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SOLANO WATER

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Single-Family Residential Water Use and Conservation Potential Pilot Study

Solano County Water Agency

February 2016

EKI B50067.00

Prepared by:

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Consulting engineers and scientists

SINGLE-FAMILY RESIDENTIAL WATER USE AND CONSERVATION POTENTIAL PILOT STUDY

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TABLE OF CONTENTS

TABLES

FIGURES

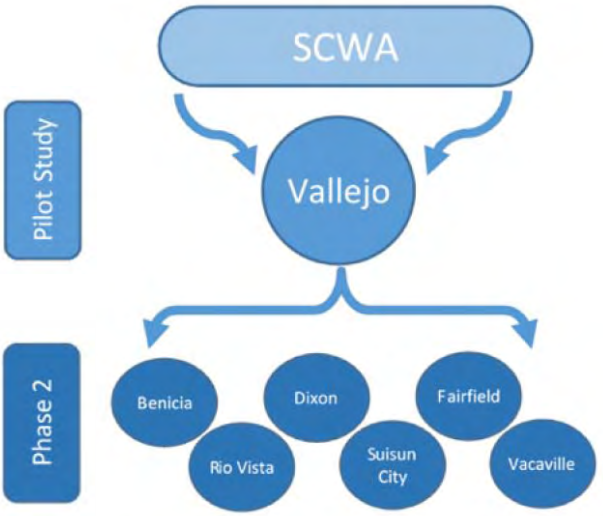
TABLE OF CONTENTS (Continued)

APPENDICES

EXECUTIVE SUMMARY

This report documents the results of the *Single-Family Residential Water Use and Conservation Potential Pilot Study* ("Pilot Study") that was conducted on behalf of Solano County Water Agency ("SCWA"). The objective of this study was to assist SCWA in gaining a greater understanding of single-family residential ("SFR") water use throughout the SCWA service area, evaluate the effectiveness of SCWA's water conservation programs, and identify remaining water conservation potential in the SFR sector.

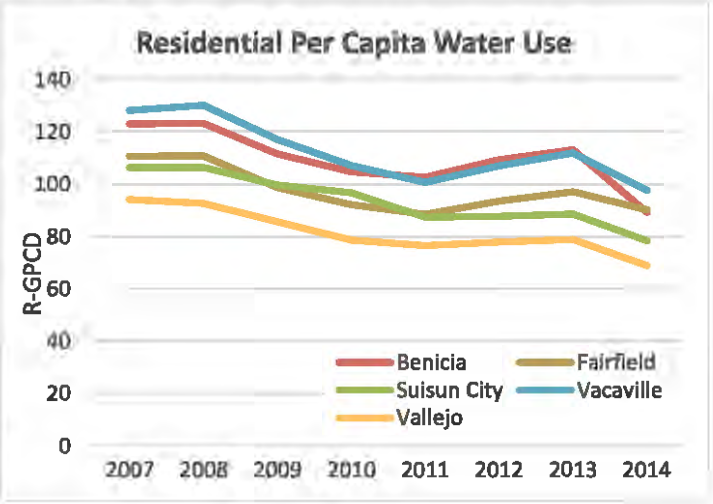
This Pilot Study first presents a high-level overview of SCWA's water conservation programs – High-efficiency ("HE") Toilet Rebates, HE Washer Rebates, Turf Replacement Rebates, Residential Water Use Surveys, and Smart Irrigation Controller Rebates – and their implementation across the seven cities (or "member units") served by SCWA: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo. The study then focuses on an analysis of individual water conservation program impacts, benefits, and opportunities within the City of Vallejo, which was selected as the subject of this Pilot Study. As illustrated by the graphic to the right, it is anticipated that, based upon the results of this Pilot Study, a similar focused analysis will be conducted in the future for additional member units, and potentially across other water use sectors, within the SCWA service area.



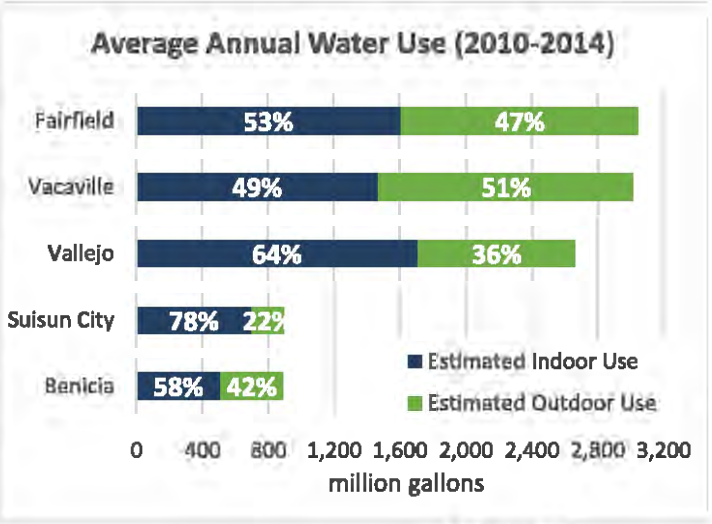
An introduction to the Pilot Study, including the study's goals and objectives, is provided in Section 1 of this report. The SCWA service area and characteristics are described in Section 2. The findings of the Pilot Study are addressed in Sections 3 through 7, and summarized below.

Member Unit Water Use Profiles

The demographics and water use profiles of the seven SCWA member units were evaluated, and to the extent that data were available, water use was summarized in terms of water use by sector, SFR monthly indoor and outdoor consumption, and annual total and per capita consumption for residential accounts.



Key findings based on these water use profiles include:



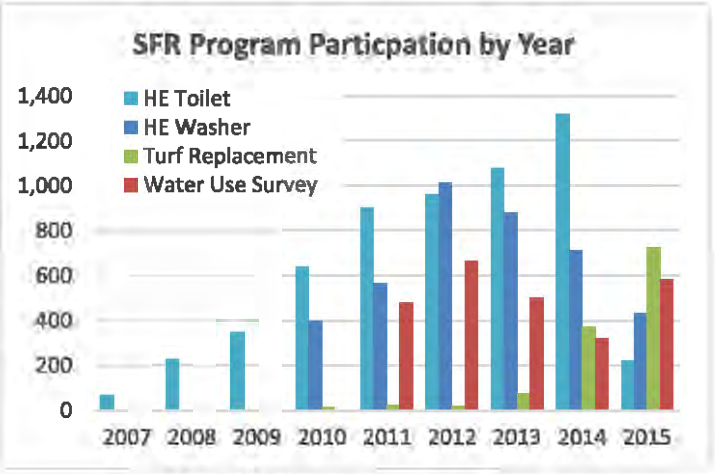
- Although water demand by SFR customers has generally declined over the last ten to fifteen years, the SFR sector uses the most water within each member unit, ranging from approximately 49% in Fairfield to 82% in Dixon.
- Monthly SFR consumption was highest in the summer and fall. The Cities of Benicia, Fairfield, and Vacaville tend to experience the greatest seasonal variability in SFR water use, likely linked to landscape irrigation.
- Residential per capita water use in 2014 ranged from approximately 69 gallons per capita per day ("R-GPCD") for Vallejo to 98 R-GPCD for Vacaville.
- In response to the historic drought of 2012-2015, each member unit has reduced its R-GPCD significantly relative to use in 2013. These reductions range from 36% in Benicia to 22% in Vallejo. As of June 2015, six member units have achieved greater savings than the target conservation goals set by the State Water Resources Control Board ("SWRCB") in accordance with Executive Order B-29-15; Rio Vista's service area fell short of its 36% conservation standard by 4.3% (SWRCB, 2016).

Water Conservation Program Participation by SFR Accounts

This Pilot Study evaluated participation by SFR accounts in the water conservation programs administered by SCWA on a County-wide basis and at more detailed level in the City of Vallejo, as the focus of the Pilot Study. Across the SCWA service area, more HE toilet rebates have been issued to SFR accounts than any of the other SCWA rebate programs. The Turf Replacement Rebate Program has seen increasing participation since 2013, while participation in the HE Washer Rebate Program has been declining since 2012. Participation in the HE in the Residential Water Survey Program has shown some decline from 2012 through 2014, with an increase in participation in 2015; it should be noted that the highest

SFR Conservation Program	Program Implemented	Total Number of Interventions	Estimated Annual Water Savings
HE Toilet Rebates	2007 – Jan. 2015	5,764	52.5 million gal.
HE Washer Rebates	2007 – present	3,997	34.5 million gal.
Turf Replacement Rebates	2013 – present	1,235	23 million gal.
Residential Water Use Surveys	2011 – present	2,554	67 million gal.
Smart Irrigation Controller Rebates	2011 – present	15	n/a

residential water users in the County are specifically targeted for participation in this program.



Review of the program participation in the City of Vallejo revealed several trends, including lower-than-expected participation in HE Toilet and HE Washer Rebate Programs in some of the older areas of the city, which are more likely to have older, less efficient fixtures and therefore be prime candidates to participate in these programs. This analysis also identified distinct clusters of participation in the Turf Replacement Rebate Program, which may indicate evidence of the public outreach and educational aspects of the turf replacement programs (i.e., the "neighbors seeing neighbors" effect).

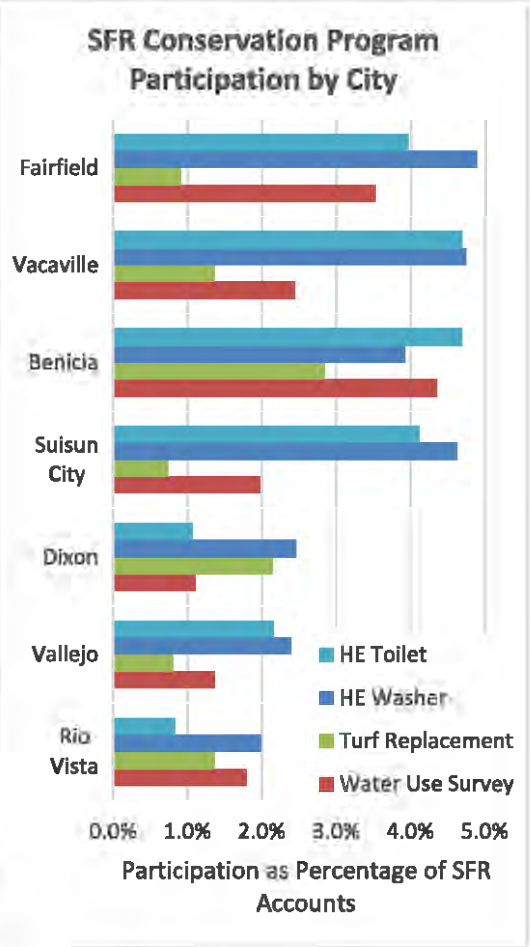
Water Conservation Program Effectiveness and Opportunities – City of Vallejo

The amount of water savings resulting from participation in each of the SCWA's major water conservation programs was estimated by comparing water use by conservation program participants in Vallejo to that of representative cohorts for periods before and after participation in a given program. Based on the results of this analysis, participation in water conservation programs by Vallejo SFR water customers resulted in significant and measurable water savings, as shown in the table below.

The analysis of the remaining water conservation potential within Vallejo's SFR sector suggests that the markets for the SCWA conservation programs within Vallejo are not yet saturated and that there are significant opportunities to continue and expand water conservation programs within the city. Specifically, as shown in the above table, based on the current information regarding program participation, housing age, and historical water use, it is estimated that up to an additional 37 million gallons per year could be saved through toilet change-outs and up to 69 million gallons per year could be saved by increasing

SFR Conservation Program	Estimated Annual Water Savings Per Account	Rebate Cost per 100 Gallons of Water Saved	Remaining Conservation Potential
HE Toilet Rebates	10,000 - 19,000 gal.	$0.06 - $0.10/100 gal.	37 million gal./year
HE Washer Rebates	7,500 - 9,800 gal.	$0.10 - $0.11/100 gal.	40 million gal./year
Turf Replacement Rebates	18,700 gal.	$0.40/100 gal.	69 million gal./year
Residential Water Use Surveys	20,900 - 31,500 gal.	n/a	60 million gal./year

participation in the Turf Replacement Rebate Program. Based on current levels of program participation across the SCWA service area (i.e., typically less than 5% of SFR accounts, as shown in the chart to the right), similar results are expected across the other member unit cities.



Based on rebate costs and measured water savings, the HE Toilet and HE Washer Rebate Programs have been the most cost effective of the water conservation programs implemented to date by SCWA. However, when considering which programs to support on a going-forward basis, there are additional factors to consider regarding overall program cost-effectiveness and success, including changes to plumbing code that diminish the impact of fixture rebate programs and the public education and outreach benefits associated with a highly visible program such as turf replacement.

Recommendations and Next Steps

The findings of the Pilot Study indicate that the SFR water conservation programs that SCWA has implemented in Vallejo have resulted in a significant and measurable amount of water savings and that additional water conservation potential remains. Given the results of this analysis, potential programs and actions that SCWA may consider are summarized below.

- Expand this study to include additional member unit cities, potentially including a refined cost-benefit analysis and evaluation of other water use sectors.
- Refine the structure and implementation of the fixture rebate programs to target specific accounts, to limit the effects of free-ridership, and to push the market toward even more efficient fixtures (e.g., 0.8 gallons per flush toilets).
- Expand and promote outdoor water use conservation programs (e.g., the Turf Replacement Rebate and Smart Irrigation Controller Rebate Programs) and consider implementing additional or alternative programs designed to target outdoor water use or to influence behavioral changes with respect to water use.
- Implement a Customer Survey to gain a greater understanding of how member unit customers use water and think about water conservation and alternative water sources (e.g., recycled water).

1. INTRODUCTION

This report documents the results of the *Single-Family Residential Water Use and Conservation Potential Pilot Study* ("Pilot Study") that was conducted on behalf of Solano County Water Agency ("SCWA"). As described below, the objective of this study was to, among other things, assist SCWA in gaining a greater understanding of single-family residential ("SFR") water use throughout the County, the effectiveness of SCWA's water conservation programs, and the remaining water conservation potential in the SFR sector. This Pilot Study presents both a high-level overview of SCWA's conservation programs, then focuses the analysis of program impacts, benefits, and opportunities within a single city (the City of Vallejo). Based on the results of this Pilot Study, it is anticipated that, among others things, a similar focused analysis will be conducted in the future at each of the cities, and potentially across other sectors, within the SCWA service area.

1.1 Background

The SCWA has surface water rights from two sources: the Solano Project administered by the United States Bureau of Reclamation ("USBR") and the State Water Project ("SWP") administered by the California Department of Water Resources ("DWR"). The SCWA serves approximately 195,000 acre-feet per year ("AFY") of untreated water to cities, institutions, and agricultural districts ("member units") in Solano County; these member units then provide treated water to residential, commercial, institutional, and other customers within the service area.

Single-family residential customers make up a significant portion of urban water use within Solano County (i.e., approximately 57% of total water use), followed by commercial, industrial, and institutional ("CII") customers at roughly 18%, and dedicated irrigation accounts at about 13%. In an effort to reduce urban water demand across its service area, SCWA administers County-wide water conservation programs to SFR and other customer sectors, including home water use surveys and rebates for high-efficiency ("HE") toilets, HE washers, smart irrigation controllers, and turf replacement. The member units, in turn, supplement SCWA's program with locally-administered water conservation programs.

Developing a greater understanding of key water-use and related information at County-wide and member unit-specific levels will provide SCWA and its member units with valuable information that will assist them in: analyzing customer demographics and behavior; quantifying the benefits of the water conservation programs administered to date; developing better water demand forecasts; identifying opportunities for targeted outreach and more effective water conservation programs; and more directly evaluating the need for and support for, developing alternative supplies (e.g., recycled water).

1.2 Pilot Study Purpose and Goals

The SCWA requested that EKI conduct this Pilot Study in order to help SCWA gain a greater understanding of SFR water use within its service area, the effectiveness of its water conservation programs, and the remaining water conservation potential in the SFR sector. The Pilot Study addresses key questions surrounding SFR water use and conservation savings based on water use data for the City of Vallejo. Specifically, the Pilot Study includes quantitative evaluation of the effectiveness of SCWA's four major conservation programs, described in detail in Section 4: HE toilet rebates, HE washer rebates, turf replacement rebates, and residential water use surveys.

The specific goals and objectives of the Pilot Study included the following:

Goal 1: Evaluate demographics and water use profiles by member unit, across Solano County.

Goal 2: Evaluate and estimate water savings achieved by active conservation efforts to date in SFR homes.

Goal 3: Evaluate the remaining water savings potential in SFR homes and the cost effectiveness of SCWA's current water conservation programs.

Goal 4: Evaluate water savings achieved by passive conservation in single-family residential homes.

Goal 5: Identify recommended next steps, including developing a survey designed to understand the public's general attitudes regarding water use and conservation.

