FLORIDA WATER STAR℠

ANNUAL WATER SAVINGS IN OSCEOLA COUNTY

10/31/2016

Measurement and Verification Report

UF | UNIVERSITY of FLORIDA
IFAS EXTENSION
Program for Resource Efficient Communities

This document was prepared for:

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OVERVIEW

Toho Water Authority (TWA) is the major public water utility in Osceola County, Florida. As it is throughout central Florida, population growth in the County is strong and is expected to increase demand for water. TWA is responsible for developing and implementing a strategic water supply plan for the area and conservation programs are an important component in the planning process.

The original Florida Water Star℠ (FWS) program (***http://floridawaterstar.com/***) was first developed in 2000 by the St. Johns River Water Management District (SJRWMD) with input from the University of Florida (UF). The program was launched in 2007, and the Southwest Florida Water Management District (SWFWMD) joined the effort in 2008 and South Florida Water Management District (SFWMD) in 2009. It continued to evolve iteratively under the primary leadership of SJRWMD into a well-tested, point-based certification program that seeks to reduce water consumption by setting efficiency standards for 1) indoor fixtures and appliances, 2) landscape design and 3) irrigation systems. In the residential Florida Water Star℠ (FWS) program, there are two residential criteria levels: Silver and Gold, Gold being the highest level. The homes in this study were built and certified at the Silver level, however it is possible that some of the owner-maintained homes meet the Gold level requirements of the Florida Water Star℠ (FWS) program.

In 2008, TWA began providing financial incentives for builders who agreed to comply with FWS standards in their new residential construction. In 2010, TWA began requiring, as a condition for connection to the public water supply system, that new subdivisions agree to design, build and certify all residential units to comply with the Florida Water Star℠ Silver level program. Because of the economic downturn the program started slowly, however by 2013, several new subdivisions in the TWA service territory were implementing the FWS program. In these subdivisions, 1,049 FWS certified homes have been built as of August, 2016 and another 3,301 parcels are identified for FWS certified residences to be built over the next few years. TWA staff review designs and inspect houses during construction in their utility service territory to certify compliance with the Silver level of FWS.

The TWA and the SJRWMD contracted with the University of Florida's Program for Resource Efficient Communities (PREC) to perform measurement and verification of water consumption savings for FWS certified homes in the TWA service territory. This study sought to evaluate water consumption of FWS certified homes compared to Non-FWS homes using an Annual Community Baseline (ACB) method. This document summarizes the results of a water consumption study with the following objectives:

1. Measure water savings for the Florida Water Star[SM] program as implemented in the TWA territory.
2. Measure indoor water savings of Florida Water Star[SM] owner-occupied and rental properties.
3. Measure outdoor water savings of Florida Water Star[SM] properties with owner-maintained and master-maintained landscapes.
4. Determine the likely impact of owner-occupancy and soil drainage classification on outdoor water savings of Florida Water Star[SM] properties.

Study Highlights

- Collectively, all homes built recently in the TWA territory use ~60kgal of water indoors and ~115kgal of water outdoors each year.

Indoor Water Savings

- Owner-occupied homes use about 7kgal/yr less water indoors than rental properties.
- Overall, homes in the study exhibited indoor water savings of 6.6% (4.1 kgal/yr) per year compared to similar homes in TWA service territory.
- Both owner occupied and rental properties designed to FWS standards showed water savings over the baseline of 6.9% (4.3kgal/yr) and 5.5% (3.5kgal/yr) respectively

Outdoor Water Savings

- Homes with owner-maintained landscapes used about 51 kgal/yr less water for irrigation than homes with master-maintained landscapes.
- Analysis for outdoor consumption revealed that master-maintained properties were also those on well drained soils with full irrigation, and owner-maintained properties were also those on poorly drained soils with no backyard irrigation – creating two distinct subgroups.
- FWS homes with owner-maintained landscapes achieved 39.1% (67 kgal/yr) savings for Year 2 of the study.
- FWS homes in neighborhoods with master-maintained landscapes use 64.3% (124 kgal/yr) more water than FWS homes with owner-maintained landscapes.
- Since Master-maintained properties accounted for 60% of the FWS housing stock in the study, this group is a key target for improving program performance.

Total Water Savings

- Extrapolating to the full FWS stock of 1,049 homes that were either built or under construction as of August 2016[2], a total daily indoor water savings of 11 kgal/day and a total daily outdoor water savings of 50 kgal/day was achieved. The projected total annual water savings for 1,049 currently in the FWS program[2] is 61 kgal/day or 22 million gallons per year.
- Based on the findings in this study, recommendations have been developed for awareness and education, planning and implementation, and further analysis.

Study Design

Data Collection

Physical characteristics of single-family residences throughout the TWA territory were obtained from the Osceola County Property Appraiser's (OCPA) office via the Computer-Assisted Mass Appraisal System (CAMA). These data included parcel location, lot size, year built, finished area, and other detailed information for individual residences. Soil classification data were obtained from the U.S. Department of Agriculture (USDA) via the Florida Geographic Data Library. Water consumption data (expressed in thousand gallons per year or kgal/yr) spanning January 1, 2014 through August 1, 2016 and associated utility location data were provided by TWA for metered single-family residences throughout their territory. Consumption data was aggregated for each meter on each property for two, 12-month periods: August 1, 2014 – July 31, 2015 (Year 1) and August 1, 2015 – July 31, 2016 (Year 2). In addition, TWA provided a listing of FWS certified properties and their relevant features including; 1) whether the home had full- or partial landscape irrigation and 2) whether the landscapes were maintained by the homeowner (owner-maintained) or by a contractor hired by the neighborhood homeowner's association (master-maintained). Key fields used in the analyses are identified in Table 1. Data from these sources were merged into a single table based on parcel number.

