landscaped and the limited amount of space available at that time, it's unlikely that this explains all the difference or that water use will rise by a large amount.

Establishing a newly installed front landscape in a WaterSense-labeled home requires greater water use at first. *Photo credit: Jim Doyle/Applied Photography LLC, provided courtesy of KB Home*

**Photo 3**

**Homes With Fully Finished Landscapes Post-Occupancy**

| Duration of Occupancy *months* | Fully Finished Landscapes *%* |
|---|---|
| 3 | 12.5 |
| 6 | 42.9 |
| 9 | 58.9 |
| 12 | 66.1 |

**Table 9**

### Market Trends in Size of Homes

As noted during the Water Smart Homes program, lot size has a clear impact on overall consumption, with smaller lots using less water because of outdoor water demand. This relationship may be more pronounced in an arid environment and is clearly observed in the data set in Figure 2.

WaterSense-labeled homes are located on smaller lots than most homes in the area, with an average lot size of under 4,200 square feet. According to the 2017 American Housing Survey (AHS) from the US Census Bureau, 63% of homes in the Las Vegas–Henderson–Paradise Metropolitan Statistical Area had lots greater than 1/8 acre (5,445 square feet, the smallest lot size bucket in AHS). Additionally, WaterSense-labeled homes are relatively large for their lot size, with an average conditioned floor space of just over 2,100 square feet. AHS reported that 59% of homes on lots smaller than 1/8 acre were under 2,000 square feet of conditioned space. Older versions of the AHS confirm that lot sizes in the Las Vegas region have trended smaller as 70% of homes had lots greater than 1/8 acre in AHS 2013.

Building on smaller lots and maximizing square footage of the home while minimizing landscape is expected to reduce total water consumption, particularly in an arid environment. However, this is likely a result of market factors and not something that should be attributed to WaterSense certification.

Standard 850 adjusts predictions based on lot and home size, which minimizes the potential of a free-rider effect in smaller homes and lots (or homes that maximize conditioned area relative to lot size). Full assessment of

the effect of market trends and size on water consumption in homes independent of product and design features associated with the WaterSense certification would require a more recent baseline data set than the SNWA data collected on homes constructed in 2008–2009.

### The Pandemic

The study period for this pilot study was entirely contained within the COVID-19 pandemic, leading to the question of whether it's a fair representation of typical water use. Numerous reports, including one by Raftelis and Duke University researchers that was published in the November 2021 *Journal AWWA* (Smull et al. 2021) and looked at data from 11 water utilities across the United States, have found that residential water use in most utilities increased during the pandemic. While it's possible water use during the study period was unusually high, it doesn't seem to be a large enough influence to counteract the anticipated savings as the homes used less water than expected, not more. Continued analysis over time is needed to fully address this question.

## Future Research

This study shows the approach used to identify water-saving products and features in Standard 850 works, and WaterSense-labeled homes are saving at least as much water as intended. Currently the savings appear to be an average of 44,000 gpy per household, or a 45% reduction.

While several factors could be obscuring the impact of WaterSense-labeled homes by either increasing or decreasing water use in the data set, the data does not indicate that any of these influences are significant enough to profoundly change the observed water use patterns.

Several areas for future research were identified during this study. First, a broader data set would allow for better understanding of what is influencing water use patterns and what savings can reliably come from WaterSense-labeled homes. Important considerations for a larger data set would be diversity across the following:

- Builders
- Markets
- Climates
- Size
- Price point
- Features

Additionally, while all homes in this data set were certified by RESNET using Standard 850 to ensure homes met the 30% efficiency requirement, other WaterSense HCOs could use a different method to establish water use/savings. A broader range of HCOs would also be beneficial.

While the results indicate that Standard 850 could be overestimating water use in the rated home, this conclusion would be premature without additional analysis. In addition to a larger and more diverse data set, disaggregated data addressing individual end uses, or at least indoor versus outdoor water use, could be used to confirm any potential overestimates and inform future improvements in the model.

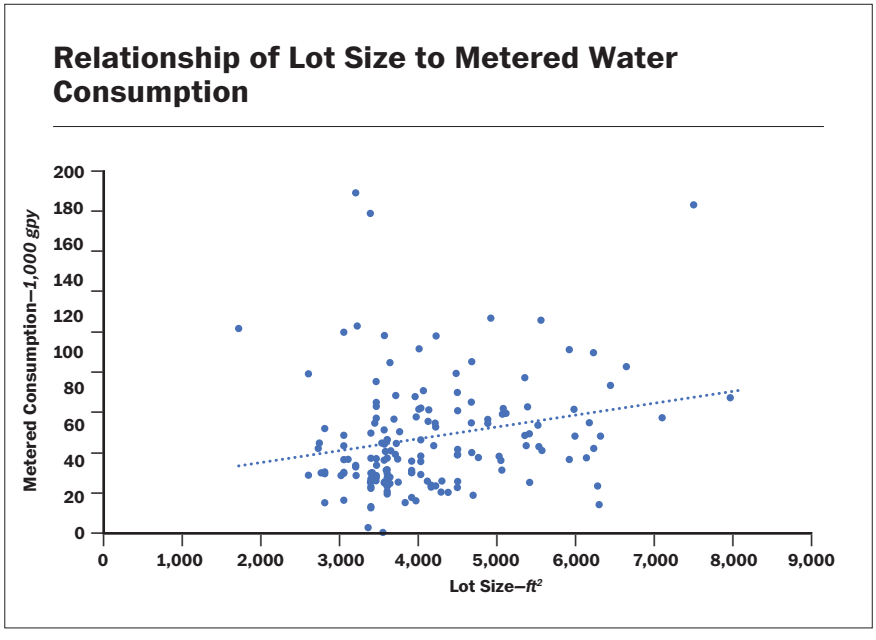


**Figure 2**

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