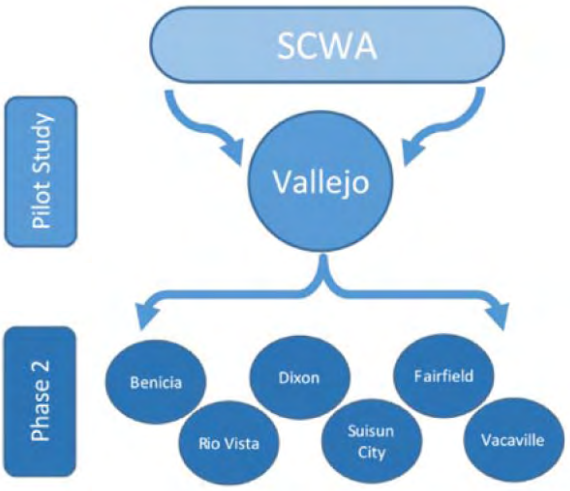
1.3 Pilot Study Approach

The information and analysis provided herein addresses each of the goals described above. Specifically, the following information is included in this study:

- Section 1 – Introduction
- Section 2 – Summary of SCWA's Service Area and Characteristics
- Section 3 – Analysis of SFR Water Use within Solano County Cities (Goal 1)
- Section 4 – SCWA Water Conservation Program Summary
- Section 5 – Pilot Study Analysis – City of Vallejo (Goals 2 and 3)
- Section 6 – Assessment of Passive Conservation and Drought Effects (Goal 4)
- Section 7 – Recommendations and Potential Next Steps (Goal 5)

- Section 8 – Conclusion
- Section 9 – References

In order to evaluate the amount of water savings achieved by participants in a given conservation program (Goal 2) and the costs to achieve that water savings (Goal 3), water use data must be considered and analyzed on a per account basis. Given that this is a very data- and resource-intensive process, both in the actual water use analysis and on the part of cities' to provide such granular discrete data, one city, the City of Vallejo, was selected to be the subject of this Pilot Study. As illustrated by the graphic to the right, it is anticipated that the analysis and methodologies developed herein will be applied to additional Solano County cities as part of a later phase of work.



2. SUMMARY OF SCWA'S SERVICE AREA AND CHARACTERISTICS

The SCWA was formed in 1951 to provide water supply and flood management services for the Solano County region. The SCWA provides wholesale water to its member units, which include agricultural districts, institutions, and cities. Institutional customers served by SCWA include: the University of California at Davis, California State Prison Solano, and Travis Air Force Base. The SCWA also provides irrigation water to Solano Irrigation District, Maine Prairie Water District, and Reclamation District 2068. The cities, or member units, served by SCWA include: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

2.1 Water Supplies

The SCWA has surface water rights from two sources: the Solano Project administered by the USBR and the SWP, administered by the DWR. The Solano Project stores water in Lake Berryessa and delivers water to local agencies through the Putah South Canal. The SCWA's contracted water supply for the Solano Project is 207,350 AFY, which it delivers to the Cities of Fairfield, Suisun City, Vacaville, and Vallejo, as well as Solano Irrigation District, Maine Prairie Water District, University of California at Davis, and California State Prison – Solano (SCWA, 2010).

The SCWA has a contract with DWR for delivery of SWP water through the North Bay Aqueduct ("NBA"). In turn, SCWA has contracts with Solano County cities for provision of this water supply. The NBA contracting cities are Benicia, Vacaville, Fairfield, Vallejo, Suisun City, Rio Vista, and Dixon. Suisun City has an allocation of NBA water, but has no facilities to take NBA water at this time. The Cities of Rio Vista and Dixon have the right to obtain a specified amount of NBA water in the future, but have no facilities to take NBA water at this time. SCWA has contracted for an ultimate allocation of 47,756 AFY of water from the SWP.

2.2 Service Area

As shown on Figure 1, the SCWA service area comprises the entirety of Solano County. Additionally, SCWA serves agricultural water to the University of California at Davis, located in Yolo County. The population, climate, demographics, and housing characteristics of the SCWA service area in Solano County are summarized in the following sections.

2.2.1 Population

The most recent available population data for the seven member units were obtained from the 2014 United States ("US") Census Bureau Subcounty Total Resident Population Estimates. Population growth projections through the year 2040 were also obtained from data published by the Association of Bay Area Governments ("ABAG") in 2013.

The majority of residential customers in SCWA's service area reside in the Cities of Vallejo, Fairfield, and Vacaville, with these three cities containing approximately 75% of the County's population (Census, 2014). The combined population of the cities comprising the seven member units is projected to grow by 19% from 431,131 in 2014 to 511,600 in 2040 (ABAG, 2013). While growth is expected for each city during this time frame, the majority of this growth is projected by ABAG (2013) to take place in the City of Fairfield, with an estimated 32% increase in population from 111,125 in 2014 to 146,500 in 2040. During the same time period, the cities of Dixon and Rio Vista are projected to have the smallest rate of growth with increases of 8% and 9%, respectively through 2040 (ABAG, 2013).

2.2.2 Climate

Climatic factors such as temperature, precipitation, and evapotranspiration can have a significant impact on residential water demand. Specifically, higher temperatures, lower amounts of precipitation, and higher rates of evapotranspiration are associated with increased residential water demand (Pacific Institute, 2012). Local climatic characteristics can have an important impact on outdoor water use as areas with hotter summers and less rainfall tend to have more seasonal increases in demand associated with outdoor irrigation.

Changes in topography cause these factors to vary across SCWA's service area, with the eastern portion of the County exhibiting mild winters and hot summers characteristic of the Sacramento River Valley and the southern and western portions of the County experiencing climate characteristics more similar to the San Francisco Bay Area including mild summers (SCWA, 2010). For example, the most eastern city in Solano County, Dixon, has an average annual reference evapotranspiration ("ET_0") of 52.1 inches, whereas the most southern city, Benicia, has an average annual ET_0 of 40.3 inches (SCWA, 2010). The average annual precipitation in the eastern portions of Solano County is between 15 and 25 inches, while higher rates of precipitation (25 to 40 inches) are experienced in the western portion of the County (SCWA, 2010).

2.2.3 Housing Characteristics

The distribution of SFR parcels in Solano County is shown on Figure 2. The majority of the SFR parcels are located within the member units' service areas, with the exception of rural residential areas in the western and northwestern portions of the County. Very few SFR parcels are located in the unincorporated areas in the eastern and southern portions of the County.

Certain characteristics related to housing construction date and type can influence, or at least be correlated with, water use. In general, older homes tend to have higher water using fixtures that were installed prior to passage of key changes to the Federal and California

Plumbing, Energy, and Building Codes;[1] these accounts present an opportunity for water conservation savings. Larger lots tend to use more water because they have larger irrigated landscaped areas. Similarly, larger homes tend to have more occupants and, therefore, more water use.

In order to assess the distribution of housing stock and other key water use characteristics, County-wide data were evaluated based on data provided by the Solano County Assessor's Office. These data included SFR lot and house sizes, the number of bedrooms and bathrooms at each account, and the housing construction date. These data are summarized in Tables 1 and 2 and on Figure 3 by city and on a County-wide basis.

Based on review of these data, it appears that the Cities of Vacaville and Dixon tend to have the largest average lot and house sizes, while the lot and house sizes in the Cities of Suisun City and Vallejo are, on average, the smallest in the County.

Additionally, while development has occurred throughout the County in the past 25 years, approximately 70% of housing in the County was built prior to 1990. Notably, only 2% of housing stock in the County was built in the past five years. The age of housing stock varies from city to city. The cities of Benicia, Dixon, Suisun City, and Vacaville contain houses predominantly built after 1970. The date of house construction in Fairfield is relatively evenly distributed between the 1950s to present. New development has occurred in the unincorporated area in the southwestern portion of the County, as well as in Rio Vista, where over 70% of the city was built after 1990. The City of Vallejo has the largest proportion of houses built before 1950 (25%).

2.3 Water Conservation Programs

In order to reduce water demand and promote public awareness of responsible water use, SCWA works with its member units to provide a wide range of water conservation programs to retail water customers across the County. As discussed in detail in Section 4, the primary conservation programs that target SFR water users include the HE Toilet Rebate, HE Washer Rebate, Turf Replacement Rebate, Residential Water Use Survey, and Smart Irrigation Controller Rebate Programs. Additionally, the member units conduct a number of local public outreach and education programs, including school outreach programs, distributing flyers and brochures as bill inserts, offering landscape and greywater classes to the public, and providing water conservation resources through their city websites, among other activities. The SCWA and its member units also provide many conservation programs that target multi-family residential ("MFR"), CII, and dedicated irrigation water users; however, analysis of these programs are outside of the scope of this study.

[1] Such as the Federal Energy Policy Act of 1992 (42 U.S.C. § 13201 et seq.); the California Appliance Efficiency Regulations (Cal. Code Regs. tit. 20 § 1601-1608); and the California Green Building Standards Code (Cal. Code Regs. tit. 24 pt. 11).

3. ANALYSIS OF SFR WATER USE WITHIN SOLANO COUNTY CITIES (GOAL 1)

The SCWA currently serves approximately 195,000 AFY of water to its member units, with deliveries expected to grow by approximately 10% by 2030 (SCWA, 2010). According to the 2010 Urban Water Management Plans ("UWMPs") prepared by each member unit, residential water deliveries, including to both SFR and MFR accounts, totaled 42,080 acre-feet[2] in 2010. The Cities of Vacaville and Rio Vista experienced the highest and lowest residential water demands in 2010, at 11,535 acre-feet and 2,217 acre-feet, respectively. In response to the historic 2012 - 2015 drought, each member unit has reduced its residential gallons per capita per day ("R-GPCD")[3] significantly for the months of June 2015 through November 2015, relative to R-GPCD during the same months in 2013. These reductions range from 36% in Benicia to 22% in Vallejo. As of June 2015, six member unit cities have achieved greater savings than the target conservation goals set by the State Water Resources Control Board ("SWRCB") in accordance with Executive Order B-29-15; Rio Vista's service area fell short of its 36% conservation standard by 4.3% (SWRCB, 2016).

Summaries of SFR water use by the seven member units are provided on Figures 4 through 9. To the extent that data were available, water use for each member unit was summarized in terms of the percentage of consumption occurring in each of the following sectors: SFR, MFR, CII, and dedicated irrigation[4]. Water use by sector is summarized for 2014 for the cities that provided data to EKI.[5] For member units that have not provided data to EKI, water use by sector is summarized for 2010 based on information provided in their 2010 UWMPs[6]. The customer sector with the highest water use for each city is the SFR sector, ranging from approximately 49% in Fairfield to 82% in Dixon[7]. To the extent that such data were provided by the member units, monthly and past consumption by SFR water users are also summarized and presented on Figures 4 through 9.

Population data for each city for the period 2000 through 2014 was then used to calculate annual R-GPCDs for the years 2000 through 2014[8]. Resultant residential per capita water use ranged from 69 R-GPCD for Vallejo in 2014 to 131 R-GPCD for Benicia in 2004.

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[2] One acre-foot is equivalent to 325,900 gallons.

[3] The SWRCB calculates R-GPCD as the total water consumption by residential accounts, including both SFR and MFR, divided by the total population.

[4] Non-revenue water was not included when calculating water use by sector for each city.

[5] The cities of Benicia, Suisun City, and Vacaville provided EKI with water use by sector data.

[6] The cities of Dixon, Fairfield, Rio Vista, and Vallejo have not provided water use by sector data to EKI.

[7] The City of Rio Vista does not distinguish between SFR and MFR water use.

[8] Population data for all cities was interpolated linearly from US Census Bureau data for 2000 and 2010 (Census, 2000; Census, 2010). Population data for 2011-2014 was obtained from the US Census Bureau Subcounty Total Resident Population Estimates (Census, 2014).

Additional information regarding SFR water use within each of the seven member units is discussed in the following sections. As the subject of this Pilot Study, additional discussion is provided below for Vallejo.

3.1 Benicia

The SFR water use profile for the Benicia is presented on Figure 4. Approximately 62% of water use in 2014 was attributed to the SFR sector, with the remainder split fairly evenly between the MFR, CII, and dedicated irrigation sectors. Total SFR water consumption over the period 2002 to 2014 ranged from approximately 1,000,000 hundred cubic feet ("HCF")[9] in 2014 to nearly 1,400,000 HCF in 2004, with water use generally declining over this period. The highest SFR water consumption in Benicia typically occurs between July and October. From 2002 to 2014, the consumption during these months was more than double the consumption experienced during the lower-water use months of January to April.

Indoor water usage generally constituted half of total SFR consumption over the period 2002 to 2014, although this percentage increased during the recent drought years. This decrease in outdoor water use may be a result of behavioral changes encouraged by public outreach on the part of SCWA and Benicia, and the state-wide emergency outdoor water restrictions mandated by Ordinance 14-4, which was adopted by the Benicia City Council on 15 July 2014. As discussed in detail in Section 4.3, the SCWA's Turf Replacement Rebate Program likely also contributed to a reduction in outdoor water use, particularly in 2014.

Residential per capita water use generally decreased over the period of 2002 to 2014, with an apparent short-term increase in 2012 and 2013.[10] Given the relatively low population increase (4%) over this period, trends in per capita consumption are not likely influenced strongly by population growth. The residential per capita water use in Benicia from June 2015 through November 2015 was 79 R-GPCD. Of all the member unit cities, Benicia has achieved the greatest reduction (36.2%) in R-GPCD water use, since 2013.

3.2 Dixon

The SFR water use profile for Dixon is presented on Figure 5. Unlike other cities in Solano County, residential water service for the Dixon is split between the City and California Water Service Company ("CalWater") Dixon District. According to CalWater's 2010 UWMP, more than 82% of water use in 2010 is attributed the SFR sector. The CII sector constituted 12% of water use, MFR used 6%, and no dedicated irrigation was reported in CalWater's 2010 UWMP. Monthly and historical water use data have not been provided for Dixon and are therefore not summarized herein. However, we do note that Dixon has met its SWRCB-

[9] One-hundred cubic feet is equal to 748 gallons.

[10] Residential per capita water use is calculated as the total water consumption by both SFR and MFR accounts divided by the total population.

mandated 28% reduction in residential per capita water use by reducing water use by 32.4% from 2013 to 2015 (SCRWCB, 2010). The resultant residential per capita water use in Dixon from June 2015 through November 2015 was 98 R-GPCD.

3.3 Fairfield

The SFR water use profile for Fairfield is presented on Figure 6. Approximately 49% of water use in 2010 is attributed to the SFR sector, with the remainder split between the CII (21%), dedicated irrigation (19%), and MFR (11%) sectors. Total SFR water consumption over the period 2007 to 2014 ranged from approximately 3,800,000 HCF in 2011 to more than 4,700,000 HCF in 2008. Water use generally declined from 2007 to 2011, increased in 2012 and 2013, and decreased in 2014. The highest SFR water consumption in Fairfield typically occurs between July and August. This water use pattern is likely due in part to the warmer climate observed in this area, as described in Section 2.2.2. Indoor water usage generally constituted half of total SFR consumption over the period 2007 to 2014, although this percentage was higher in 2009 (63%), 2011 (56%), and 2014 (58%).

Per capita SFR water use followed a similar trend as total consumption over the study period, generally decreasing from 2007 to 2011, increasing in 2012 and 2013, and decreasing again in 2014. Notably, Fairfield has experienced the highest growth rate of the member units, with an 8% increase in population from 2007 to 2014. In response to a 20% conservation standard mandated by the SWRCB, Fairfield has achieved a 23.6% reduction in residential per capita water use, between 2013 and 2015 (SWRCB, 2016). The resultant residential per capita water use in Fairfield from June 2015 through November 2015 was 95 R-GPCD.

3.4 Rio Vista

The SFR water use profile for Rio Vista is also presented on Figure 5. Rio Vista does not distinguish between SFR and MFR water use, and the combined total consumption of these sectors comprised 92% of Rio Vista's water use in 2010. The remaining 8% of water consumption is attributed to the CII sector; no dedicated irrigation was reported in Rio Vista's 2010 UWMP. Rio Vista has achieved a 31.7% reduction in R-GPCD[3] from 2013 to 2015, but fell short of its 36% conservation standard by 4.3% (SWRCB, 2016). The residential per capita water use in Rio Vista from June 2015 through November 2015 was 166 R-GPCD.

3.5 Suisun City

The SFR water use profile for Suisun City is presented on Figure 7. More than 77% of water use in 2014 was attributed to the SFR sector, with the remainder of use split between the MFR (7%), CII (6%), and dedicated irrigation (10%) sectors. Total SFR water consumption increased in the early 2000s and remained steady at approximately 1,300,000 HCF from 2003 to 2008, and then decreased over the following five years. The lowest water consumption (approximately 1,000,000 HCF) occurred in 2014. The highest SFR water consumption

typically occurs in July and September, but Suisun City generally experiences less seasonal variability in water consumption than the other SCWA member units.