TABLE 1: DATA FIELDS USED

	Data Field Name	Source	Description
1	Property ID	TWA	Water service property ID
2	Year	Calculated	Annual year of consumption
3	N	Calculated	Number of meter readings during Year
4	Water Consumption	Calculated	Potable water consumption (kgal) by year for indoor or single-meter properties.
5	Potable Irrigation Consumption	Calculated	Potable water consumption (kgal) by year for irrigation
6	Reclaimed Irrigation Consumption	Calculated	Reclaimed water consumption (kgal) by year for irrigation
7	Outdoor Water Consumption	Calculated	Sum of Potable or Reclaimed Irrigation Consumption
8	Total Consumption	Calculated	Sum of Water, Irrigation, and Reclaimed Consumption
9	FWS	TWA	List of FWS certified home by subdivision and builder
10	FWS Characteristics	TWA	List of subdivisions that had no backyard irrigation, had master-maintained landscapes or were master-metered for landscape irrigation.
11	Lot Size	OCPA	Parcel size
12	Irrigable Area	Calculated	Lot Size converted to square feet, minus the sum of the home footprint and any extra property features (OCPA records)
13	Year Built	OCPA	Year property was built
14	Sale Date	OCPA	Date the house was sold by the builder to the residential owner
15	Finished Area	OCPA	Space conditioned area of the home (interior or living space)
16	Bedrooms	OCPA	Number of bedrooms in the home
17	Bathrooms	OCPA	Number of bathrooms in the home
18	Homestead Exemption	OCPA	Indicates if there is a Homestead exemption on the property (OCPA records)
19	Soil Drainage Class	Calculated	From USDA Soil Data, soils were grouped into categories for poorly-drained and well-drained soils based on Drainage Classification field.

FWS Subgroups

Indoor Water Use

Indoor water use varies based on efficiency of appliances and fixtures, number of occupants and occupant behavior. The FWS program guidelines directly address efficiency of appliances and fixtures to lower indoor water use but occupancy issues are beyond the scope of the program. Among

the FWS homes in the TWA service territory, there are two distinct categories for indoor water use: owner-occupied homes and rental properties. Owner-occupied homes are identified by the homestead tax exemption in the OCPA data. Homes without a homestead exemption are considered as rental, vacation or other short-term use properties. Due to the differences in indoor water use behavior (see Figure 1), the owner-occupied and rental subgroups were analyzed separately. We refer to these properties as "owner-occupied" and "rental" when describing the analysis and results for indoor water use in this report.

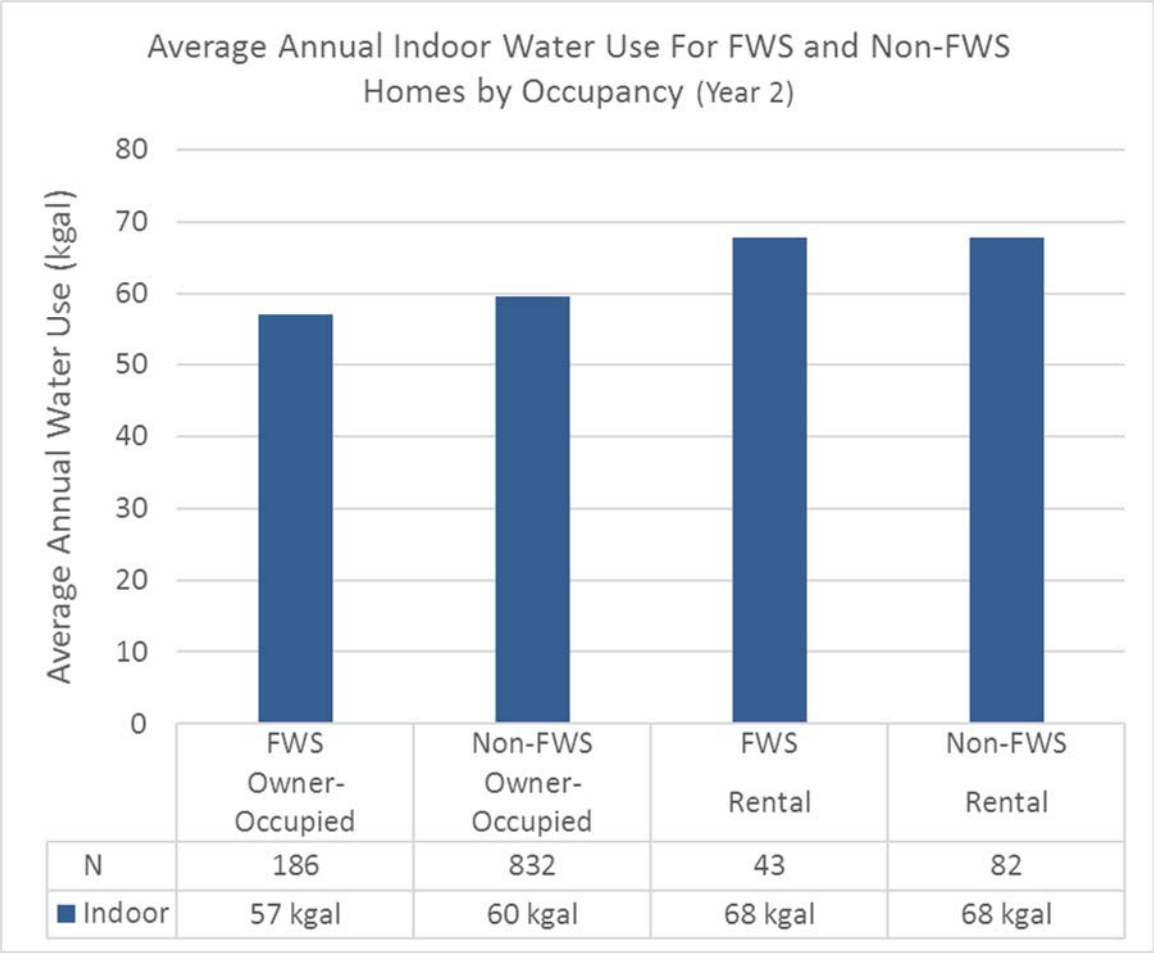

FIGURE 1: AVERAGE ANNUAL INDOOR WATER USE FOR FWS AND NON-FWS HOMES BY OCCUPANCY.

Outdoor Water Use

In reviewing the relevant features for outdoor water use in FWS homes, there were two distinct subgroups represented in the sample. The first group represents a typical scenario where the homeowner is responsible for maintaining the landscape on their property to comply with neighborhood standards. The homeowner is responsible for irrigation, fertilizing, mowing, etc. (and for paying the utility bill). We refer to these properties as "owner-maintained" when describing the analysis and results in this report. In this study, homes in the owner-maintained group are all built on "poorly-drained" soils, which is typical for the area. Ninety percent of the single-family, detached homes in the TWA service territory are built on soils that the USDA defined as "poorly-drained" (see Figure 2). A key defining characteristic of the FWS owner-maintained subgroup is that their properties only had partial irrigation systems, with no irrigation in the backyard area of the lot. Limiting installation of irrigation systems in the backyard portion of residential properties has been a

key focus of TWA staff that help to implement and enhance the FWS program in their service territory.

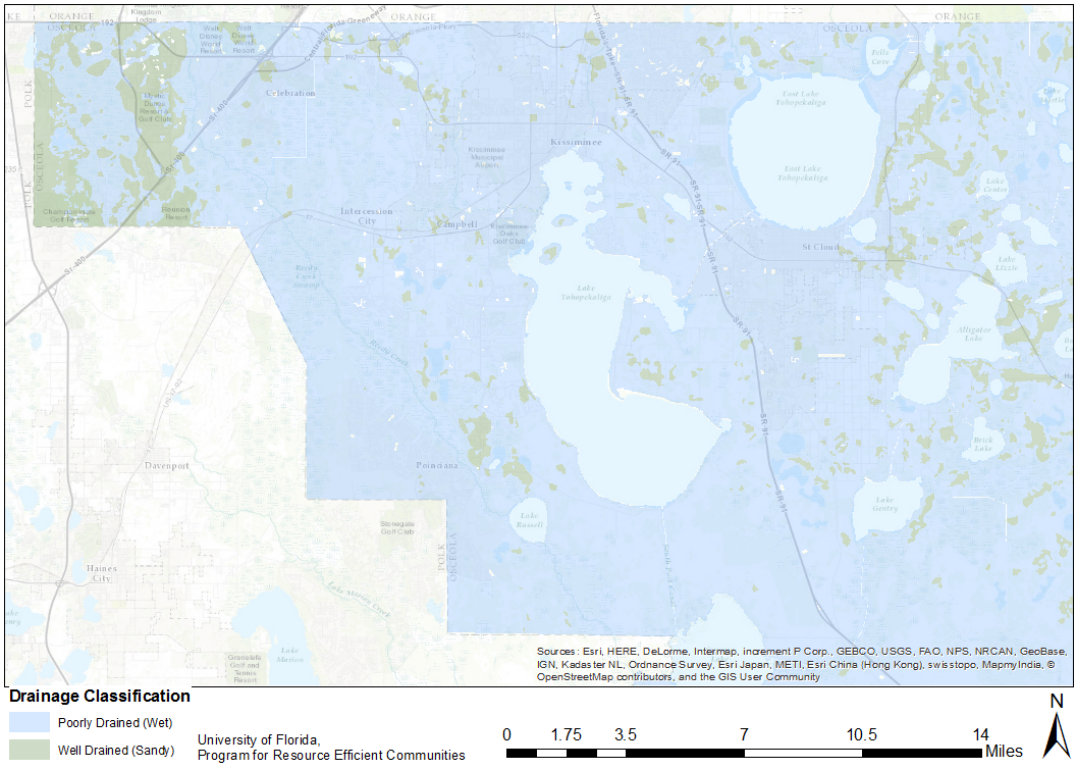

FIGURE 2: MAP OF SOIL DRAINAGE CLASSIFICATION FOR OSCEOLA COUNTY, FLORIDA.

The second group of FWS homes are in neighborhoods where the homeowner's association contracted for landscaping services for each home in the community. In this case, the landscaping contractor is responsible for irrigation, fertilizing, mowing, etc., while the homeowner pays the utility bill. We refer to these properties as "master-maintained" when describing the analysis and results in this report. Only ten percent of the single-family, detached homes in the TWA service territory are built on "well-drained" soils. All homes in the FWS master-maintained group are built on "well-drained" soils. Homes in the master-maintained group have full landscape irrigation, in the front- and backyards, and individual, lot-level irrigation controllers, as is typical of community developments in the area.

Figure 3 gives average annual outdoor water use for FWS and Non-FWS homes with owner-maintained and master-maintained landscapes. Average annual outdoor water use ranges from 67 kgal in FWS owner-maintained properties to 192 kgal in FWS master-maintained properties and shows a clear delineation between outdoor water use properties with owner-maintained and master-maintained landscapes. Due to the differences in landscape maintenance practices, soil types and annual consumption, outdoor water use was analyzed separately for the owner-maintained and master-maintained subgroups.