Indoor water usage appears to have comprised more than 75% of water consumption in Suisun City over the period 2001 to 2014. Outdoor water consumption appears to have increased relative to indoor water usage in 2014. This relative decrease in indoor water use is likely influenced by the relatively higher proportion of indoor water use historically. Because outdoor water use appears to be relatively minimal, there was likely a greater opportunity for SFR water users to decrease their indoor water use given the recent, historic drought conditions.

Residential per capita water use in Suisun City increased between 2001 and 2004 and has decreased steadily since, with an annual residential per capita consumption of 79 R-GPCD in 2014.

In response to a 28% conservation standard mandated by the SWRCB, the Suisun City has achieved a 28.1% reduction in R-GPCD[3] water use, including both SFR and MFR, between 2013 and 2015 (SWRCB, 2016). The resultant residential per capita water use in Suisun City from June 2015 through November 2015 was 81 R-GPCD.

3.6 Vacaville

The SFR water use profile for the Vacaville is presented on Figure 8. Approximately 58% of water use in 2014 was attributed to the SFR sector. The second highest consuming sector is CII, followed by dedicated irrigation and MFR. Total SFR water consumption generally decreased from 2008 to 2011, increased in 2012 and 2013, and then decreased again in 2014 to roughly the same total use as in 2011. Overall, total water consumption decreased by more than 1,000,000 HCF (22%) over a six-year period, from nearly 5,000,000 HCF in 2008 to less than 4,000,000 HCF in 2014. Per capita water use in Vacaville followed a similar trend as total consumption, falling from 130 R-GPCD in 2008 to 98 R-GPCD in 2014. In response to a 32% conservation standard mandated by the SWRCB, the Vacaville has achieved a 33.7% reduction in residential per capita water use, between 2013 and 2015 (SWRCB, 2016). The resultant residential per capita water use in Vacaville from June 2015 through November 2015 was 136 R-GPCD.

The highest SFR water consumption is experienced in the summer and fall.[11] This water use pattern is likely due in part to the warmer climate observed in this area, as described in Section 2.2.2. Consumption is much lower for the months of December through May, with

[11] A small portion of the City of Vacaville's SFR accounts (approximately 0.3%) include separate dedicated meters for irrigation. The estimated indoor and outdoor water usage is based on usage by SFR meters, not including the dedicated irrigation meters, which may result in a slight underestimation of outdoor water use relative to indoor water use.

these six months representing just one third of total water consumption over the period 2007 to 2014. Indoor water usage is estimated to be about half of SFR water consumption in Vacaville over the period 2007 to 2014. Although residential per capita and total consumption dropped substantially from 2013 to 2014, the percentage of indoor water use appears to have remained the same.

3.7 Vallejo

The SFR water use profile for Vallejo is presented on Figure 9. Approximately 55% of water use in 2010 was attributed to the SFR sector in 2010, with the remainder split between the CII (20%), MFR (13%), and dedicated irrigation (12%) sectors. Total SFR water consumption generally decreased from 2000 to 2014. Overall, total SFR water consumption decreased by more than 1,300,000 HCF, or nearly 30%, over the 14-year period from 2000 to 2014. As of 2014, per capita SFR water use in Vallejo was the lowest among SCWA member unit cities that provided water use data. Residential per capita consumption has followed a similar trend as total consumption, falling from 101 R-GPCD in 2000 to 69 R-GPCD in 2014. In response to a 16% conservation standard mandated by the SWRCB, Vallejo has achieved a 21.5% reduction in residential per capita water use, between 2013 and 2015 (SWRCB, 2016). The resultant residential per capita water use in Vallejo from June 2015 through November 2015 was 78 R-GPCD.

The summer and fall months experience higher water consumption in Vallejo, with the highest SFR water consumption occurring between June and October. In general, however, Vallejo experiences less significant seasonal variability in water consumption than other SCWA member units. In part, this may be due to the cooler climate observed in this area (Section 2.2.2). Estimated indoor water usage consistently comprised between than 60% and 70% of water consumption in Vallejo over the period 2000 to 2014.

As mentioned in Section 2.2.3, Vallejo is distinguished from other SCWA member units by the age of its housing stock. Nearly 25% of SFR housing units in the city were built prior to 1950, and the number of the housing units of this age in Vallejo is more than twice the number of such units in the rest of the SCWA service area combined (Table 1). The age and distribution of SFR housing stock in Vallejo is presented on Figure 10. The older SFR housing stock is mostly concentrated in the center and central western portions of the city. The age of housing generally increases to the east and north, with the newest SFR development focused in the northeastern portion of Vallejo. Some new SFR development has occurred in the western portion of the city as well. Very little SFR development has occurred in the city since 2011.

As the subject of this Pilot Study and to allow for the analyses presented in Section 5 below, EKI was provided with historical water use records by SFR account for Vallejo from 2000 through mid-2015. The spatial distribution of high water use SFR accounts (defined as the top 10% of water users) in Vallejo is presented in Figure 11 for the years 2000, 2005, 2010, and 2015. The distribution appears to be fairly consistent over time, with the most water-

intensive SFR accounts located on the eastern and northern portion of the city. Interestingly, the location of these high water users coincides with the location of newer housing stock. For example, a heavy concentration of the top 10% water users is located among the new SFR housing in the northeastern corner of the city. This somewhat counterintuitive result indicates that even though new housing stock would be expected to have more water-efficient fixtures, other elements such as lot size, irrigated landscape area, persons per household, etc. appear to counteracting the benefits of the water efficient fixtures and the unit water demands for these new dwelling units are actually greater than that of existing, older units. This finding has an important implication for the development of future demand projections, Water Supply Assessments and the like.

4. SCWA WATER CONSERVATION PROGRAM SUMMARY

Several rebates and services are available to SFR customers in Solano County to encourage water conservation and promote responsible water use across the SCWA's service area. The SCWA administers many of these programs directly to SFR customers, in coordination with the member units' staff. Member units also provide additional conservation programs within their respective service areas, typically focused on public outreach and education. In order to better understand the extent and spatial distribution of participation in SCWA conservation programs, program participation records maintained by SCWA were matched to parcel records maintained by the Solano County Assessor's office.[12,13]

Participation by SFR water customers in the four principal water conservation programs and across all seven member units is summarized in Tables 3 through 7 and presented on Figures 12 through 15.

4.1 HE Toilet Rebates

The HE Toilet Rebate Program was launched by SCWA in 2007 to provide member unit customers a financial incentive to replaced older, inefficient toilets (typically 3.5 gallons per flush, "gpf") with new, higher efficiency toilets (using a maximum of 1.28 gpf). The HE Toilet Rebate Program was offered to all SFR households through January 2015, when it was ended. SCWA is considering options for HE toilet-based conservation programs in the future. Over the lifetime of the program, more rebates were issued to SFR customers under the HE Toilet Rebate Program than any of the other SCWA rebate programs.

Participation in the HE Toilet Rebate Program in Solano County is summarized in Table 3 and on Figure 12. From the beginning of the program in 2007 through 19 June 2015, a total of 5,764 rebates were issued to 3,622 unique SFR accounts, totaling $638,086 in rebates (or roughly $111 per rebate). Over the period of record, the most rebates were issued in Vacaville (1,789), and the fewest rebates were issued in Rio Vista (48). As a percentage of the total SFR accounts in each city, the highest participation rate occurred in the cities of Benicia and Vacaville (4.7%), and the lowest participation rate occurred in Rio Vista (0.8%). Although the program ended in January 2015, applications received prior to this date were processed and rebates were issued until March 2015; a total of 222 rebates were issued in 2015.

[12] The Solano County Assessor office provided detailed geospatial data for Solano County, which included parcel-specific information such as land use type, number of bedrooms, number of bathrooms, building interior size, among other characteristics. These records were provided in August 2015.

[13] Only records that could be positively matched to an Assessor Parcel Number ("APN") in the Solano County Assessor office dataset were maintained for data analysis. More than 96% of the data obtained for the HE Washer Rebate, HE Toilet Rebate, Turf Replacement Rebate, and Residential Water Use Survey Programs could be positively matched to a county APN.

4.2 HE Washer Rebates

The SCWA partnered with Pacific Gas and Electric Company ("PG&E") to provide a combined rebate of $150[14] to customers of SCWA member unit cities who purchase a washing machine included on the ENERGY STAR Most Efficient list and only one HE washer rebate may be issued to each SFR household. The water efficiency of new washers currently available for purchase on the market ranges more broadly than for other water-using fixtures such as toilets. Given the way the PG&E rebate program is structured, only the most efficient washers are eligible for rebates, although all washers currently available for sale are significantly more efficient than their older counterparts. The HE Washer Rebate Program was launched in 2007, but rebate participation records prior to 2010 were not available for use in the Pilot Study.

Participation in the HE Washer Rebate Program in Solano County is summarized in Table 4 and Figure 13. Interest in the program has been strong; out of the five SCWA conservation programs described in Section 4, the HE Washer Rebate Program has the highest aggregate rate of participation, as a percentage of total SFR accounts. From 2010 through 1 May 2015, a total of 3,997 rebates were issued, totaling $364,150 in rebates. Over this period, the most rebates were issued in Fairfield (1,254), and the fewest rebates were issued in Dixon (64). As a percentage of the total SFR accounts in each city, the highest participation rate occurred in Fairfield (4.9%), and the lowest participation rate occurred in Rio Vista (2.0%). The county-wide participation rate in the HE Washer Rebate Program increased from 2010 to 2012 and has been declining since. This decline may be influenced by factors such as the decreasing rebate amount and the fact that the most efficient washers available on the market tend to be the most expensive.

4.3 Turf Replacement Rebates

The Turf Replacement Rebate Program, or Water-Efficient Landscape Rebate Program, was launched in the summer of 2010 as a pilot program to promote water conservation and support the installation of healthy, sustainable, low-water-use landscapes. The program provides a financial incentive to retail customers within Solano County to replace existing turf with sustainable watershed-appropriate water-efficient landscaping. The cash rebate offered to SFR customers is currently $1.00 per square foot of turf replaced, for up to a maximum of 1,000 square feet of turf.[15] In order to receive a rebate, new landscaping must consist of drought-tolerant plants with at least two inches of mulch that are irrigated by a low-volume, drip method. Alternatively, SFR customers may install permeable hardscaping, such as decomposed granite. Turf replacement projects are inspected upon completion by SCWA staff to ensure compliance with these requirements prior to the rebate being issued.

[14] The SCWA contributes $100 to the rebate, while PG&E adds $50.

[15] When the program began in 2010, the rebate amount was $0.50/square foot. In 2012, the rebate amount was increased to $0.60/square foot and again increased in 2013 to the current $1.00/square foot.

Participation in the Turf Replacement Rebate Program in Solano County is summarized in Table 5 and on Figure 14. Although the program was created more recently than the HE Toilet and HE Washer Rebate Programs discussed in Sections 4.1 and 4.2, participation has been significant. In 2010 through December 2015, a total of 1,235 rebates were issued to SFR accounts, totaling 1,156,226 square feet of turf replaced, 928,948 square feet of turf rebated, and $910,458 in rebates. The area of turf replaced per rebate was generally between 900 and 1,000 square feet, with the lowest average occurring in Rio Vista (approximately 690 square feet) and highest in Suisun City (approximately 1,070 square feet). Even though the maximum turf area eligible for a rebate amount is 1,000 square feet, approximately 37% of program participants replaced an area of turf greater than 1,000 square feet. Over the six-year program period, the highest rate of participation has been in Benicia (with 2.9% of SFR accounts participating) and the lowest participation has been in Fairfield, Suisun City, and Vallejo, with less than 1% of SFR accounts participating. Most cities experienced similar trends in participation, where limited participation occurred prior to 2013 and participation increased substantially in both 2014 and 2015. Notably, in Vallejo there was a slight drop off in program participation from 2014 to 2015, wherein the number of rebates issued to SFR accounts decreased from 116 to 108. The significant increase in program participation seen from 2013 onwards is likely influenced in part by: (1) the increase in rebate amount, (2) the increased public awareness and desire to conserve water in response to the extraordinary drought conditions and the associated media attention, and (3) additional public awareness of the program's existence.

4.4 Residential Water Use Surveys

The Residential Water Use Survey Program has been implemented by SCWA since 2010. As part of this program, the top 10% of residential water users within each member unit's service area are offered a free water survey intended to identify ways that a customer can save water. Additionally, new SFR accounts are offered a free residential water use survey. Depending on the findings of a water use survey, hardware is often distributed to the SFR account at no cost. Examples of hardware distributed by SCWA include: kitchen and bathroom sink aerators, showerheads, hose nozzles, hose timers, and dye tablets to identify toilet leaks. An initial review of the program found that 34% of resulting water savings came from fixing irrigation leaks and leaking toilets (SCWA, 2013). The most common area of potential water savings identified in SFR water use surveys is overwatering. In 70% of SFR homes visited, the surveyor found that altering the occupants' watering schedule would save water.

Participation in the Residential Water Use Survey Program in Solano County is summarized in Table 6 and on Figure 15. Although the program was created in 2010, only one survey was performed in this year. From 2010 through 9 November 2015, a total of 2,554 surveys were conducted at SFR accounts. Over this period, the most surveys were conducted in Fairfield (905) and the fewest surveys were conducted in Dixon (29). As a percentage of the total SFR accounts in each city, the highest participation rate occurred in Benicia (4.4%), and the lowest

participation rate occurred in Dixon (1.1%). The county-wide participation rate has varied from year to year, ranging from a low of 320 surveys performed in 2014 to a high of 665 surveys in 2012. The trend in participation varies from city to city, however. For example, participation in the cities of Fairfield and Vallejo was highest in the 2011 and 2012, whereas 65 of the 67 surveys conducted in Rio Vista occurred in 2015, and participation in Vacaville increased substantially after 2013.

4.5 Smart Irrigation Controller Rebates

The Smart Irrigation Controller Rebate Program offers customers a financial incentive to install a qualifying smart controller to irrigate existing landscaping. These weather-based controllers determine the total amount of time required to operate each irrigation station based on various factors, including the prevailing weather conditions, soil moisture levels, sunlight, temperature, and humidity. The rebate amount depends on the number of station timers that are installed: $300 for 4-12 station timers, $700 for 13-24 station times, and $1,000 for more than 25 station timers.

The Smart Irrigation Controller Rebate Program was launched in 2008 and SFR participation in the program through 23 November 2015 is summarized in Table 7. Participation in the program has been minimal, with a total of 15 rebates issued to SFR accounts since program inception. No SFR accounts in the cities of Rio Vista or Suisun City have received a rebate. Due to limited participation in the Smart Irrigation Controller Program to date, the program is not assessed further in the Pilot Study.

5. PILOT STUDY ANALYSIS – CITY OF VALLEJO (GOALS 2 AND 3)

In this section of the report, a detailed analysis of water conservation program participation, estimated water conservation savings, and potential remaining water conservation savings is presented based on water use and other data provided by the Solano County Assessor's office, the SCWA, and City of Vallejo staff.

5.1 Conservation Program Participation

The spatial data generated as part of the County-wide evaluation of SCWA conservation program participation, described in Section 4, was analyzed in detail for Vallejo. Participation by Vallejo SFR customers in each of the four main SCWA programs – HE Toilet Rebates, HE Washer Rebates, Turf Replacement Rebates, and Residential Water Use Surveys – is presented on Figures 16 through 19.

In addition, as can be seen on Figures 16 through 19, a spatial "hot spot" analysis across the city was performed. This analysis evaluated the spatial distribution of program participants across SFR parcels in Vallejo, and identified the presence of participation clusters, or "hot spots".[16] A participation hot spot is an area where a higher density of participation is observed than would be expected by randomly distributed participation. Similarly, "cold spots," or areas of lower than expected participation, were identified. This analysis was conducted in order to identify the areas where limited participation has occurred to date. As discussed in Section 5.3, this information is used to identify areas to target for future implementation of SCWA conservation programs within the city.

5.1.1 HE Toilet Rebates

Over the period of 2007 through March 2015, 1,068 HE toilet rebates were issued to 678 SFR accounts within Vallejo, at a cost of $22,618. Approximately 2.2% of SFR accounts participated in the HE Toilet Rebate Program during this time. Prior to the program's ending in January 2015, participation increased in every year except 2011. As illustrated by the distribution of hot spots in Figure 16, the eastern and southern portions of the city exhibited the strongest interest in the HE Toilet Rebate Program. Conversely, the western and northeastern portions of the city demonstrated below average participation in the program. This area of the city corresponds to older houses (Figure 10), which are more likely to have older low-efficiency toilets. The lower level of participation in the northeast portion of the

[16] The ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool was used for hot spot analysis of the City of Vallejo's program participation. The hot spot analysis calculates a Getis Ord GI* statistic for each cell. This statistical z-score evaluates how the event (in this case, participation in the program) clusters spatially, by looking at the cell in the context of the neighboring cells. For the purposes of the Pilot Study, hot and cold spots are identified as cells with a 90% or greater level of statistical confidence.

city corresponds to an area of newer SFR development where there fewer high-water-use toilets would be expected (Figure 10).[17]

5.1.2 HE Washer Rebates

From 2010 through 1 May 2015, 751 HE washer rebates were issued to Vallejo customers, totaling $69,050. Approximately 2.4% of SFR accounts participated in the HE Washer Rebate Program. Participation increased from 2010 until 2012 and has decreased since. As mentioned in Section 4.2, above, this decline was seen across the County and may be influenced by factors such as the decreasing rebate amount and the fact that the most efficient washers available on the market tend to be the most expensive.