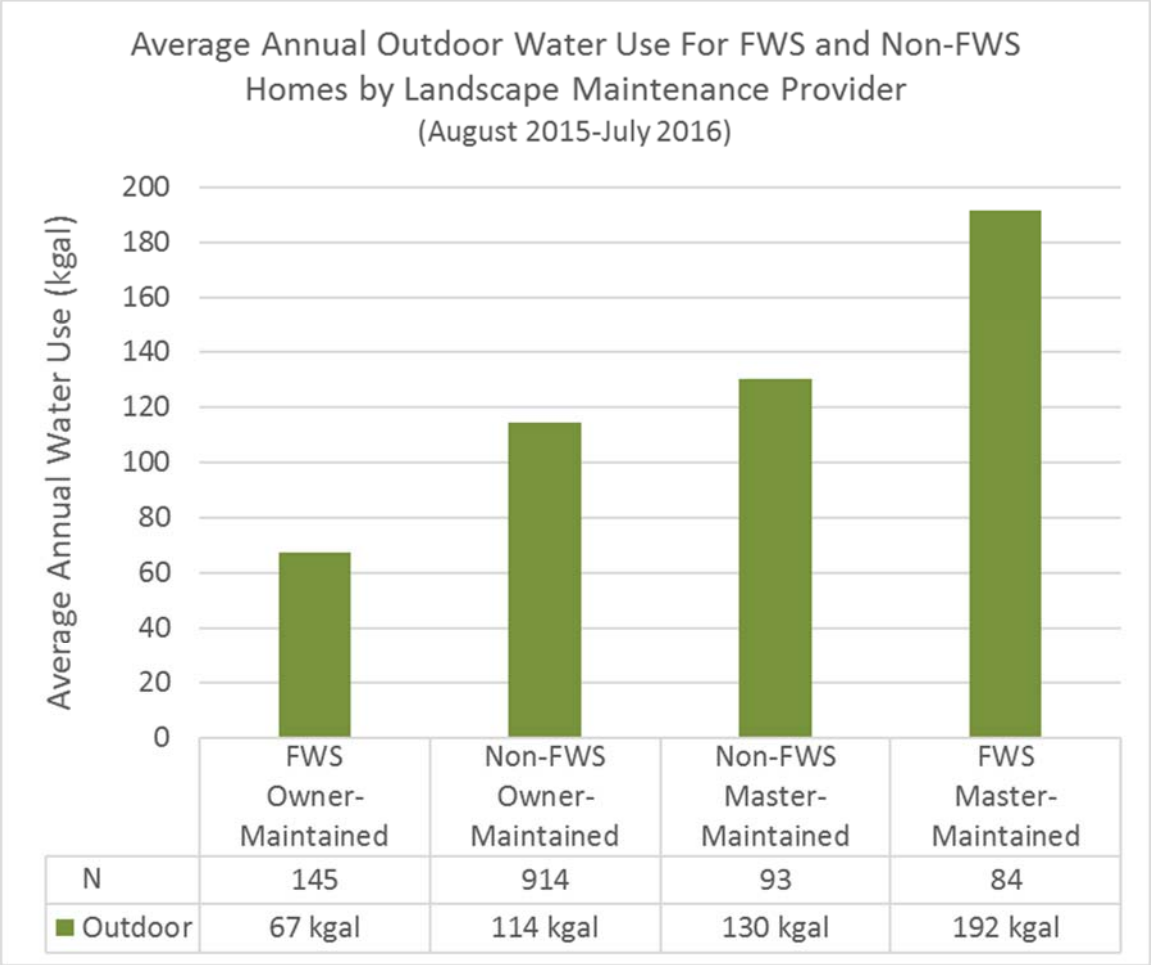

FIGURE 3: AVERAGE ANNUAL WATER USE FOR FWS AND NON-FWS HOMES BY LANDSCAPE MAINTENANCE PROVIDER.

Data Screening

The data was screened to ensure that comparable groups of consistently occupied homes are selected for each year of the analysis. The first screening step was to remove homes that were not sold and occupied before the beginning of each analysis period. The second step was to remove homes that did not have full, consistent indoor water consumption in each of the analysis periods. The third screening step was used to select appropriate comparison groups for both the FWS owner-maintained and FWS master-maintained subgroups. The Non-FWS population was selected to match the distributions for year built, number of bedrooms, finished floor area, and lot size for the FWS subgroups. TWA staff helped to identify master-maintained residential communities among the Non-FWS population to serve as a comparison group for the FWS master-maintained group. The fourth screening step was to remove outliers, and properties in the lowest 1% and highest 1% of annual indoor and outdoor water consumption, respectively. The final screening step was to omit any properties that did not have dual metering. Using only homes that are separately metered for indoor and outdoor water use (dual metered) allow for independent measurement of impacts on indoor water use and landscape irrigation.

There were 39 FWS homes, including only 1 FWS master-maintained home, that passed the screening criteria in analysis Year 1. Thirty-eight FWS owner-maintained properties were tested and the FWS

master-maintained was omitted in analysis Year 1. In analysis Year 2, the number of occupied FWS homes increased to 229, including 145 FWS owner-maintained and 84 FWS master-maintained homes. Table 2 summarizes the screening parameters and the resulting number of properties after each screening step for the FWS, Non-FWS, Owner-Maintained, and Master-Maintained subgroups in analysis Year 2. Figures 2 and 3 show average water consumption for each of the FWS and Non-FWS subgroups. Differences in consumption between the owner-maintained and master-maintained properties support the need for separate analysis of the FWS owner-maintained and FWS master-maintained subgroups.

TABLE 2: RESULTS OF SCREENING PROCESS AS EACH PARAMETER IS APPLIED FOR ANALYSIS YEAR 2.

<table>
<tr><td colspan="8">All TWA Single-Family Detached Homes
47,754</td></tr>
<tr><td colspan="8">The original set of single family detached residential TWA customers that could be matched to Osceola Property Appraiser data:</td></tr>
<tr><td colspan="4">Florida Water Star
1,049</td><td colspan="4">Non-FWS
46,705</td></tr>
<tr><td colspan="8">Step 1: Keep only houses with sale dates before August 1, 2015 - 2nd Year Analysis Period:</td></tr>
<tr><td colspan="4">607</td><td colspan="4">46,377</td></tr>
<tr><td colspan="8">Step 2: Keep only dual metered houses</td></tr>
<tr><td colspan="4">548</td><td colspan="4">10,771</td></tr>
<tr><td colspan="8">Step 3: Keep only houses with consistent consumption records</td></tr>
<tr><td colspan="4">325</td><td colspan="4">7,149</td></tr>
<tr><td colspan="8">At this point in the data preparation, different screening criteria were applied to outdoor water consumption for properties with Owner-Maintained landscapes and properties with Master-Maintained landscapes.</td></tr>
<tr><td colspan="4">Step 4: Screen building characteristics to keep only houses with:
Year Built 2013-2015
Bedrooms 2-5
Finished Area 1,500-4,000 sqft
Lot Size .09-.5 acres</td><td colspan="4">Step 4: Screen building characteristics to keep only houses with:
Year Built 2000-2015
Bedrooms 2-5
Finished Area 1,500-4,000 sqft
Lot Size .09-.5 acres</td></tr>
<tr><td colspan="3">Florida Water Star
147</td><td>Non-FWS
930</td><td>Florida Water Star
85</td><td colspan="3">Non-FWS
96</td></tr>
<tr><td colspan="4">Step 5: Remove upper and lower 1% of Indoor water users and remove upper and lower 1% of Outdoor water users as outliers:</td><td colspan="4">Step 5: Remove upper and lower 1% of Outdoor water users as outliers:</td></tr>
<tr><td colspan="2">Owner-Occupied
186</td><td colspan="2">Rental
43</td><td>Owner-Occupied
832</td><td>Rental
82</td><td colspan="2" rowspan="2">Master-Maintained</td></tr>
<tr><td>Owner-Maintained</td><td>Master-Maintained</td><td>Owner-Maintained</td><td>Master-Maintained</td><td colspan="2">Owner-Maintained</td></tr>
<tr><td>129</td><td>57</td><td>16</td><td>27</td><td colspan="2">914</td><td>84</td><td>93</td></tr>
</table>

ANALYSIS METHODS

Annual Community Baselines

Single-family, detached homes that met the screening criteria were used to create ACBs[1] of indoor water consumption and outdoor water consumption in each analysis year. The ACB method uses a multivariate regression to baselines of consumption for properties with similar features. The ACB for indoor water consumption was created using building characteristics as independent variables ["Finished Area" (15), "Bedrooms" (16), "Bathrooms" (17) and "Year Built" (13)] and indoor "Water

[1] Jones, P. H., Taylor, N. W., Kipp, M. J., & Knowles, H. S. (2010). Quantifying household energy performance using annual community baselines. International Journal of Energy Sector Management, 4(4), 593–613. ***http://dx.doi.org/10.1108/17506221011092797***

Taylor, N. W., Jones, P. H., Searcy, J. K., & Miller, C. R. (2014). Evaluating ten years of energy performance of HERS-rated homes in Alachua County, Florida. Energy Efficiency. ***http://doi.org/10.1007/s12053-013-9251-5***

Consumption" (4) as the dependent variable. The ACB for outdoor water consumption was created using "Irrigable Area" (12) of the property and "Year Built" (13) as the independent variables and the annual "Outdoor Water Consumption" (7) as the dependent variable.

Consumption Performance

Indoor consumption performance was calculated as the difference between each individual house's measured "Water Consumption" (4) and its corresponding projected ACB consumption. Likewise, outdoor consumption performance was calculated as the difference between measured "Outdoor Water Consumption" (7) and its corresponding projected ACB consumption. Consumption performance is a measure of how much water each home has used compared to similar homes and serves as a water savings value for each home.

Testing Subgroups

Annual indoor- and outdoor- consumption performance were tested between FWS subgroups and their respective comparison groups from the Non-FWS population using an analysis of variance (ANOVA) to measure average savings and statistical significance. The primary purpose of this study was the comparison of FWS homes to Non-FWS homes. Two subgroups of FWS homes were tested to determine average indoor water savings: 1) owner-occupied homes and 2) rental/vacation homes; and two FWS subgroups were tested to determine outdoor water savings: 1) owner-maintained landscapes and 2) master-maintained landscapes.

Results and Discussion

Indoor Water Savings

Indoor water savings were calculated for all FWS homes as well as for two subgroups of FWS homes; 1) owner-occupied homes and 2) rental/vacation homes. Figure 4 shows average annual indoor water savings for the analysis period between August 2015 and July 2016 and the adjoining table gives the number of homes, average annual consumption, relative savings (%), and absolute savings (kgal/yr).

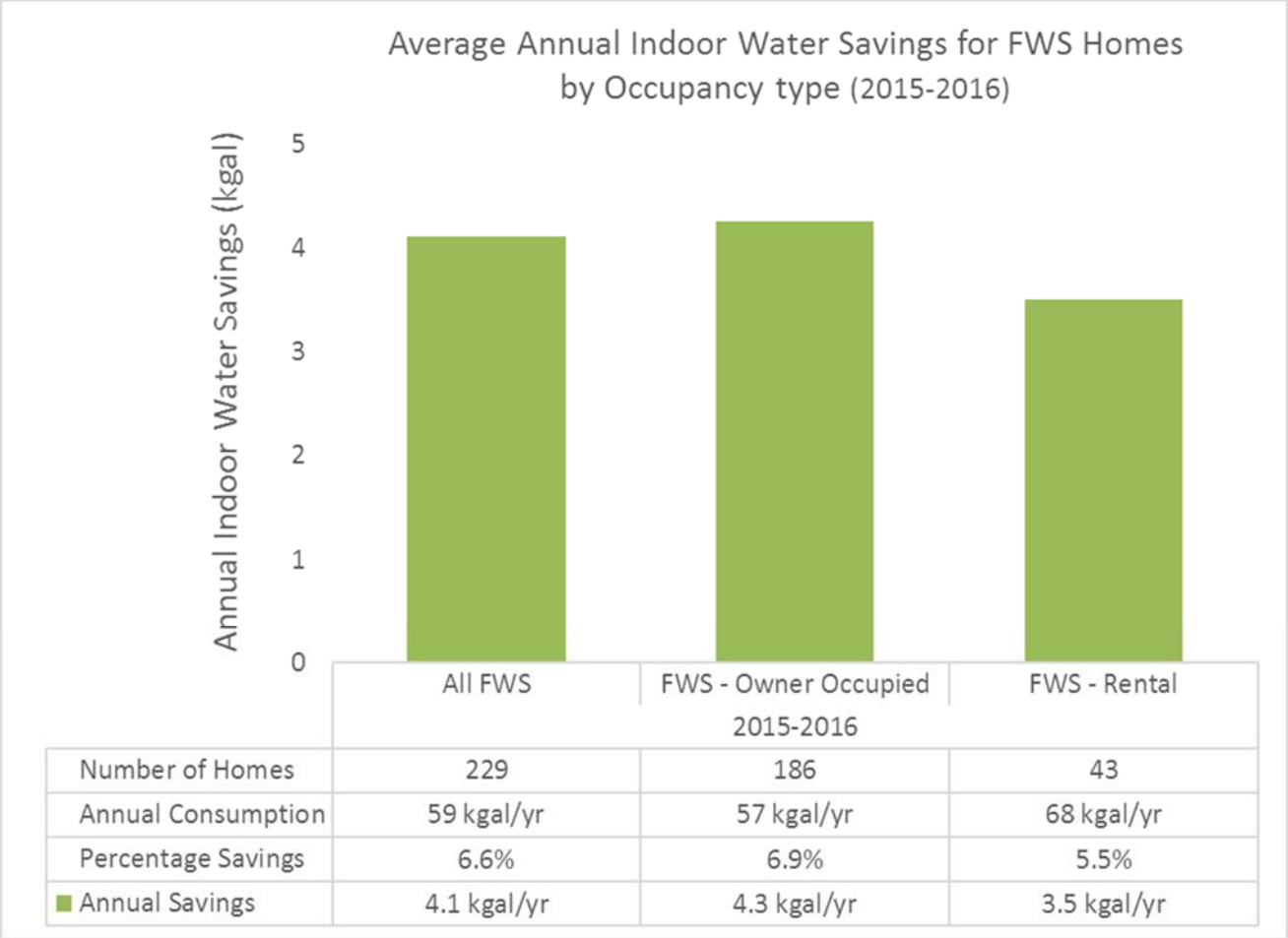

FIGURE 4: AVERAGE ANNUAL INDOOR WATER SAVINGS FOR FWS HOMES BY OCCUPANCY TYPE.