As illustrated by the distribution of hot spots in Figure 17, high participation in the HE Washer Rebate Program occurred in the northwest portion of the city and the northeast portion of the central block of the city. The western portion of the city demonstrated below average participation in the program, and is a potential candidate for targeted outreach and increased program participation. This western portion of the city corresponds to older houses (Figure 10), which are more likely to have older less-efficient clothes washers.

5.1.3 Turf Replacement Rebates

From 2010 through December 2015, 255 turf replacement rebates were issued to Vallejo SFR customers, totaling $187,832 and corresponding to 236,570 square feet of turf replaced (191,362 square feet of turf rebated). Approximately 0.81% of SFR accounts participated in the Turf Replacement Rebate Program. Participation was highest in 2014 (113 rebates issued), with slightly less participation in 2015 (108 rebates issued). As mentioned in Section 4.3, above, this higher level of program participation in 2014 and 2015 compared to previous years was observed across the County, is likely influenced in part by: (1) the increase in rebate amount, (2) the increased public awareness and desire to conserve water in response to the extraordinary drought conditions and the associated media attention, and (3) additional public awareness of the program's existence.

Several hot spots, or areas of higher density participation, are identified on Figure 18. Turf replacement projects are far more visible to neighbors than interior improvements such as replacing toilets and washers. The hot spots identified by this analysis may indicate the benefit of a "cluster effect" wherein observing that a neighbor has replaced their landscaping motivates additional accounts within a neighborhood to undertake similar projects, or a "neighbors seeing neighbors" effect. This observation of the apparent cluster effect reinforces the additional public outreach and education elements of turf replacement programs, which are difficult to quantify, but important never-the-less.

[17] The 1992 Federal Energy Policy Act (effective 1994) required that all new toilets sold in the United States be 1.6 gpf or more efficient.

5.1.4 Residential Water Use Surveys

Over the period 2010 through 9 November 2015, 430 residential water use surveys were conducted in Vallejo, representing participation among 1.4% of SFR accounts. Participation in the Residential Water Use Survey Program increased during the initial years, peaking at 151 surveys conducted in 2012, and decreased each year through the partial year 2015. The hot spot analysis presented on Figure 19 identified three areas of high participation: the southeast portion of the city, the northeast portion of the central block of the city, and the northeast portion of the city. These hot spots correspond with areas of high water use accounts shown on Figure 11, indicating that the program has been successful in targeting the appropriate candidates.

5.2 Estimated Water Savings

Estimated Annual Water Savings Per Account	
HE Toilet:	10,000-19,000 gallons
HE Washer:	7,500-9,800 gallons
Turf Replacement:	18,700 gallons
SFR Water Use Surveys:	20,900-31,500 gallons

As discussed in Section 3 above and shown on Figures 4 through 9, water demand by SFR customers has declined across Solano County and in Vallejo. While the water conservation programs provided by SCWA have certainly contributed to this reduction in water use, other factors including passive water conservation, drought conditions, economic influences, and a greater public awareness of responsible water use are likely also contributing to this reduction. In order to assess the benefits of SCWA's programs, the amount of water savings directly resulting from participation by Vallejo's SFR customers in the SCWA's four major conservation programs was estimated and is discussed in the following sections.

Water use savings were estimated for each SCWA SFR water conservation program, with the exception of the Smart Irrigation Controller Rebate Program, for which participation has been minimal. This analysis was conducted for Vallejo, as the target of this Pilot Study. In order to estimate the effect on water use of participation in a conservation program itself, water use by program participants was compared to water use by a representative cohort. Given that factors such as age and size of house, and household income can influence water use, and that these same factors are generally relatively consistent within given neighborhoods, the comparison cohorts were selected and stratified based on 2010 US Census Blocks. For every one participating account in a given Census Block, five non-participating accounts were selected within that same Census Block. For example, if six HE Toilet Rebate Program participant accounts were located in Census Block 2517.010, then 30 SFR accounts that did not receive HE toilet rebates were randomly selected from Census Block 2517.010 and included in the representative cohort.

The water savings attributed to participation in each program was estimated by comparing water use by the participant group and the representative cohort for the three years prior to the year of analysis and the three years following the year of analysis[18]. The estimated annual water savings associated with the conservation program was then calculated as the incremental amount of water saved by the program participants over that of the representative cohort accounts. For the three rebate programs, the cost-effectiveness of each program was estimated as the rebate cost per gallon of water saved over a ten-year period.

The analysis described above was conducted for the HE Toilet Rebate, HE Washer Rebate, and Residential Water Use Survey Programs for the years 2011 and 2013. The year 2011 was selected for analysis because it represents a period after the most significant effects of the economic downturn were felt and prior to the start of the current drought. The year 2013 was selected for analysis because it is the most recent participation year where a full year of water use data was available post-participation. Because participation in the Turf Replacement Rebate Program in Vallejo was minimal prior to 2013, this analysis was only performed for 2013. The results of these conservation program savings analyses are presented in Tables 8 through 14 and described in detail in the following sections.

5.2.1 Water Savings from HE Toilet Rebate Program

The estimated water savings achieved by participation in the HE Toilet Rebate Program by Vallejo SFR customers in 2011 and 2013 are presented in Tables 8 and 9, respectively.

As shown in Table 8, in 2011, 69 SFR accounts for which historical water use data were available participated in the HE Toilet Rebate Program and a comparison cohort of 345 SFR accounts that did not participate in the HE Toilet Rebate Program were selected. Multiple HE toilet rebates per SFR household are permitted under the rebate program. Of the 69 SFR accounts participating in the program, 21 accounts received two rebates and 13 accounts received three rebates, resulting in a total of 116 HE toilet rebates issued to the participant group. The total cost of these rebates was $13,425 and the average amount of each rebate issued was $116. As shown in the Table 8 chart, both groups reduced water use from 2008-2010 to 2012-2014, but the participant group reduced consumption by more than the comparison cohort. Based on the difference in annual water use reduction per account – 37 HCF for participants and 11 HCF for comparison cohort accounts – the estimated annual water savings per rebate attributed to the HE Toilet Program was 26 HCF (19,448 gallons). Normalizing this number for accounts receiving multiple rebates, the estimated annual water savings per HE toilet rebate was 15 HCF (11,220 gallons). The results of this analysis suggest that every $0.06 of an HE toilet rebate issued results in 100 gallons of water saved over a ten-year period.

[18] When analyzing program participation in 2013, the period of water use data following program participation was less than three years and varied, depending on availability of data.

The results from the replicate analysis for 2013, shown in Table 9, are generally consistent with the findings of the 2011 analysis. In 2013, 121 SFR accounts participated in the HE Toilet Rebate Program and a comparison cohort of 605 SFR accounts that did not participate in the HE Toilet Rebate Program was selected. Of the 121 SFR accounts participating in the program, 24 accounts received two rebates and 18 accounts received three rebates, resulting in a total of 181 HE toilet rebates issued to the participant group. The total cost of these rebates was $19,747 and the average amount of each rebate issued was $109. Based on the difference in annual water use reduction per account – 25 HCF for participants and 11 HCF for comparison cohort accounts – the estimated annual water savings attributed to the HE Toilet Rebate Program was 14 HCF (10,472 gallons). Normalizing this number for accounts receiving multiple rebates, the estimated annual water savings per HE toilet rebate was 9.1 HCF (6,807 gallons). The results of this analysis suggest that every $0.10 of an HE toilet rebate issued results in 100 gallons of water saved over a ten-year period.

The average annual water savings per HE toilet rebate estimated by this study of 6,807 gallons to 11,220 gallons per rebate, is generally consistent with what one would expect based on a replacing a high-water-use toilet with a HE toilet[19].

When evaluating the success of HE toilet-focused conservation programs, additional factors beyond rebate cost per water savings should be considered. Due to plumbing code and efficiency standard changes, all toilets on the market are currently considered high efficiency, with a rating of 1.28 gpf or lower. The greatest benefit from an HE toilet rebate program is seen when it encourages and accelerates the replacement of an older inefficient toilet, rather than when it is utilized to replace a broken fixture (i.e., "free-ridership"). If an HE toilet-based program can be strategically designed and implemented to accelerate the changeout of inefficient toilets and steer the market towards the new higher efficiency toilets (e.g., 1.0 gpf or 0.8 gpf toilets that have recently entered the market), it will be effective in light of plumbing code and efficiency standard changes.

5.2.2 Water Savings from HE Washer Rebate Program

The estimated water savings achieved from the HE Washer Rebate Program in Vallejo for 2011 and 2013 are presented in Tables 10 and 11, respectively.

In 2011, 107 SFR accounts for which historical water use data were available participated in the HE Washer Rebate Program and a comparison cohort of 535 SFR accounts that did not

[19] Expected annual water savings per HE toilet change out would be approximately 4,580 gallons, using the following calculation (BAWSCA, 2013): (3.5 gal/fl - 1.28 gal/fl) x 5 fl/toilet/day/person x 2.6 persons/house / 2.3 toilets/house x 365 days = 4,580 gal. This calculation assumes that a toilet rated at 3.5 gal/fl actually operates at 3.5 gal/fl. However, the operational water use may be substantially higher depending on the condition of the toilet and how well it has been maintained (Aquacraft, 2011).

participate in the HE Washer Rebate Program was selected. The total cost of these rebates was $11,275 and the average amount of each rebate issued was $105. As shown in the Table 10 chart, both groups reduced water use from 2008-2010 to 2012-2014, but the participant group reduced consumption by more than the comparison cohort. Based on the difference in annual water use reduction per account – 22 HCF for participants and 8 HCF for comparison cohort accounts – the estimated annual water savings per rebate attributed to the HE Washer Rebate Program was 13 HCF (9,724 gallons). The results of this analysis suggest that every $0.11 of an HE washer rebate results in 100 gallons of saved water over a ten-year period.

The results from the replicate analysis for 2013 are generally consistent with the findings of the 2011 analysis. In 2013, 162 SFR accounts participated in the HE Washer Rebate Program and a comparison cohort of 810 SFR accounts that did not participate in the HE Washer Rebate Program was selected. The total cost of these rebates was $12,150 and the average amount of each rebate issued was $75. As shown in the Table 11 chart, both groups reduced water use from 2010-2012 to 2014, but the participant group reduced consumption by more than the comparison cohort. Based on the difference in annual water use reduction per account – 22 HCF for participants and 11 HCF for comparison cohort accounts – the estimated annual water savings per rebate attributed to the HE Washer Rebate Program was 10 HCF (7,480 gallons). The results of this analysis suggest that every $0.10 of an HE washer rebate results in 100 gallons of saved water over a ten-year period.

The average annual water savings per HE washer rebate estimated by this study of 7,480 gallons to 9,724 gallons per rebate, is generally consistent with what one would expect based on a replacing a high-water-use washer with a HE washer.[20]

Similar to HE toilet-focused programs discussed above, when evaluating the overall success of HE washer rebate programs additional factors beyond rebate cost per water savings should be considered. Due to plumbing code and efficiency standard changes, all new clothes washers currently on the market are significantly more efficient than those available in the past. Efficiency standards for clothes washers range more broadly than for toilets, and the highest efficient clothes washers available on the market tend to actually be the most expensive to purchase. The way the HE Washer Rebate Program is currently structured through the partnership with PG&E, only the most efficient washers are eligible for rebates and the bar is continuously being raised. At the same time, the individual rebate amounts are declining. The greatest benefit from an HE washer rebate program is seen when it encourages and speeds up replacement of an older inefficient washer, rather than when it is utilized to replace a broken appliance (i.e., "free-ridership"). If an HE washer program can be strategically designed and implemented to accelerate changeout of clothes washers and

[20] Expected annual water savings per HE washer change out would be approximately 9,129 gallons, using the following calculation (BAWSCA, 2013; Aquacraft, 2011): (39 gal/load - 13 gal/load) x 2.6 people/house x 0.37 loads/person/day x 365 days = 9,129 gal.

steer the market towards more efficient washers, it will be effective in light of plumbing code and efficiency standard changes.

5.2.3 Water Savings from Turf Replacement Rebate Program

The estimated water savings achieved from the Turf Replacement Rebate Program in Vallejo for 2013 is presented in Table 12.

In 2013, 17 Vallejo SFR accounts participated in the Turf Replacement Rebate Program; a comparison cohort of 85 SFR accounts that did not participate in the Turf Replacement Rebate Program was selected. While both groups displayed a wide range in the age of housing and similar size of house, the participant group contained a much larger average lot size (12,980 square feet) than the comparison cohort (7,743 square feet). This stark difference may be a product of self-selecting bias, wherein those SFR accounts that chose to participate in the Turf Replacement Rebate Program are accounts with more landscaped area, and thus may be (1) more willing to convert a portion of that landscaping to with sustainable watershed-appropriate water-efficient landscaping, and/or (2) more motivated by the cost savings associated with reducing one's water use. The total area of turf replaced in 2013 was 14,874 square feet, of which 13,031 square feet received a rebate; the remaining 1,843 square feet represents area replaced in excess of the 1,000 square foot rebate maximum. The average area of turf replaced per SFR account was 875 square feet. The total cost of these rebates was $12,657 and the average amount of each rebate issued was $745.

As shown in the Table 12 chart, both groups reduced water use from 2010-2012 to 2014, but the participant group reduced consumption by more than the comparison cohort. Based on the difference in annual water use reduction per account – 30 HCF for participants and 5 HCF for comparison cohort accounts – the estimated annual water savings attributed to the Turf Replacement Rebate Program was 25 HCF. Normalizing this number for the area of turf replaced,[21] the estimated annual water savings per 100 square feet of turf replaced was 3 HCF (2,244 gallons). For the average area of turf replaced per rebate (875 square feet), this translates to 19,634 gallons of annual water savings. The results of this analysis suggest that it costs $0.40 to save 100 gallons of water over a ten-year period using turf replacement rebates.

The average annual water savings per rebate of 19,634 gallons is generally consistent with what one would expect based on an assumed reduction in applied water of 2.5 acre feet per acre.[22]

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[21] Water savings were normalized by the total area of turf replaced, rather than only the area of turf replaced that received a rebate. This is a conservative method of analysis, because it results in a lower water savings per square foot.

[22] Expected annual water savings per 875 sq ft of replaced turf would be approximately 16,000 gallons, using the following calculation (BAWSCA, 2013): (3.5 acre-feet/acre - 1.0 acre-feet/acre) /43,560 sq ft/acre x 875 sq ft x 325,851 gal/acre-foot = 16,363 gal.

While the current drought situation may have contributed to the high level of participation in the Turf Replacement Rebate Program, water savings from the program are anticipated to persist at a high degree once the drought is over. The SCWA's Turf Replacement Rebate Program is structured such that program participants only receive their rebate after SCWA staff inspect the project and verify that the irrigation system has been altered as appropriate for the new low-water-use plantings (e.g., the sprinkler system that had previously irrigated a lawn has been removed). Therefore, program participants will not be able to "flip a switch" on their irrigation system and revert to their previous level of water use. To change a yard back to a higher water use landscape would require a significant investment. Furthermore, new landscapes would be required to comply with Vallejo's Water-Efficient Landscaping Ordinance (Ordinance 1634), and therefore, would not likely use as much water as prior to participation in the Turf Replacement Rebate Program.

Turf replacement projects are highly visible to the public and therefore result in significant benefits beyond just the observed water savings, much more so than indoor programs such as toilet replacements. Such benefits include increasing public awareness and encouraging conversations about responsible water use among neighbors. Additionally, it has been observed that as more homes in a community convert lawn-centric yards to water efficient landscapes, a new norm for landscape aesthetics in a community can be established.

5.2.4 Water Savings from Residential Water Use Survey Program

The estimated water savings achieved from the Residential Water Use Survey Program in Vallejo for 2011 and 2013 are presented in Tables 13 and 14, respectively.