Average annual savings for indoor water use among 229 FWS homes tested was 4.1 kgal/yr (6.6%). The owner-occupied FWS subgroup saved 4.3 kgal/yr compared to similar, Non-FWS homes. While average savings was similar in the rental FWS subgroup (3.5 kgal/yr – 5.5%), the number of homes in the subgroup was small, resulting in lower statistical confidence in the savings estimate. The findings do, however, indicate that among a larger group of rental properties, the FWS program may achieve savings comparable to those seen in owner-occupied FWS homes. Annual indoor water savings found in this study are about 36% lower than modeled indoor water savings for FWS based on Environmental Protection Agency (EPA) WaterSense and EPA Energy Star estimates (see Table 3).

There are three potential reasons why actual indoor savings do not match model predictions. The first reason is that many of the modeled savings estimates are based on replacement of an old appliance with a new, more efficient model. This study compares groups of newly constructed homes where efficiency gains for appliances and fixtures are lower. The second explanation for indoor water savings that are lower than modeled savings is that the people are using appliances and fixtures less than was anticipated in the modeled scenarios (i.e., shorter showers or less loads of laundry). The third reason that the measured indoor water savings do not match modeled savings estimates is that some Non-FWS builders likely install low-flow toilets, low-flow faucets, and Energy Star appliances as standard practice. This study measures water use performance of FWS homes against current building practices in the TWA service territory. The purpose of programs like WaterSense, Energy

Star and Florida Water Star℠ is to promote efficient technologies and techniques that improve standards of practice across the building industry and measurably reduce water use.

TABLE 3: MODELED INDOOR WATER SAVINGS FOR FWS BASED ON EPA WATERSENSE AND EPA ENERGY STAR ESTIMATES.

FWS Indoor Water Savings – Per EPA Water Sense and Energy Star Estimates	
	Gallons Saved per Year
Energy Star Clothes Washer	3,000
Energy Star Dishwasher	160
WaterSense Toilet	1,200
WaterSense Showerhead	1,800
WaterSense Faucets	400
Annual Savings	6,560

Outdoor Water Savings

Water used outdoors, for landscape irrigation, accounts for nearly 65% of the total water used on residential properties. For this study, outdoor water use was measured for two distinct subgroups of FWS homes with; 1) owner-maintained landscapes and 2) master-maintained landscapes. Comparable Non-FWS homes were selected for each subgroup using the criteria detailed in the "Data Screening" section.

FWS Owner-Maintained Properties

Owner-maintained properties are those where the homeowner is responsible for irrigation, fertilizing, mowing, etc. and for making sure that the landscape is in compliance with neighborhood standards. In addition to irrigation system efficiencies required by FWS standards, FWS owner-maintained homes in this study also reduced outdoor water consumption by having no high-volume irrigation in the backyard of the lot. FWS owner-maintained properties were tested against comparable owner-maintained, Non-FWS properties built between 2013 and 2015. Figure 5 shows average annual outdoor water savings for FWS homes with owner-maintained landscapes in analysis Year 1 (August 2014-July 2015) and Year 2 (August 2015-July2016) and the adjoining table gives the number of homes, average annual consumption, relative savings (%), and absolute savings (kgal/yr).

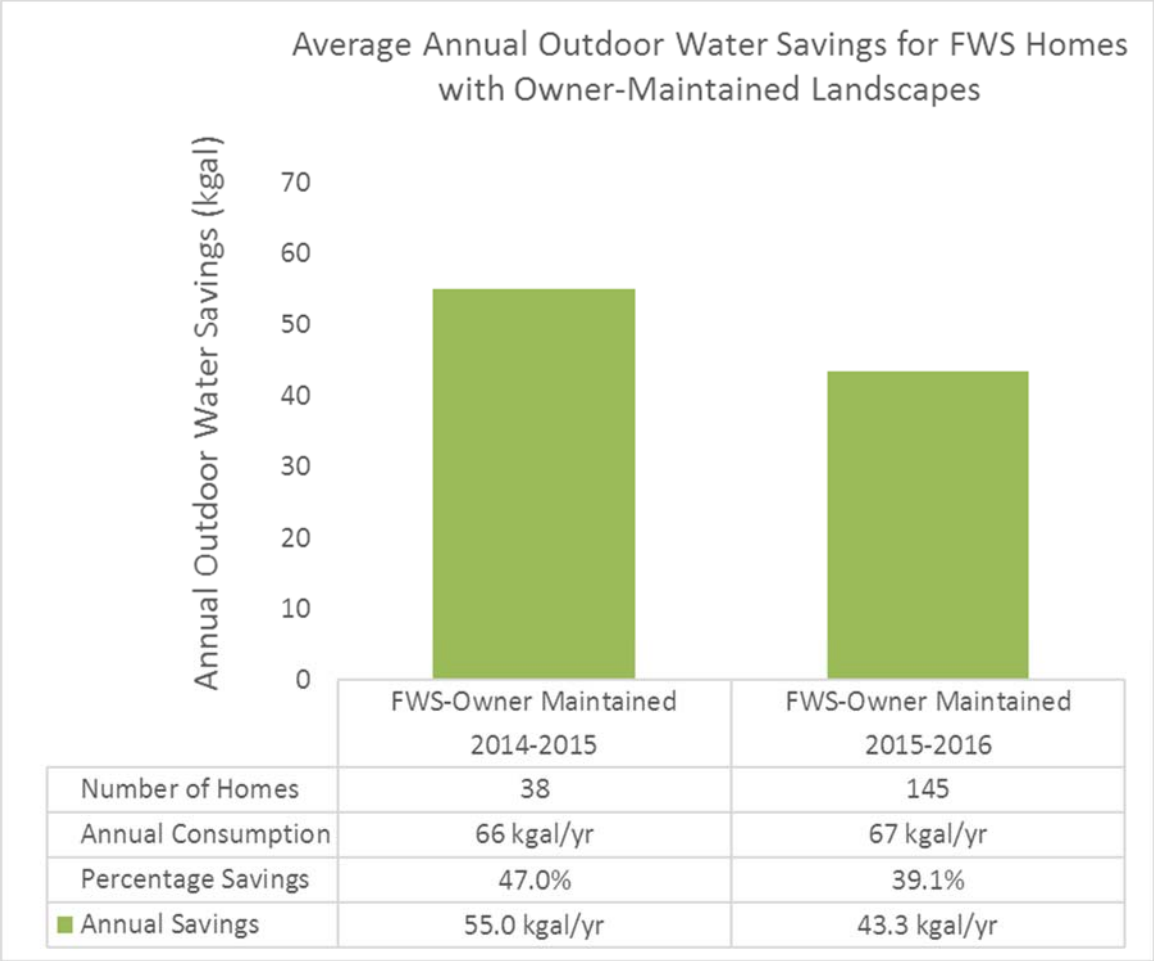

FIGURE 5: ANNUAL OUTDOOR WATER SAVINGS FOR FWS HOMWS WITH OWNER-MAINTAINED LANDSCAPES.

Owner-Maintained FWS homes used 55 kgal (47%) less outdoor water in Year 1 and 43 kgal (39.1%) less outdoor water in Year 2 than comparable Non-FWS homes. Outdoor water savings for both analysis periods are highly statistically significant indicating a strong trend in outdoor water savings that is likely to continue in FWS homes with owner-maintained landscapes in the TWA service territory. Reducing the amount of high-volume irrigation on a lot is likely a strong contributor to this savings.

FWS Master-Maintained Properties

Master-maintained properties are part of a neighborhood scale approach to landscape maintenance where the homeowner's association contracts for landscaping services for all homes in the community. The landscaping contractor is responsible for irrigation, fertilizing, mowing, etc., in order to meet neighborhood standards. There were no master-maintained properties, besides the FWS subgroup, built in the TWA service territory between 2013 and 2015, so the range of vintages for comparable homes had to be expanded. FWS master-maintained properties were tested against comparable master-maintained, Non-FWS properties built between 2001 and 2010. Figure 6 shows average annual outdoor water savings for FWS homes with master-maintained landscapes in analysis Year 2 (August 2015-July2016) and the adjoining table gives the number of homes, average annual consumption, relative savings (%), and absolute savings (kgal/yr). The number of master-maintained FWS homes grew from one in Year 1 (omitted from study) to 84 in Year 2. Results in Figure 6 show

that master-maintained FWS properties used an average of 26.7 kgal/yr (23.7%) more water than comparable, Non-FWS master-maintained properties.

This was an unexpected result given the savings seen in other FWS consumption analyses. The predominant factor affecting the variation in water use efficiency appears to be whether or not a community is centrally (master) controlled and metered. Master controlled irrigation has the important advantage of significant time savings in adjusting watering schedules and patterns compared to individually controlling irrigation at each property. Master metering vs. individual metering can also affect water use efficiency. A master metered community will realize the consumption patterns (and potential savings) as a whole more rapidly, whereas individually metered community presents the necessary of obtaining and comparing usage for each individual property and periodically adjusting. The master-maintained homes in the study did not have master metering or control, therefore, the advantages of centralized maintenance of schedules and watering patterns were not available. Current best practice is to employ master controller and metering for master-maintained communities to increase efficiency. Other factors for the observed higher than average consumption are likely present and more investigation may be necessary to confirm and consider other contributory factors resulting in variation. We hope to see more investigation on this matter in the future.