In 2011, 95 SFR accounts participated in the Residential Water Use Survey Program, and a comparison cohort of 475 SFR accounts was selected. Both groups displayed a wide range in the age of housing and similar housing characteristics in terms of number of bedrooms and number of bathrooms. Houses participating in the program were somewhat larger (2,075 square feet) than houses in the comparison cohort (1,847 square feet). During the 95 surveys performed, leaks were identified for 10 accounts, sprinkler settings were adjusted for 32 accounts, and hardware was distributed to 24 accounts.[23] As shown in the Table 13 chart, both groups reduced water use from 2008-2010 to 2012-2014, but the participant group reduced consumption by more than the comparison cohort. Notably, the participant group started at a much higher average annual water use than the comparison cohort. This difference is part of the program design (i.e., the SCWA only markets the program to SFR accounts that fall in the top 10% of all SFR water users). Based on the difference in annual water use reduction per account – 56 HCF for participants and 14 HCF for comparison cohort

[23] As described in Section 4.4, examples of hardware distributed by SCWA include: kitchen and bathroom sink aerators; showerheads; hose nozzles; hose timers; and dye tablets to identify toilet leaks.

accounts – the estimated annual water savings per survey attributed to the Residential Water Use Survey Program was 42 HCF (31,416 gallons).

The results from the replicate analysis for 2013 are generally consistent with the findings of the 2011 analysis, although the water savings per survey was somewhat lower. In 2013, 34 SFR accounts participated in the Residential Water Use Survey Program and a comparison cohort of 170 SFR accounts was selected. Similar to the 2011 analysis, the two groups possessed comparable housing characteristics in terms of number of bedrooms and number of bathrooms, but houses participating in the program were larger (2,242 square feet) than houses in the comparison cohort (1,757 square feet). During the 34 surveys performed, six leaks were identified, 11 sprinkler settings were adjusted, and in 28 cases hardware was distributed to SFR account. As shown in the Table 14 chart, both groups reduced water use from 2010-2012 to 2014, but the participant group reduced consumption by more than the comparison cohort. As with the 2011 analysis, the participant group started at a much higher average annual water use than the comparison cohort, which is likely attributed to the fact that the program targets SFR accounts that fall in the top 10% of all SFR water users. Based on the difference in annual water use reduction per account – 32 HCF for participants and 4 HCF for comparison cohort accounts – the estimated annual water savings per survey attributed to the Residential Water Use Survey Program was 28 HCF (20,944 gallons).

5.3 Identified Additional Water Conservation Opportunities

Based on the results of this analysis, it appears that the water conservation programs provided by SCWA to SFR water users in Vallejo – HE Toilet Rebate, HE Washer Rebate, Turf Replacement Rebate, and Residential Water Use Survey Programs – produced significant and measurable water savings. Additional analysis, presented in the following sections, suggests that the markets for these programs within Vallejo are not yet saturated, and there are significant opportunities to continue and expand the programs within the city (and therefore, likely the County).

5.3.1 Savings and Cost per Rebate Program

The estimated savings and costs of the HE Toilet Rebate, HE Washer Rebate, and Turf Replacement Rebate Programs in Vallejo are summarized in Table 15[24]. The Turf Replacement Rebate Program produced the most estimated annual water savings per account (18,700 gallons). The HE

Rebate Program Cost per Water Saved	
Turf Replacement:	$0.40/100 gallons
HE Toilet:	$0.06 - $0.10/100 gallons
HE Washer:	$0.10 - $0.11/100 gallons

[24] The Residential Water Use Survey Program is not directly comparable to the rebate programs because the survey can result in different actions (e.g., distribution of certain types of hardware) depending on what the surveyor discovers. It is beyond the scope of the Pilot Study to investigate the effects of individual actions resulting from the survey, but such an analysis could be conducted as a next step and is discussed in Section 7.

Toilet Rebate Program produced between 10,000 and 19,000 gallons of estimated annual water savings per account and the HE Washer Rebate Program produced between 7,500 and 9,800 gallons of estimated annual water savings per account. Over a ten-year period, the average of these estimated savings result in savings of 187,000, 86,000, and 150,000 gallons per account for the Turf Replacement Rebate, HE Washer Rebate, and HE Toilet Rebate Programs, respectively.

Based on water savings are rebate cost alone, the cost per 100 gallons of water saved over a ten-year period ranged between $0.06 and $0.10 for the HE Toilet Rebate Program, between $0.10 and $0.11 for the HE Washer Rebate Program, and was approximately $0.40 for the Turf Replacement Rebate Program. However, as discussed in Section 5.2 above, there are additional factors to consider when evaluating program cost-effectiveness, including program free ridership often seen with fixture and appliance rebate programs, as well as the added non-quantifiable benefits associated with a highly visible program like turf replacement rebates.

5.3.2 Opportunities for Future HE Toilet Programs

In order to evaluate potential opportunities for future SFR HE toilet savings in Vallejo, four factors were considered: prior participation in the HE Toilet Rebate Program; the general level of participation in the HE Toilet Rebate Program in an area; age of housing stock; and current water use. As shown on Figure 20, these factors were used to identify where the greatest potential savings for an HE Toilet program remain in Vallejo.[25] Based on this analysis, 2,495 SFR accounts were identified as having the highest potential for savings through participation in a HE Toilet program because they:

1) Have not previously received a rebate through SCWA's HE Toilet Rebate Program;
2) Are located in areas with average or low participation in the HE Toilet Rebate Program to date (see the "hot spot" analysis presented in Figure 16);
3) Have houses constructed prior to 1994 (i.e., were built prior to the effective date of the Energy Policy Act of 1992, which mandated that an efficiency standard of 1.6 gpf or less for toilets within the United States); and
4) Were among the top 20% of SFR water users in 2014.

If all of these 2,495 SFR accounts were to replace existing high-water-use toilets with HE toilets, and based on the estimated savings demonstrated by prior program participants (Table 15), it is estimated that an additional 49,000 HCF/year or about 37 million gallons per year of water savings could be achieved.

[25] The HE Toilet Rebate Program was recently suspended by SCWA and options for future programs are being considered, which may include rebates, direct-install, or other similar programs.

5.3.3 Opportunities for HE Washer Rebate Program

In order to evaluate potential opportunities for future SFR HE washer savings in Vallejo, four factors were considered: prior participation in the HE Washer Rebate Program; the general level of participation in the HE Washer Rebate Program in an area; age of housing stock; and current water use by the account. As shown on Figure 21, these factors were used to identify where the greatest potential savings for the HE Washer Rebate Program remain in Vallejo. Based on this analysis, 4,584 SFR accounts were identified as having the highest potential for savings through the HE Washer Rebate Program because they:

1) Have not previously received a rebate through SCWA's HE Washer Rebate Program;
2) Are located in areas with average or low participation in the HE Washer Rebate Program to date (see the "hot spot" analysis presented in Figure 17);
3) Have houses constructed prior to 2007 (i.e., when the 2005 California Appliance Efficiency Regulations became effective and established minimum standards for the efficiency of residential clothes washers); and
4) Were among the top 20% of SFR water users in 2014.

Estimated Potential Savings	
HE Toilet:	37 million gallons/year
HE Washer:	40 million gallons/year
Turf Replacement:	69 million gallons/year
Water Use Survey:	60 million gallons/year

If all of these 4,584 SFR accounts were to replace existing low-efficiency clothes washers with HE washers, and based on the estimated savings demonstrated by prior program participants (Table 15), it is estimated that an additional 53,000 HCF per year or 40 million gallons per year of water savings could be achieved.

5.3.4 Opportunities for Turf Replacement Rebate Program

In order to evaluate potential opportunities for future SFR Turf Replacement Rebate Program savings in Vallejo, four factors were considered: prior participation in the Turf Replacement Rebate Program; size of potential landscape area; age of housing stock; and current water use by the account. As shown in Figure 22, these factors were used to identify where the greatest potential savings for incentivized turf replacement remain in Vallejo. Based on this analysis, 3,692 SFR accounts were identified as having the highest potential for savings through the Turf Replacement Rebate Program because they:

1) Have not previously received a rebate through SCWA's Turf Replacement Rebate Program;
2) Have a greater than average potential landscape area (estimated as the difference between total lot size and square footage of a home's first floor, per parcel data provided by the Assessor's Office);

3) Have houses constructed prior to 2010 (i.e., when the Vallejo Water-efficient Landscaping Ordinance (Ordinance 1634) became effective and established minimum standards for the efficiency residential landscape irrigation); and
4) Were among the top 20% of SFR water users in 2014.

If all of these 3,692 SFR accounts were to replace an approximately 875 square foot area of turf with water efficient landscaping, and based on the estimated savings demonstrated by prior program participants (Table 15), it is estimated that an additional 92,000 HCF/year or about 69 million gallons per year of water savings could be achieved.

5.3.5 Opportunities for Residential Water Use Survey Program

In order to evaluate potential opportunities for future residential water use surveys in Vallejo, three factors were considered: prior participation in the Residential Water Use Survey Program; trend in water use since 2010; and current water use by the account. As shown in Figure 23, these factors were used to identify where the greatest potential savings for residential water use surveys remain in Vallejo. Based on this analysis, 3,598 SFR accounts were identified as having the highest potential for savings through the Residential Water Use Survey Program because they:

1) Have not previously participated in the SCWA Residential Water Use Survey Program;
2) Increased their water use between 2010 and 2014 (potentially indicating the presence of a leak or change in behavior); and,
3) Were among the top 20% of SFR water users in 2014.

If all of these 3,598 SFR accounts were to receive a water use survey from SCWA, and based on the estimated savings demonstrated by prior program participants (Tables 13 and 14), it is estimated that an additional 126,000 HCF/year or about 60 million gallons per year of water savings could be achieved.

6. ASSESSMENT OF PASSIVE CONSERVATION AND DROUGHT EFFECTS (GOAL 4)

Independent of active conservation programs, residential per capita water use across a community generally declines over time – this decline is often referred to as "passive water conservation" and is attributed primarily to increasing efficiency standards, as discussed further below. In addition, California has been experiencing a historic multi-year drought since 2012 and residents have been required to reduce their water use in response to SWRCB and local emergency regulations. The reduction in water demand due to passive conservation is understood to largely be permanent, while demand reductions associated with droughts tend to be primarily linked to behavioral changes and will rebound at least to some degree following the drought. Passive water conservation and the effects of the drought are discussed in the following sections.

6.1 Passive Water Conservation

Passive water conservation refers to the reduction in water use that occurs as a result of the natural replacement of water-using fixtures and appliances with more efficient fixtures. Some of the primary policy directives influencing fixture and appliance efficiency in the SCWA service area include: the Federal Energy Policy Act of 1992 (42 U.S.C. § 13201 et seq.); the California Appliance Efficiency Regulations (Cal. Code Regs. tit. 20 § 1601-1608); local ordinances adopting or expanding upon the California Model Water Efficient Landscape Ordinance (Cal. Code Regs. tit. 230 § 490-495); and the California Green Building Standards Code (Cal. Code Regs. tit. 24 pt. 11). Passive water conservation also accounts for program "free-riders." A program free-rider is a participant that would have taken the same water-conserving action in the same timeframe had the program not existed. Therefore, the water savings achieved from free-riders that participate in SCWA water conservation programs are not additional savings added by the program and should not be considered active, incentivized water conservation.

A pair of recent studies conducted by DWR and the City of Fairfield underscore the difficulty associated with the estimation of passive conservation rates. In a draft guidebook published to support development of the 2015 UWMP updates, DWR provided guidance to water suppliers who wish to account for passive water conservation in their water demand projections. The guidebook walks through potential methods of estimating water savings from adopted codes, standards, ordinances, or transportation and land use plans. A thorough estimation of these savings is time-intensive and is beyond the scope of the Pilot Study. Recognizing the difficulties inherent in these calculations, DWR suggests that water purveyors may conservatively assume that existing residential customers will reduce unit demands by 5% to 10% by 2035 as a result of passive conservation (DWR, 2016).

The City of Fairfield conducted a study in Fall 2015 to estimate the degree of saturation of low-flow toilets within its service area. City of Fairfield staff conducted in-person surveys at pre-1993 SFR accounts to determine how many low-flow toilets (i.e., 1.6 gpf or less) were

present in the house. The *Low-Flow Toilet Saturation Study* (City of Fairfield, 2015) found that, out of a total of 207 toilets surveyed, 62% were low-flow, which is an increase from 59% of low-flow toilets reported in a similar study conducted in Fairfield in 2008. The results of this study suggest that a 3% increase in low-flow toilet saturation occurred over the seven-year period from 2008 to 2015; this would indicate that toilets are replaced at a rate of approximately 0.4% per year. The Low-Flow Toilet Saturation Study did not report whether or not surveyed households had participated in the HE Toilet Rebate Program, so the rate of program free ridership cannot be estimated. Over the same period from 2008 to 2015, approximately 3.9% of SFR accounts in Fairfield participated in this HE Toilet Rebate Program. It is thus likely that the HE Toilet Rebate Program comprised a significant portion of the 3% increase in low-flow toilet saturation.

6.2 Potential Post-Drought Rebound Effects

In response to the historic drought of 2012-2015, Californians have been asked to reduce their water use significantly, and on 18 May 2015 the SWRCB implemented state-wide prohibitions covering certain water using activities. The SWRCB-mandated prohibitions directly affecting SFR water use include:

- Using potable water to irrigate outdoor landscapes in a manner that causes runoff to adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures;
- Using a hose that dispenses potable water to wash a motor vehicle, unless the hose is fitted with a shut-off nozzle;
- Applying potable water to any driveway or sidewalk;
- Using potable water in a fountain or decorative water feature, unless the water is recirculated;
- Applying potable water to outdoor landscapes during and within 48 hours after measurable rainfall;
- Irrigation of ornamental turf on medians with potable water; and
- Irrigation with potable water of landscapes outside of newly constructed homes and buildings in a manner inconsistent with standards published by the California Building Standards Commission and the Department of Housing and Community Development.

These mandated water use restrictions and people's general willingness to conserve water in the face of drought have certainly resulted in a significant decline in residential water use throughout the state and in Solano County over the last several years (as demonstrated on Figures 4 through 9). However, the degree to which the observed reduction in water demand is a result of the drought, and not other factors such as passive and active conservation, is

not known. Following the drought, SFR water demand in Solano County is likely to rebound to some degree, although it is unlikely to fully recover to pre-drought levels.

The Alliance for Water Efficiency ("AWE") examined the issue of post-drought water demand rebound in a recent report on water use efficiency and demand hardening (AWE, 2015). Using the experiences of seven water suppliers[26] across the Southwestern United States over the past forty years as case studies, the report discovered varying degrees of per capita demand rebound following a period of drought or water shortage. Demand reductions during shortage events in the 1970s and 1980s were primarily achieved through short-term conserving behavior, and thus these reductions did not persist after normal conditions resumed (AWE, 2015). For example, following the California drought of 1976-1977, the City of Santa Rosa, City of Petaluma, and Monte Vista Water District experienced demand rebounds close to or even exceeding pre-drought demands. In recent times, however, longer-term water conservation efforts have been made in response to shortage events, such as the adoption of plumbing codes, replacement of fixtures, installation of water-efficient appliances, and implementation of conservation water rates. Water savings associated with these responses tend to remain even after normal conditions return. Support for these conclusions regarding reduced post-drought water demand rebound is provided in several of the case studies examined in AWE (2015), including the following: Irvine Ranch Water District and the City of Petaluma during the drought of the late 1980s and early 1990s; the City of Santa Fe during the droughts of 1996 and 2000 through 2006; the City of Santa Rosa during the drought of 2007 through 2009; and the City of Boulder during the drought of 2002 through 2003.

While a portion of water demand reduction achieved during the current drought of 2012-2015 is likely due to short-term water conserving behavior, per capita demand is unlikely to rebound to pre-drought levels. As behavioral restrictions, such as landscape irrigation restrictions, are eased, higher consumption will inevitably return. However, the water savings achieved by the HE Toilet Rebate, HE Washer Rebate, and Turf Replacement Rebate Programs, are likely to persist following a return to normal conditions because they are not dependent on behavioral changes. The post-drought response of water savings associated with the Residential Water Use Survey Program will vary depending on what actions were taken by a particular survey. For example, repaired leaks will continue to generate water savings, whereas savings associated with behavioral changes, such as adjustments to sprinkler settings, may be lost as customers revert to prior habits. Overall, the case studies of AWE (2015) suggest that per capita demand will rebound slightly, but will not return to pre-drought levels.

[26] The water suppliers analyzed by AWE (2015) include: City of Boulder, Colorado; City of Santa Fe, New Mexico; San Antonio Water System, Texas; City of Petaluma, California; City of Santa Rosa, California; Monte Vista Water District, California; and Irvine Ranch Water District, California.

7. RECOMMENDATIONS AND POTENTIAL NEXT STEPS (GOAL 5)

As discussed in Section 1, the purpose of the Pilot Study is to gain a greater understanding of SFR water use, water savings achieved by the SCWA SFR water conservation programs to date, and identify remaining water conservation potential. The findings of the Pilot Study show that the SCWA SFR water conservation programs implemented in Vallejo have resulted in a significant and measurable amount of water savings and indicate that additional water conservation potential remains. The scope of this study was developed as an initial set of analyses to guide and inform future conservation activities and analysis by SCWA. Based on the findings of this Pilot Study, potential programs and actions that SCWA may consider are discussed below, including additional analyses that may be performed and potential next steps for conservation programs and public outreach.