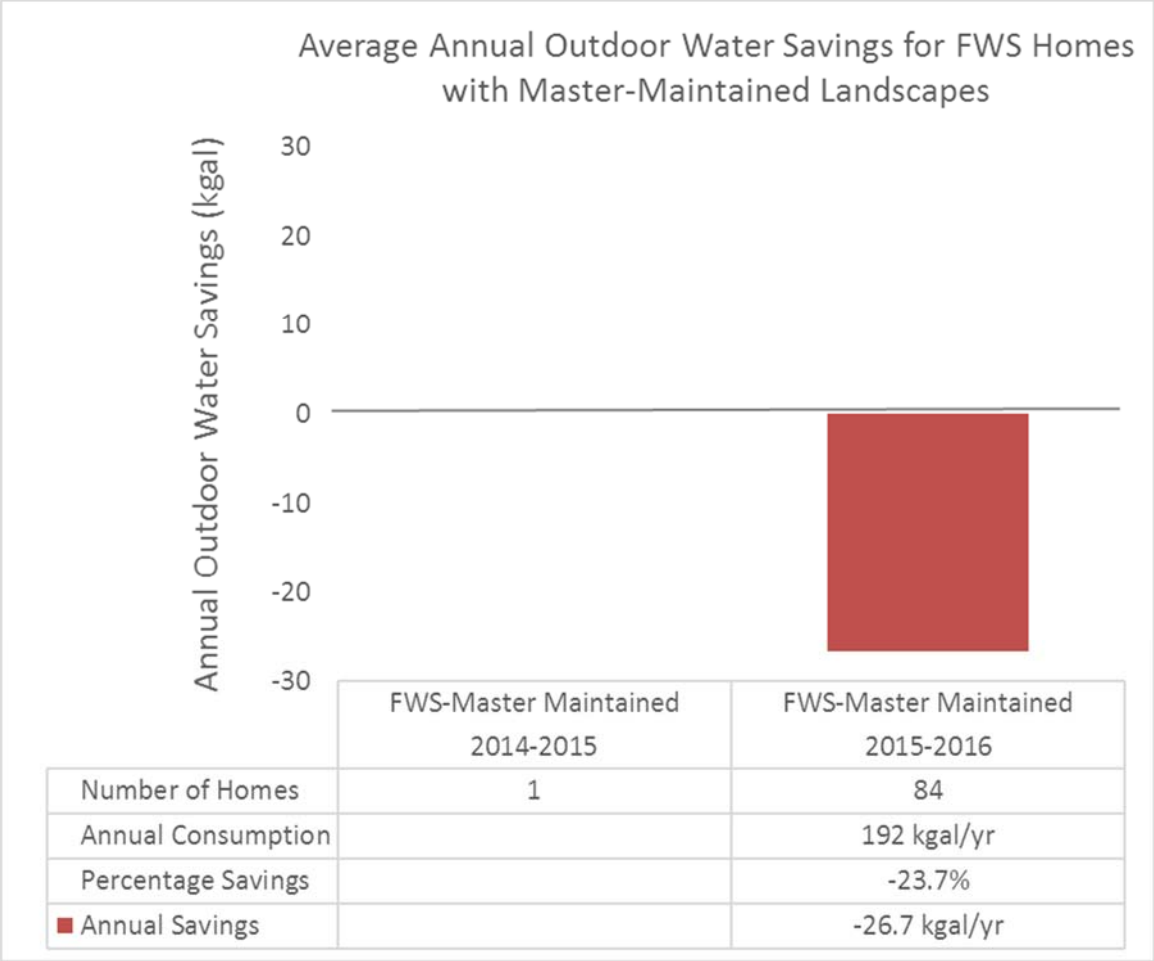

FIGURE 6: AVERAGE ANNUAL OUTDOOR WATER SAVINGS FOR FWS HOMES WITH MASTER-MAINTAINED LANDSCAPES.

Owner-Occupancy

The relationship between owner occupancy and outdoor water use was tested within the owner-maintained and master-maintained subgroups. Analysis resulted in no statistical difference between outdoor water use for owner-occupied and rental properties. The occupancy (owner-occupied or rental) of an FWS property is beyond the scope of the FWS program framework and beyond the control of builders who are required to comply. The finding of no statistical difference indicates that owner-occupancy or rental use of FWS properties is unlikely to impact overall program savings for outdoor water use.

Soil Types

Soil drainage was investigated as a potential driver of increased water use for properties on sandy, well-drained soils. Given the constraints of the FWS study population, with all FWS master-maintained homes on well-drained soils and all FWS owner-maintained homes on poorly drained soils, no reasonable comparison could be made regarding the impact of soil types on water savings in FWS homes. However, in comparing Non-FWS homes (built between 2013 and 2015) on poorly-drained and well-drained soils there was no statistical difference in outdoor water use. The finding of no statistical difference for Non-FWS homes indicates that soil type is not likely to be a major driver of water use and related water savings in FWS homes.

Total Water Savings

Results of this analysis can be applied to the larger population of FWS homes to estimate program-level savings resulting from the implementation of the FWS program in the TWA service territory. When results are extrapolated to the larger population of FWS homes[2] that sold prior to August 2016, total indoor water savings of 6.5 kgal/day and total outdoor water savings of 28 kgal/day was achieved. Extrapolating to the full FWS stock of 1,049 homes that were either built or under construction as of August 2016[2], a total daily indoor water savings of 11 kgal/day and a total daily outdoor water savings of 50 kgal/day was achieved. The projected total annual water savings for 1,049 currently in the FWS program[2] is 61 kgal/day or 22 million gallons per year.

CONCLUSIONS AND RECOMMENDATIONS

Indoor water savings were consistent across the owner-occupied and rental subgroups in analysis Year 2, averaging 4.1 kgal/yr (6.6%) across the full FWS test group. Outdoor water savings in owner-maintained FWS properties averaged 45.7 kgal/yr across both analysis periods, indicating a strong trend in outdoor water savings that is likely to continue in the FWS homes with owner-maintained landscapes. The owner-maintained homes are responsible for most of the aggregate FWS program savings in the TWA service territory to date and provide a firm foundation for continued program development.

Having landscape professionals control irrigation systems has been presumed by many to result in more efficient operation and lower outdoor water use. Results from this analysis show that master-maintained FWS properties used an average of 26.7 kgal/yr (23.7%) more water than comparable, Non-FWS, master-maintained properties. In addition, FWS master-maintained homes used an average of 124 kgal/yr more water for landscape irrigation than the FWS owner-maintained group. Master-maintained homes accounted for 36% of the FWS homes used in this study. As of August 2016, master-maintained homes accounted for 60% of the FWS housing stock in the TWA service territory, providing a significant target for program improvement.

Awareness and education play a key role in the success of most conservation programs. Additional training for utility staff involved with program implementation, land developers, home builders, building sub-contractors, landscape maintenance professionals, homeowner's association representatives, and homeowners can help to maximize water savings in the Florida Water Star^{SM} program. Specific recommendations for awareness and education include:

- All utility staff involved with FWS program implementation complete Florida Water Star Certifier training.
- Recommend to builders and homeowner's associations that all landscape sub-contractors attend the Florida Water Star Accredited Professional training.
- Homeowner's association representatives should become familiar with requirements of the FWS program and efficient operation of irrigation systems.

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[2] Extrapolated result excludes outdoor water savings for master-maintained properties.

- Engage with the Florida Friendly Landscape program and UF / Institute of Food and Agricultural Sciences Extension to offer homeowner landscaping training.

Recommendations for planning and implementation with builders and developers include:

- Work with developers to include language in Community Covenants and Restrictions requiring irrigation systems remain as designed to maximize long-term water savings.
- For communities that engage contracted landscape services for master maintenance programs, ensure operating efficiencies that protect water savings by planning for master controlled and master metered irrigation systems.
- Ensure ongoing communication with builders prior to commencement of their projects to ensure that all landscape, irrigation and indoor specifications are pre-approved.

In addition to education and awareness, and planning and implementation recommendations, continued monitoring, performance tracking and analysis can help to identify strengths and weaknesses for continued program enhancement. Specific recommendations for data driven monitoring and analysis include:

- Track and trend water use in all FWS homes and provide reports of trends in water use to property managers showing progress toward meeting goals.
- Ongoing annual analysis to further explore program impacts and areas for programs improvement, especially in relation to factors that raised questions in outdoor consumption:
    - Further analysis of impacts of water savings on well drained soils vs poorly drained soils
    - Analysis into the different configurations of master-maintained properties:
        - centrally controlled vs individual controlled
        - master metered vs individually metered
- Develop a water budget approach that effectively creates an incentive for appropriate water usage.

In the TWA service territory, 1,049 FWS certified homes have been built to date and another 3,301 parcels are identified for FWS certified residences to be built over the next few years. Study findings and recommendations included in this report can help to significantly increase the impact of the Florida Water Star℠ program for Toho Water Authority.