Recommended Follow-On Analyses

- This Pilot Study includes a detailed analysis of the impact of conservation program participation on water use for Vallejo SFR customers. Given the diversity of communities within Solano County, particularly with respect to housing age and climate, (two significant factors in determining a customer's water use), the water savings achieved by these programs may be substantially different for other communities. EKI recommends that the analysis presented in Section 5 be performed for additional cities in Solano County, which would result in a more robust estimate of water savings in these areas and in total across the County.

- The SFR accounts with the highest potential water savings opportunities for the four major SCWA conservation programs were identified for Vallejo (Section 5). The SCWA may consider expanding this analysis to include additional cities within Solano County. Such analysis could be used to identify additional areas to target across the County, and allow for more strategic outreach and marketing of water conservation programs in the future.

- The analysis presented herein may be updated to include 2015 water use data and water conservation program participation for Vallejo. Due to the timing of this Pilot Study, water use data were only available through October 2015. Therefore, the analysis for participation in the year 2013 was limited to one year of water use data post-participation. This limitation particularly affects the Turf Replacement Rebate Program analysis, as this program had limited participation its first four years (31 Vallejo SFR participants in 2010-2013) as compared to 2014 and 2015 (113 and 108 Vallejo SFR participants, respectively). If this analysis were updated to include water use for 2015, a longer period post-participation in 2013 could be analyzed, and a much larger set of participants in 2014 could be evaluated relative to their 2015 water use. These additional analyses may help to refine and improve confidence in

the water savings values estimated based on the relatively small dataset of 2013 participants currently available.

- The cost-benefit analysis included as part of this Pilot Study was limited to evaluating the amount of water savings achieved relative to the value of the rebates issued. The analyses could be expanded to consider:

    - SCWA costs associated with administering the programs,
    - costs to treat and supply water,
    - costs to manage and treat wastewater,
    - avoided costs to increase or obtain new water supply sources,
    - energy savings associated with water treatment, and/or
    - additional non-tangible, benefits such as public engagement and education.

    These additional costs and benefits can be modeled and evaluated using available modelling tools (e.g., the Water Conservation Tracking Tool provided by the AWE). The SCWA may consider using such a tool to perform a more detailed cost-benefit analysis on all or some of its water conservation programs, as well as to evaluate cumulative water conservation savings across multiple sectors and over a longer time horizon than was included in the scope of this effort. For reference, further information on the AWE Water Conservation Tracking Tool is provided in Appendix A.

Conservation Programs and Public Outreach

- The Vallejo SFR accounts with the highest potential water savings for each of the four major SCWA conservation programs are identified in Section 5, above. The SCWA may consider targeting these accounts in particular for participation in its programs. Outreach to these accounts may include bill inserts coordinated through the City of Vallejo, direct mailing of brochures, emails (if email information is available), or via other outreach efforts (e.g., door knockers, social media, etc.).

- The SCWA may consider revising its HE Washer Rebate Program and structuring any future HE toilet-focused programs to more actively limit the effects of free-ridership and push the market towards even more efficient fixtures (e.g., less than 1 gpf toilets).

- The SCWA Smart Irrigation Controller Rebate Program has received very little participation to date. As demonstrated by the success of the Turf Replacement Rebate Program, significant water savings can be achieved by reducing outdoor irrigation at SFR accounts. The SCWA may consider expanding and promoting this program, particularly to the areas of the County that appear to experience a greater amount of outdoor water use as identified in the city water use profiles discussed in Section 3 above (e.g., for the cities of Benicia, Fairfield, Vacaville, and Vallejo).

- The SCWA may consider additional or alternative programs designed to target outdoor water use. One such program to consider is as an irrigation controller retrofit program where SFR customers are provided a device that is added to older (non "smart") irrigation controllers. This device then allows customers to adjust their watering intensity relative to the current weather conditions and watering needs. The customers would then periodically (e.g., weekly) receive an email from SCWA indicating what intensity their device should be set to.[27] Another program to consider is a voucher program for water-efficient sprinkler nozzles. These nozzles can replace older, less-efficient sprinkler nozzles and would improve sprinkler performance and reduce water use.[28]

- The SCWA may evaluate the benefit and potential cost-effectiveness of additional water conservation programs such as Home Water Use Reports, direct HE toilet install programs, rebating 0.8 gpf toilets, or implementing other, new water conservation programs could potentially be evaluated using the AWE tool described above, or other similar tools.

- In order to gain a greater understanding of how SFR customers use and think about water conservation, SCWA and its member units may implement a Customer Survey, such as the draft survey provided in Appendix B. This brief survey is intended to gather basic customer information, understand customers' perception of their own water use, and their actions, attitude, and motivations regarding water conservation or the development of supplemental water supply sources such as recycled water. Strategies to increase overall participation and response to the survey may include:

    - providing the survey as a bill insert;
    - providing the survey electronically via the SCWA website;
    - providing incentives to customers such as a chance to win a gift card, HE toilet, smart irrigation controller, or other relevant prize(s); and/ or
    - linking the survey to an event promoting environmental and water awareness such as World Water Day or Earth Day.

[27] A similar program is currently being implemented by the Santa Margarita Water District using the WaterDex device. Information on this program is available on the Santa Margarita Water District website at: http://www.smwd.com/conservation/waterdex/

[28] This program is currently being implemented by water agencies across California. Additional Information on this program is available at the Free SprinklerNozzles.com website: https://www.freesprinklernozzles.com/

8. CONCLUSION

The findings of the Pilot Study show that SCWA's water conservation programs have resulted in a significant and measurable amount of water savings in the SFR sector and indicate that additional cost-effective water conservation potential remains within the SCWA service area. The scope of this study was developed as an initial set of analysis to guide and inform future conservation activities and analysis by SCWA. Based on the findings of this Pilot Study, potential programs and actions that SCWA and its member units can implement have been identified for future consideration.

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Table 1
Summary of Solano County SFR Housing Stock
Solano County Water Agency, California

Housing Age	Benicia	Dixon	Fairfield	Rio Vista	Suisun City	Vacaville	Vallejo	Unincorporated County
pre-1950	1,032	379	371	309	112	611	7,565	93
1950-1969	536	696	6,773	486	57	4,152	7,616	88
1970-1989	4,424	1,706	10,320	186	5,126	13,097	10,311	405
1990-2009	1,376	2,319	8,565	2,437	2,681	8,097	4,796	1,163
2010-2015	32	6	456	307	50	350	55	1,027

Notes
(a) Housing age is summarized per information provided by the Solano County Assessor's Office, August 2015.

Table 2
Summary of SFR Parcel Characteristics
Solano County Water Agency, California

City	Number of SFR Parcels	Average Year Built	Average Lot Size (sq ft)	Average Interior Space (sq ft)	Average Number of Bedrooms	Average Number of Bathrooms
Benicia	7,403	1975	9,467	2,003	3.5	2.4
Dixon	5,143	1966	48,165	1,801	3.4	2.1
Fairfield	26,494	1981	25,990	1,911	3.6	2.3
Rio Vista	3,729	1988	29,432	1,683	2.5	2.1
Suisun City	8,030	1985	7,311	1,652	3.4	2.2
Vacaville	26,348	1979	54,470	1,802	3.4	2.2
Vallejo	30,361	1965	7,315	1,599	3.3	2.0
Unincorporated County	2,800	1982	93,729	2,275	2.6	2.5
County-Wide	**110,308**	**1978**	**27,534**	**1,785**	**3.4**	**2.2**

Abbreviations:
SFR = single-family residential
sq ft = square feet

Notes
(a) Parcel characteristics are summarized per information provided by the Solano County Assessor's Office, August 2015.

Table 3
SFR HE Toilet Rebate Program Participation
Solano County Water Agency, Solano, California

Calendar Year	City							Total
	Benicia	Dixon	Fairfield	Rio Vista (b)	Suisun City	Vacaville	Vallejo	
Number of HE Toilet Rebates Issued to SFR Accounts								
2007	7	0	33	0	3	13	10	66
2008	44	0	69	1	17	56	40	227
2009	83	0	98	0	30	58	79	348
2010	102	0	245	1	74	96	123	641
2011	82	9	315	9	89	275	120	899
2012	66	11	258	9	97	375	147	963
2013	106	11	256	19	94	392	201	1,079
2014	182	18	283	8	85	443	300	1,319
2015	25	0	50	1	17	81	48	222
Total	**697**	**49**	**1,607**	**48**	**506**	**1,789**	**1,068**	**5,764**
Number of SFR Accounts Receiving HE Toilet Rebates (c)								
2007	3	0	13	0	2	6	5	29
2008	27	0	40	1	11	38	20	137
2009	40	0	55	0	17	31	44	187
2010	56	0	155	1	45	59	77	393
2011	47	4	198	5	57	178	71	560
2012	45	7	165	5	65	239	98	624
2013	64	8	172	11	62	248	134	699
2014	108	9	182	7	53	293	193	845
2015 (d)	14	0	36	1	10	51	36	148
Total	**404**	**28**	**1,016**	**31**	**322**	**1,143**	**678**	**3,622**
Total Rebate Dollars Spent								
2007	$948	$0	$5,114	$0	$391	$2,175	$1,700	$10,328
2008	$6,409	$0	$9,933	$125	$3,025	$8,505	$6,600	$34,597
2009	$9,738	$0	$11,090	$0	$2,785	$6,722	$8,593	$38,928
2010	$11,879	$0	$26,929	$125	$8,427	$10,895	$14,100	$72,355
2011	$9,955	$1,125	$36,248	$1,125	$9,892	$32,393	$13,889	$104,627
2012	$7,727	$1,325	$28,593	$946	$10,585	$42,388	$16,755	$108,319
2013	$12,181	$1,150	$28,051	$2,106	$10,172	$44,041	$21,914	$119,616
2014	$18,611	$1,853	$28,554	$813	$8,535	$44,303	$30,294	$132,964
2015 (d)	$1,748	$0	$3,502	$50	$1,190	$6,195	$3,668	$16,353
Total	**$79,196**	**$5,453**	**$178,015**	**$5,290**	**$55,002**	**$197,617**	**$117,513**	**$638,086**
Percentage of Participating Accounts	**4.7%**	**1.1%**	**4.0%**	**0.8%**	**4.1%**	**4.7%**	**2.2%**	**3.5%**

Abbreviations:
HE = high efficiency
SFR = single-family residential

Notes:
(a) Program participation numbers are provided above only for SFR accounts, and only for those records that could be positively matched to Solano County Assessor's parcels.

Table 3
SFR HE Toilet Rebate Program Participation
Solano County Water Agency, Solano, California

(b) Rio Vista residential accounts included both single- and multi-family accounts.
(c) More than one rebate may be issued to an account.
(d) The HE Toilet Rebate Program ended in January 2015, with rebates processed and issued through March 2015. All 2015 records are included.

Table 4
SFR HE Washer Rebate Program Participation
Solano County Water Agency, Solano, California

Calendar Year	City							Total
	Benicia	Dixon	Fairfield	Rio Vista (b)	Suisun City	Vacaville	Vallejo	
Number of HE Washer Rebates Issued to SFR Accounts								
2010	36	4	135	4	35	104	80	398
2011	37	7	193	16	51	152	109	565
2012	91	7	299	16	102	287	210	1,012
2013	63	16	267	18	71	280	163	878
2014	51	15	237	12	69	220	107	711
2015	60	15	123	8	33	112	82	433
Total	**338**	**64**	**1254**	**74**	**361**	**1155**	**751**	**3,997**
Total HE Washer Rebate Dollars Spent								
2010	$4,500	$500	$16,875	$500	$4,375	$13,000	$10,000	49,750
2011	$3,925	$775	$20,125	$1,650	$5,425	$15,800	$11,500	59,200
2012	$8,400	$625	$27,725	$1,550	$9,450	$26,075	$19,325	93,150
2013	$4,725	$1,200	$20,025	$1,350	$5,325	$21,000	$12,225	65,850
2014	$3,850	$1,175	$17,950	$1,000	$5,225	$16,650	$8,000	53,850
2015 (c)	$6,125	$1,400	$12,150	$875	$3,125	$10,675	$8,000	42,350
Total	**$31,525**	**$5,675**	**$114,850**	**$6,925**	**$32,925**	**$103,200**	**$69,050**	**$364,150**
Percentage of Participating Accounts	**3.9%**	**2.5%**	**4.9%**	**2.0%**	**4.6%**	**4.7%**	**2.4%**	**3.8%**

Abbreviations:
HE = high efficiency
SFR = single-family residential

Notes:
(a) Program participation numbers are provided above only for SFR accounts, and only for those records that could be positively matched to Solano County Assessor's parcels.
(b) Rio Vista residential accounts included both single- and multi-family accounts.
(c) Program participation numbers provided for 2015 represent a partial year only. HE washer rebate records are included through 1 May 2015. HE washer rebate records prior to 2010 were not available.

Table 5
SFR Turf Replacement Rebate Program Participation
Solano County Water Agency, Solano, California

Calendar Year	City							Total
	Benicia	Dixon	Fairfield	Rio Vista (b)	Suisun City	Vacaville	Vallejo	
Number of Turf Replacement Rebates Issued to SFR Accounts								
2010	2	0	7	1	1	3	3	17
2011	2	2	7	0	0	9	4	24
2012	5	2	4	0	2	3	4	20
2013	13	1	19	2	5	16	20	76
2014	77	8	50	21	9	91	116	372
2015 (c)	147	43	148	27	41	212	108	726
Total	**246**	**56**	**235**	**51**	**58**	**334**	**255**	**1,235**
Area of Turf Replaced (square feet)								
2010	1,900	0	11,555	375	1,101	1,310	6,190	22,431
2011	1,564	1,529	4,536	0	0	8,000	3,567	19,196
2012	2,916	1,592	2,561	0	1,960	3,839	5,434	18,302
2013	13,177	1,307	17,720	1,548	4,934	13,784	17,813	70,282
2014	65,320	9,302	44,314	12,615	7,123	90,644	109,333	338,651
2015 (c)	134,047	42,204	149,874	20,509	46,848	199,650	94,233	687,365
Total	**218,924**	**55,934**	**230,560**	**35,047**	**61,966**	**317,227**	**236,570**	**1,156,226**
Area of Turf Rebated (square feet) (d)								
2010	1,900	0	6,310	375	1,000	1,310	3,000	13,895
2011	1,564	1,529	4,312	0	0	6,838	3,305	17,548
2012	2,872	1,592	2,561	0	1,900	3,000	3,977	15,902
2013	9,934	1,000	15,265	1,384	4,140	12,052	15,643	59,418
2014	58,713	6,760	37,744	12,290	6,605	74,519	88,413	285,044
2015 (c)	109,001	33,867	111,785	17,838	33,485	154,142	77,024	537,142
Total	**183,984**	**44,748**	**177,977**	**31,887**	**47,130**	**251,861**	**191,362**	**928,948**
Total Rebate Dollars Spent								
2010	$950	$0	$4,155	$190	$600	$655	$2,800	$9,350
2011	$950	$919	$2,419	$0	$0	$4,109	$1,940	$10,337
2012	$1,712	$956	$1,547	$0	$1,140	$1,800	$2,386	$9,541
2013	$9,934	$1,000	$15,265	$1,384	$4,140	$12,052	$15,269	$59,044
2014	$58,713	$6,760	$37,744	$12,290	$6,605	$74,519	$88,413	$285,044
2015 (c)	$109,001	$33,867	$111,785	$17,838	$33,485	$154,142	$77,024	$537,142
Total	**$181,260**	**$43,502**	**$172,915**	**$31,702**	**$45,970**	**$247,277**	**$187,832**	**$910,458**
Percentage of Participating Accounts	**2.9%**	**2.14%**	**0.92%**	**1.37%**	**0.74%**	**1.37%**	**0.81%**	**1.19%**

Abbreviations:
SFR = single-family residential

Notes:
(a) Program participation numbers are provided above only for SFR accounts, and only for those records that could be positively matched to Solano County Assessor's parcels.
(b) Rio Vista residential accounts included both single- and multi-family accounts.
(c) Turf replacement rebate records are included through December 2015.
(d) Rebates are issued for a maximum of 1,000 sqare feet of replaced turf for SFR accounts. Approximately 37% of program participants replaced an area of turf greater than 1,000 square feet.

Table 6
SFR Residential Water Use Survey Program Participation
Solano County Water Agency, Solano, California

Calendar Year	City							Total
	Benicia	Dixon	Fairfield	Rio Vista (b)	Suisun City	Vacaville	Vallejo	
Number of Water Use Surveys Performed at SFR Accounts								
2010	0	0	0	0	1	0	0	1
2011	60	6	221	1	24	54	114	480
2012	145	10	258	0	32	69	151	665
2013	66	12	141	0	21	194	69	503
2014	58	1	111	1	39	58	52	320
2015 (c)	46	0	174	65	37	219	44	585
Total	**375**	**29**	**905**	**67**	**154**	**594**	**430**	**2,554**
Percentage of Participating Accounts	**4.4%**	**1.1%**	**3.5%**	**1.8%**	**2.0%**	**2.4%**	**1.4%**	**2.5%**

Abbreviations:
SFR = single-family residential

Notes:
(a) Program participation numbers are provided above only for SFR accounts, and only for those records that could be positively matched to Solano County Assessor's parcels.
(b) Rio Vista residential accounts include both single- and multi-family accounts.
(c) Program participation numbers provided for 2015 represent a partial year only. Residential water survey records are included through 9 November 2015.

Table 7
SFR Smart Irrigation Controller Rebate Program Participation
Solano County Water Agency, Solano, California

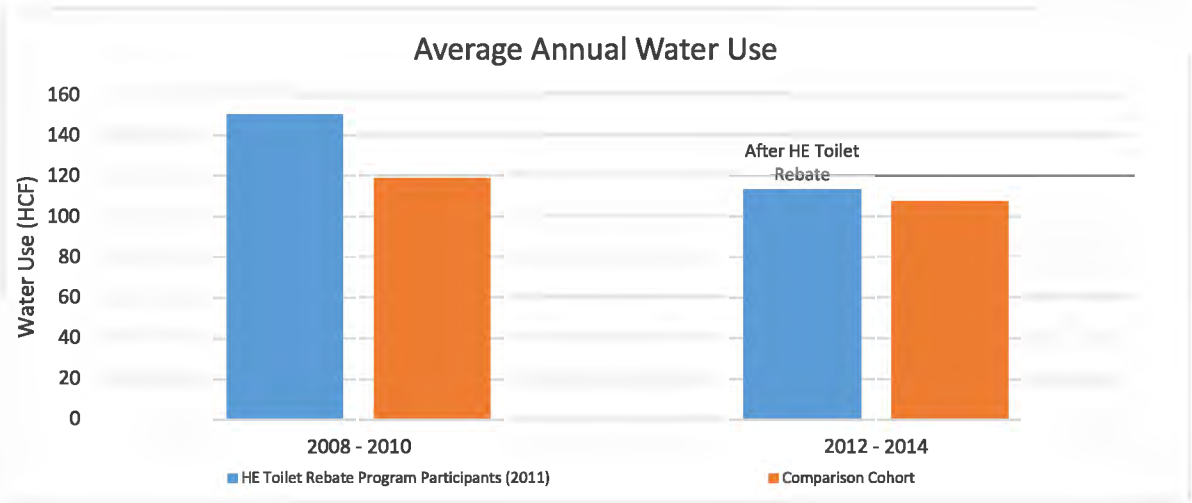
Calendar Year	Member Unit							Total
	Benicia	Dixon	Fairfield	Rio Vista (b)	Suisun City	Vacaville	Vallejo	
Number of Smart Irrigation Controller Rebates Issued to SFR Accounts								
2011	0	0	1	0	0	0	2	3
2012	0	0	1	0	0	1	1	3
2013	2	0	1	0	0	0	1	4
2014	1	1	2	0	0	0	1	5
2015 (c)	1	0	1	0	0	2	2	6
Total	**4**	**1**	**4**	**0**	**0**	**2**	**4**	**15**
Percentage of Participating Accounts	**0.05%**	**0.04%**	**0.02%**	**0%**	**0%**	**0.008%**	**0.01%**	**0.01%**

Abbreviations:
SFR = single-family residential

Notes:
(a) Program participation numbers are provided above only for SFR accounts, and only for those records that could be positively matched to Solano County Assessor's parcels.
(b) Rio Vista residential accounts included both single- and multi-family accounts.
(c) Program participation numbers provided for 2015 represent a partial year only. Smart irrigation controller rebate records are included through 23 November 2015.

Table 8
SFR HE Toilet Rebate Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

	Units	HE Toilet Rebate Program Participants (a)	Comparison Cohort (b)
Account Characteristics			
Number of Accounts	--	69	345
Age of Housing	--	1890 - 1999	1898 - 2010
Average House Size	sq ft	1,839	1,514
Average Number of Bedrooms	--	3.6	3.3
Average Number of Bathrooms	--	2.3	2.0
Total Number of Rebates Issued	--	116	n/a
Number of Accounts Receving 1 Rebate	--	35	n/a
Number of Accounts Receving 2 Rebates	--	21	n/a
Number of Accounts Receving 3 Rebates	--	13	n/a
Total Dollar Value of Rebates Issued	$	13,425	n/a
Average Rebate Value	$	116	n/a
Water Use			
Average Annual Water Use 2008 - 2010	HCF	150	119
Average Annual Water Use 2012 - 2014	HCF	113	107
Estimated Water Savings			
Annual Water Use Reduction per Account	HCF	37	11
Annual Water Savings due to HE Toilet Rebate Program Participation per Account (c)	HCF	26	n/a
	gal	19,448	n/a
Annual Water Savings per HE Toilet Rebate Issued (c) (d)	HCF	15	n/a
	gal	11,220	n/a
Rebate Cost per 100 Gallons of Water Saved Over a 10-Year Period (e)	$/100 gal	0.06	n/a



Abbreviations

BAWSCA = Bay Area Water Supply and Conservation Agency
fl = flush
FY = fiscal year
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

Table 8
SFR HE Toilet Rebate Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

Notes

(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.

(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received HE toilet rebates in 2011.

(c) Estimated annual water savings associated with the HE Toilet Rebate Program are calculated as the incremental amount of water saved by the HE Toilet Rebate Program participants over that of the Comparison Cohort accounts, after accounting for those accounts that received multiple rebates.

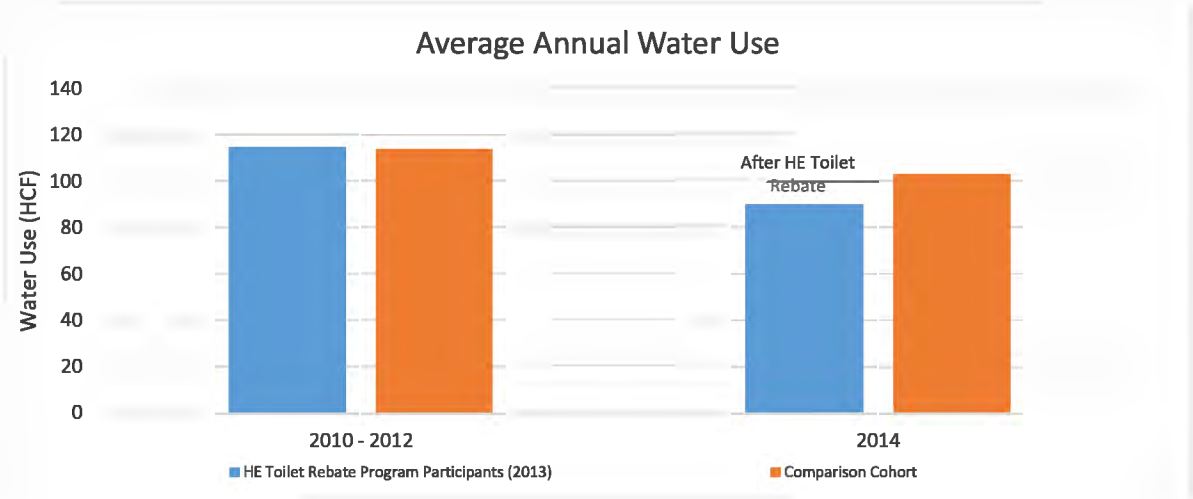
(d) Expected annual water savings per HE toilet change out would be approximately 5,618 gallons, using the following calculation (BAWSCA, 2013):
(3.5 gal/fl - 1.28 gal/fl) x 5 fl/toilet/day/person x 2.6 persons/house / 2.3 toilets/house x 365 days = 4,580 gal
This calculation assumes that a toilet rated at 3.5 gal/fl actually operates at 3.5 gal/fl. However, the operational water use may be substantially higher depending on the condition of the toilet and how well it has been maintained (Aquacraft, 2011).

(e) Rebate cost per 100 gallons of water saved over a ten-year period is calculated as the total dollar value of rebates issued divided by the annual water savings per HE toilet rebate extended over a ten-year period.

(f) Totals may not sum exactly due to rounding.

Table 9
SFR HE Toilet Rebate Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

	Units	HE Toilet Rebate Program Participants (a)	Comparison Cohort (a)
Account Characteristics			
Number of Accounts	--	121	605
Age of Housing	--	1910 - 2005	1900 - 2010
Average House Size	sq ft	1,652	1,626
Average Number of Bedrooms	--	3.3	3.3
Average Number of Bathrooms	--	2.1	2.0
Total Number of Rebates Issued	--	181	n/a
Number of Accounts Receving 1 Rebate	--	79	n/a
Number of Accounts Receving 2 Rebates	--	24	n/a
Number of Accounts Receving 3 Rebates	--	18	n/a
Total Dollar Value of Rebates Issued	$	19,747	n/a
Average Rebate Value	$	109	n/a
Water Use			
Average Annual Water Use 2010 - 2012	HCF	115	114
Average Annual Water Use 2014	HCF	90	103
Estimated Water Savings			
Annual Water Use Reduction per Account	HCF	25	11
Annual Water Savings due to HE Toilet Rebate Program Participation per Account (c)	HCF	14	n/a
	gal	10,472	n/a
Annual Water Savings per HE Toilet Rebate Issued (c) (d)	HCF	9.1	n/a
	gal	6,807	n/a
Rebate Cost per 100 Gallons of Water Saved Over a 10-Year Period (e)	$/100 gal	0.10	n/a



Abbreviations
BAWSCA = Bay Area Water Supply and Conservation Agency
fl = flush
FY = fiscal year
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

Table 9
SFR HE Toilet Rebate Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

Notes

(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.

(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received HE toilet rebates in 2013.

(c) Estimated annual water savings associated with the HE Toilet Rebate Program are calculated as the incremental amount of water saved by the HE Toilet Rebate Program participants over that of the Comparison Cohort accounts, after accounting for those accounts that received multiple rebates.

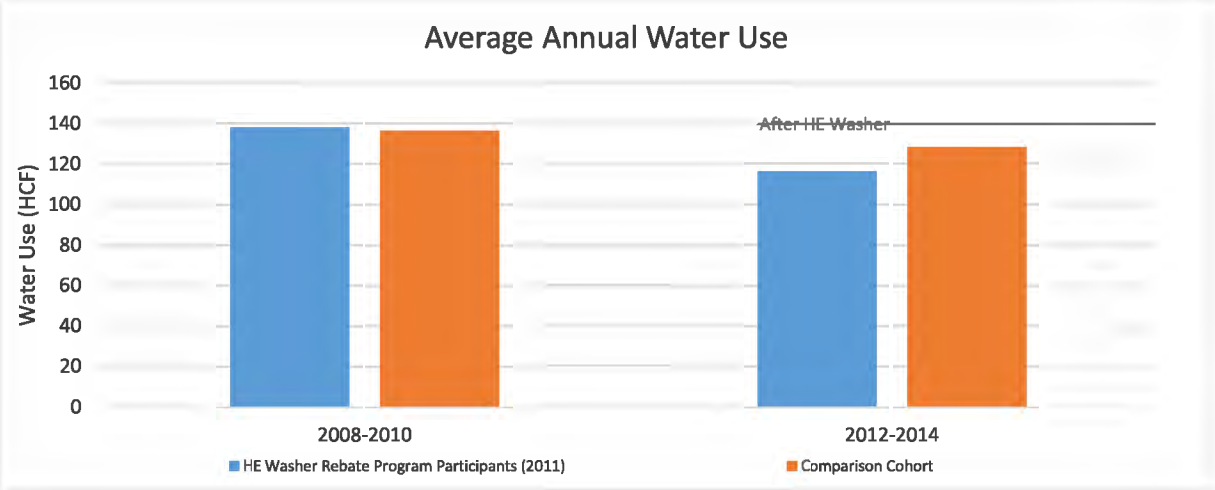
(d) Expected annual water savings per HE toilet change out would be approximately 5,618 gallons, using the following calculation (BAWSCA, 2013):
(3.5 gal/fl - 1.28 gal/fl) x 5 fl/toilet/day/person x 2.6 persons/house / 2.3 toilets/house x 365 days = 4,580 gal
This calculation assumes that a toilet rated at 3.5 gal/fl actually operates at 3.5 gal/fl. However, the operational water use may be substantially higher depending on the condition of the toilet and how well it has been maintained (Aquacraft, 2011).

(e) Rebate cost per 100 gallons of water saved over a ten-year period is calculated as the total dollar value of rebates issued divided by the annual water savings per HE toilet rebate extended over a ten-year period.

(f) Totals may not sum exactly due to rounding.

Table 10
SFR HE Washer Rebate Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

	Units	HE Washer Rebate Program Participants (a)	Comparison Cohort (b)
Account Characteristics			
Number of Accounts	--	107	535
Age of Housing	--	1915-2011	1890-2010
Average House Size	sq ft	1,776	1,764
Average Number of Bedrooms	--	3.5	2.2
Total Number of Rebates Issued	--	107	n/a
Total Dollar Value of Rebates Issued	$	11,275	n/a
Average Rebate Value	$	105	n/a
Water Use			
Average Annual Water Use 2008-2010	HCF	138	136
Average Annual Water Use 2012-2014	HCF	116	128
Estimated Water Savings			
Reduction in Water Use per Account	HCF	22	8
Annual Water Savings per HE Washer Rebate Issued (c) (d)	HCF	13	n/a
	gal	9,724	n/a
Rebate Cost per 100 Gallons of Water Saved Over a 10-Year Period (e)	$/100 gal	0.11	n/a



Abbreviations
BAWSCA = Bay Area Water Supply and Conservation Agency
FY = fiscal year
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

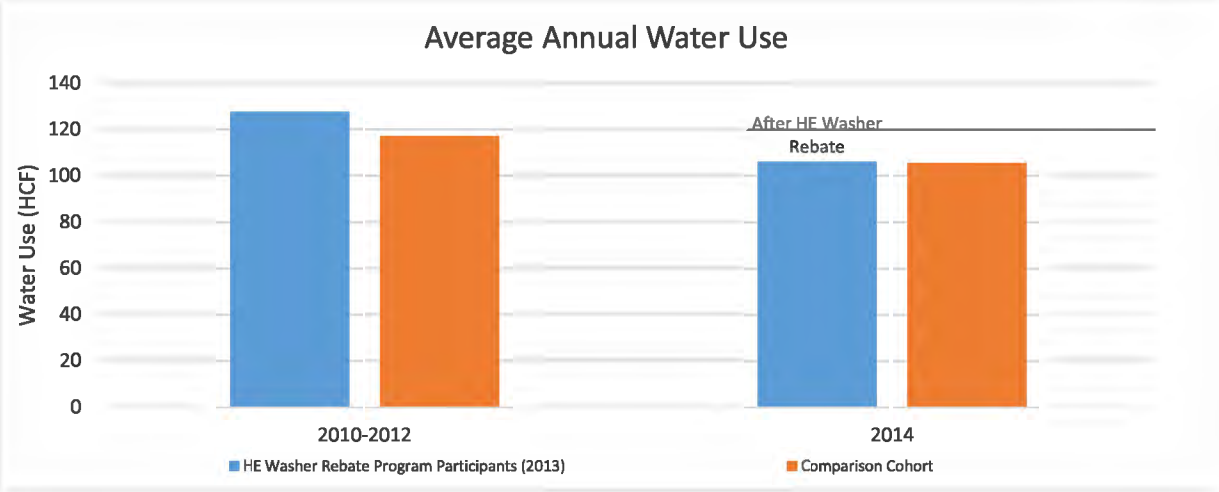
Notes
(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.
(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received HE washer rebates in 2011.

Table 10
SFR HE Washer Rebate Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

(c) Estimated annual water savings associated with the HE Washer Rebate Program are calculated as the incremental amount of water saved by the HE Washer Rebate Program participants over that of the Comparison Cohort accounts.
(d) Expected annual water savings per HE washer change out would be approximately 9,129 gallons, using the following calculation (BAWSCA, 2013; Aquacraft, 2011):
(39 gal/load - 13 gal/load) x 2.6 people/house x 0.37 loads/person/day x 365 days = 9,129 gal.
(e) Rebate cost per 100 gallons of water saved over a ten-year period is calculated as the total dollar value of rebates issued divided by the annual water savings per HE washer rebate extended over a ten-year period.
(f) Totals may not sum exactly due to rounding.

Table 11
SFR HE Washer Rebate Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

	Units	HE Washer Rebate Program Participants (a)	Comparison Cohort (b)
Account Characteristics			
Number of Accounts	--	162	810
Age of Housing	--	1890-2010	1890-2011
Average House Size	sq ft	1,753	1,712
Average Number of Bedrooms	--	3.5	3.4
Total Number of Rebates Issued	--	162	n/a
Total Dollar Value of Rebates Issued	$	12,150	n/a
Average Rebate Value	$	75	n/a
Water Use			
Average Annual Water Use 2010 - 2012	HCF	128	117
Average Annual Water Use 2014	HCF	106	106
Estimated Water Savings			
Reduction in Water Use per Account	HCF	22	11
Annual Water Savings per HE Washer Rebate Issued (c) (d)	HCF	10	n/a
	gal	7,480	n/a
Rebate Cost per Gallon of Water Saved Over a 10-Year Period (e)	$/100 gal	0.10	n/a



Abbreviations

BAWSCA = Bay Area Water Supply and Conservation Agency
FY = fiscal year
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

Notes

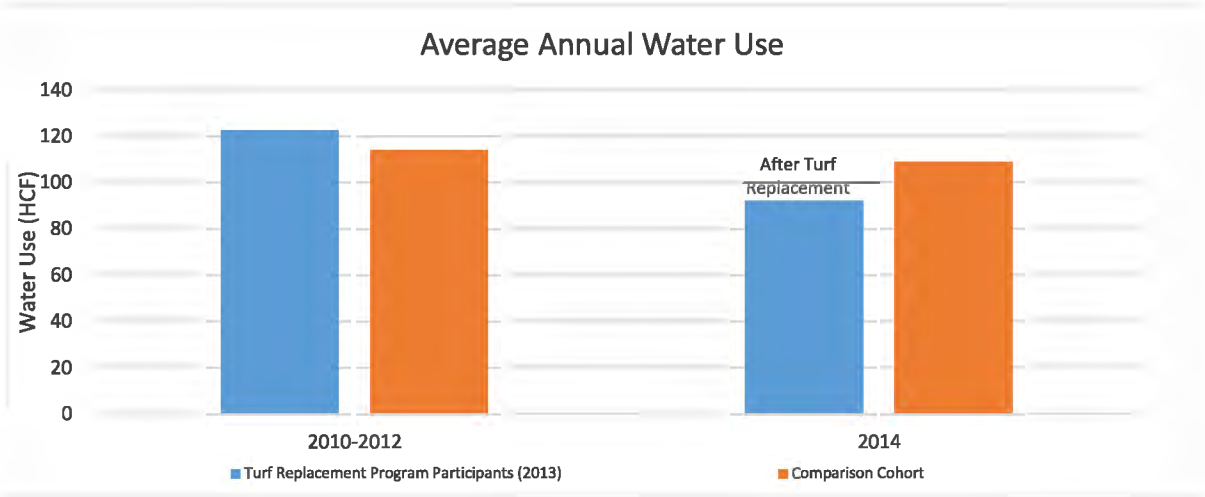
(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.
(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received HE washer rebates in 2013.

Table 11
SFR HE Washer Rebate Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

(c) Estimated annual water savings associated with the HE Washer Rebate Program are calculated as the incremental amount of water saved by the HE Washer Rebate Program participants over that of the Comparison Cohort accounts.
(d) Expected annual water savings per HE washer change out would be approximately 9,129 gallons, using the following calculation (BAWSCA, 2013; Aquacraft, 2011):
(39 gal/load - 13 gal/load) x 2.6 people/house x 0.37 loads/person/day x 365 days = 9,129 gal.
(e) Rebate cost per 100 gallons of water saved over a ten-year period is calculated as the total dollar value of rebates issued divided by the annual water savings per HE washer rebate extended over a ten-year period.
(f) Totals may not sum exactly due to rounding.

Table 12
SFR Turf Replacement Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, Solano, California

	Units	Turf Replacement Program (a)	Comparison Cohort (b)
Account Characteristics			
Number of Accounts	--	17	85
Home Construction Years	--	1918 - 1995	1930 - 1994
Average House Size	sq ft	1,798	1,707
Average Lot Size	sq ft	12,980	7,743
Total Area of Turf Replaced Under Rebate	sq ft	13,031	n/a
Total Area of Turf Replaced, Including Area in Excess of Rebate (c)	sq ft	14,874	n/a
Average Area of Turf Replaced per Account	sq ft	875	n/a
Total Dollar Value of Rebates Issued	$	12,657	n/a
Average Rebate	$	745	n/a
Water Use			
Average Annual Water Use 2010 - 2012	HCF	123	114
Average Annual Water Use 2014	HCF	92	109
Estimated Water Savings			
Reduction in Water Use per Account	HCF	30	5
Annual Water Savings per Average Turf Replacement Project (875 sq ft) (d) (e)	HCF	25	n/a
	gal	18,700	
Annual Water Savings per 100 sq ft turf replaced (d)	HCF	3	n/a
	gal	2,244	n/a
Rebate Cost per 100 Gallons of Water Saved Over a 10-Year Period (f)	$/gal	0.40	n/a



Abbreviations
BAWSCA = Bay Area Water Supply and Conservation Agency
FY = fiscal year
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

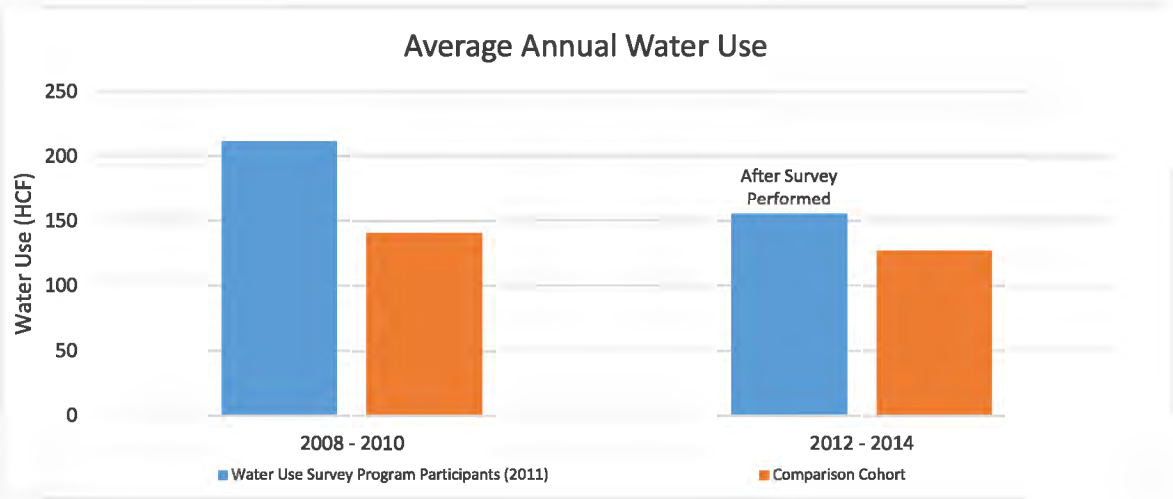
Table 12
SFR Turf Replacement Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, Solano, California

Notes

(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.
(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received turf replacement rebates in 2013.
(c) In 2013, rebates were issued for a maximum of 1,000 sq ft of replaced turf for SFR accounts. The total amount of turf replaced exceeded 1,000 sq ft for 7 out of the 17 participating accounts.
(d) Estimated annual water savings due to the Turf Replacement Program are calculated as the incremental amount of water saved by the Turf Replacement Program Participants over that of the Comparison Cohort accounts.
(e) Expected annual water savings would be approximately 16,363 gallons per average turf replacement project (875 sq ft), using the following calculation (BAWSCA, 2013):
(3.5 acre-feet/acre - 1.0 acre-feet/acre) /43,560 sq ft/acre x 875 sq ft x 325,851 gal/acre-foot = 16,363 gal
(f) Rebate cost per gallon of water saved over a ten-year period is calculated as the total dollar value of rebates issued divided by the annual water savings per average turf replacement project (assumed to be 875 sq ft) extended over a ten-year period.
(g) Totals may not sum exactly due to rounding.

Table 13
SFR Water Use Survey Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

	Units	Water Use Survey Program Participants (a)	Comparison Cohort (b)
Account Characteristics			
Number of Accounts	--	95	475
Home Construction Years	--	1912 - 2006	1890 - 2010
Average House Size	sq ft	2,075	1,847
Average Number of Bedrooms	--	3.7	3.5
Average Number of Bathrooms	--	2.4	2.3
Average Lot Size	sq ft	10,784	7,664
Median Lot Size	sq ft	8,146	6,610
Number of Surveys Performed	--	95	n/a
Number of Surveys - Leaks Identified	--	10	n/a
Number of Surveys - Irrigation System Settings Adjusted	--	32	n/a
Number of Surveys - Hardware Distributed (c)	--	34	n/a
Water Use			
Average Annual Water Use 2008 - 2010	HCF	211	141
Average Annual Water Use 2012 - 2014	HCF	155	127
Estimated Water Savings			
Reduction in Water Use per Account	HCF	56	14
Annual Water Savings per Survey Performed (d)	HCF	42	n/a
	gal	31,416	n/a



Abbreviations
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

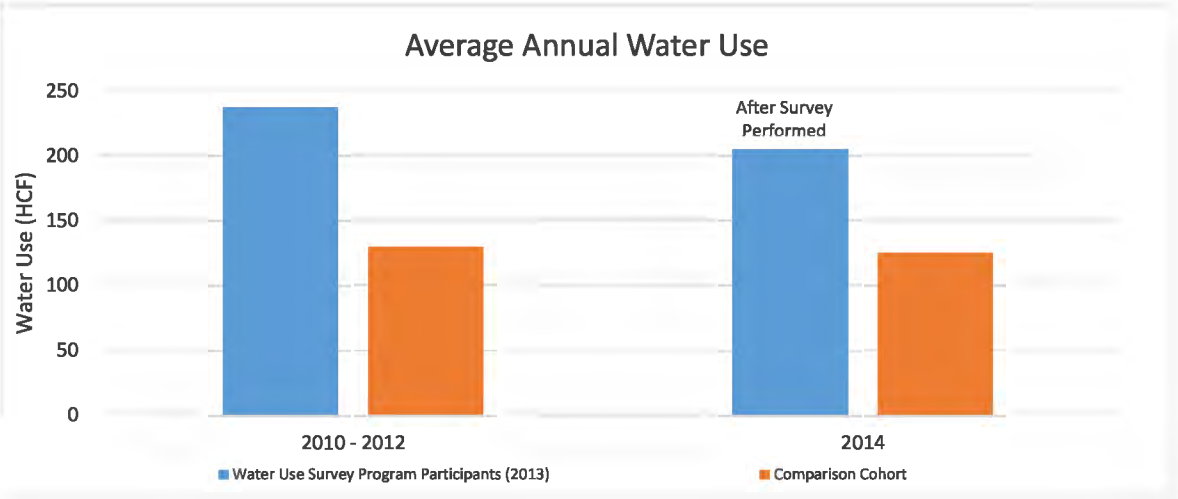
Notes
(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.
(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received a water use survey in 2011.

Table 13
SFR Water Use Survey Program Water Savings (2011) – City of Vallejo
Solano County Water Agency, California

(c) Fixture hardware distributed includes kitchen and bathroom sink aerators, showerheads, and hose nozzles.
(d) Estimated annual water savings associated with the Water Use Survey Program are calculated as the incremental amount of water saved by the Water Use Survey Program participants over that of the Comparison Cohort accounts.

Table 14
SFR Water Use Survey Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

	Units	Water Use Survey Program Participants (a)	Comparison Cohort (a)
Account Characteristics			
Number of Accounts	--	34	170
Home Construction Years	--	1933 - 2011	1890 - 2007
Average House Size	sq ft	2,242	1,757
Average Number of Bedrooms	--	3.5	3.3
Average Number of Bathrooms	--	2.5	2.5
Average Lot Size	sq ft	11,234	7,321
Median Lot Size	sq ft	8,548	6,876
Number of Surveys Performed	--	34	n/a
Number of Surveys - Leaks Identified	--	6	n/a
Number of Surveys - Irrigation System Settings Adjusted	--	11	n/a
Number of Surveys - Hardware Distributed (c)	--	28	n/a
Water Use			
Average Annual Water Use 2008 - 2010	HCF	237	129
Average Annual Water Use 2012 - 2014	HCF	205	125
Estimated Water Savings			
Reduction in Water Use per Account	HCF	32	4
Annual Water Savings per Survey Performed (d)	HCF	28	n/a
	gal	20,944	n/a



Abbreviations
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
n/a = not applicable
SFR = single-family residential
sq ft = square feet

Notes
(a) Accounts included for analysis are limited to those (1) for which water billing history was available and (2) that are identified by as single-family residences by the Solano County Assessor's Office.
(b) Accounts selected for the "Comparison Cohort" were randomly selected from the same neighborhoods (i.e., same census tract) as those that received a water use survey in 2013.

Table 14
SFR Water Use Survey Program Water Savings (2013) – City of Vallejo
Solano County Water Agency, California

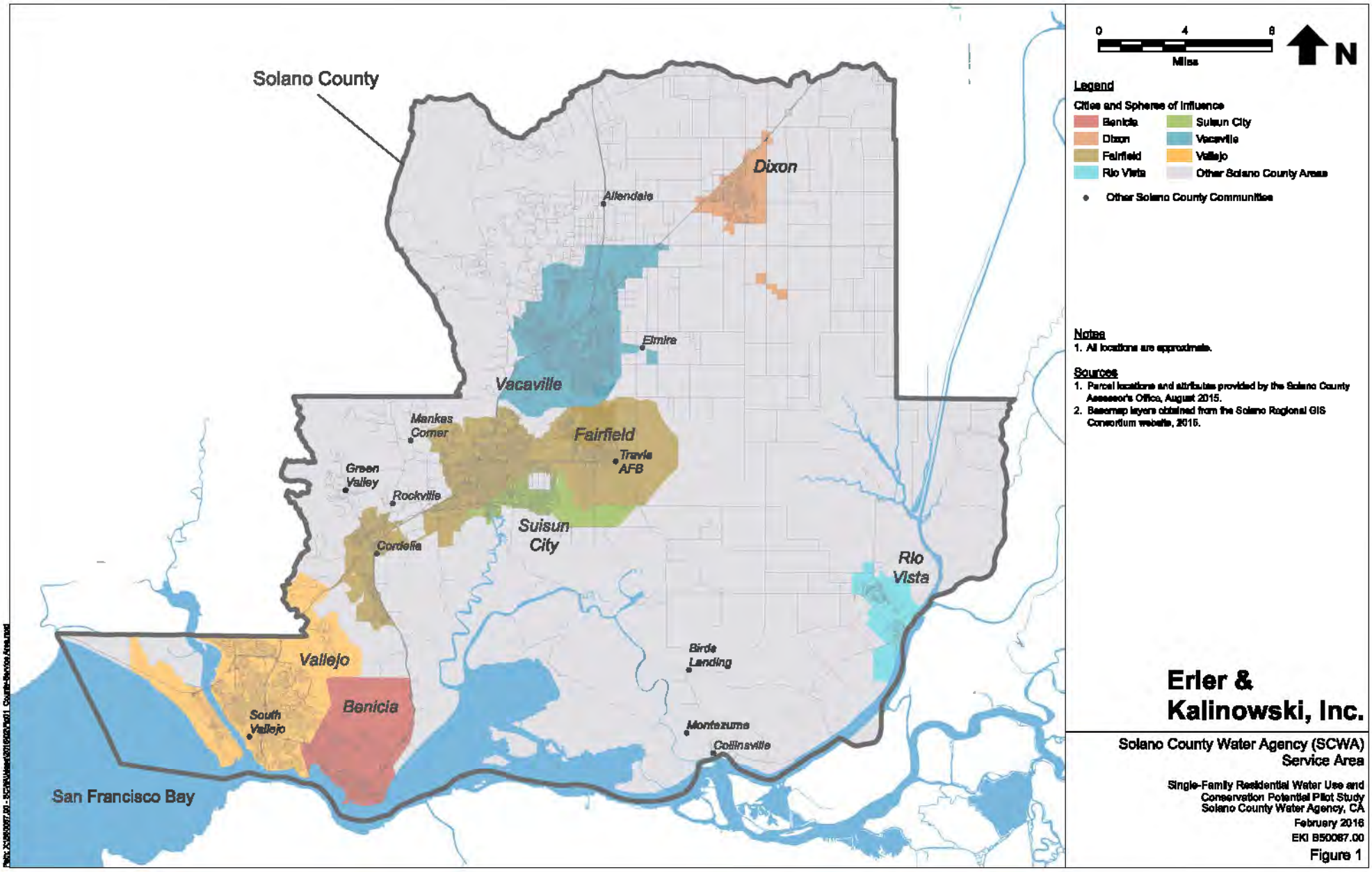
(c) Fixture hardware distributed includes kitchen and bathroom sink aerators, showerheads, and hose nozzles.
(d) Estimated annual water savings associated with HE Toilet Rebate Program are calculated as the incremental incremental amount of water saved by the Water Use Survey Program participants over that of the Comparison Cohort accounts.

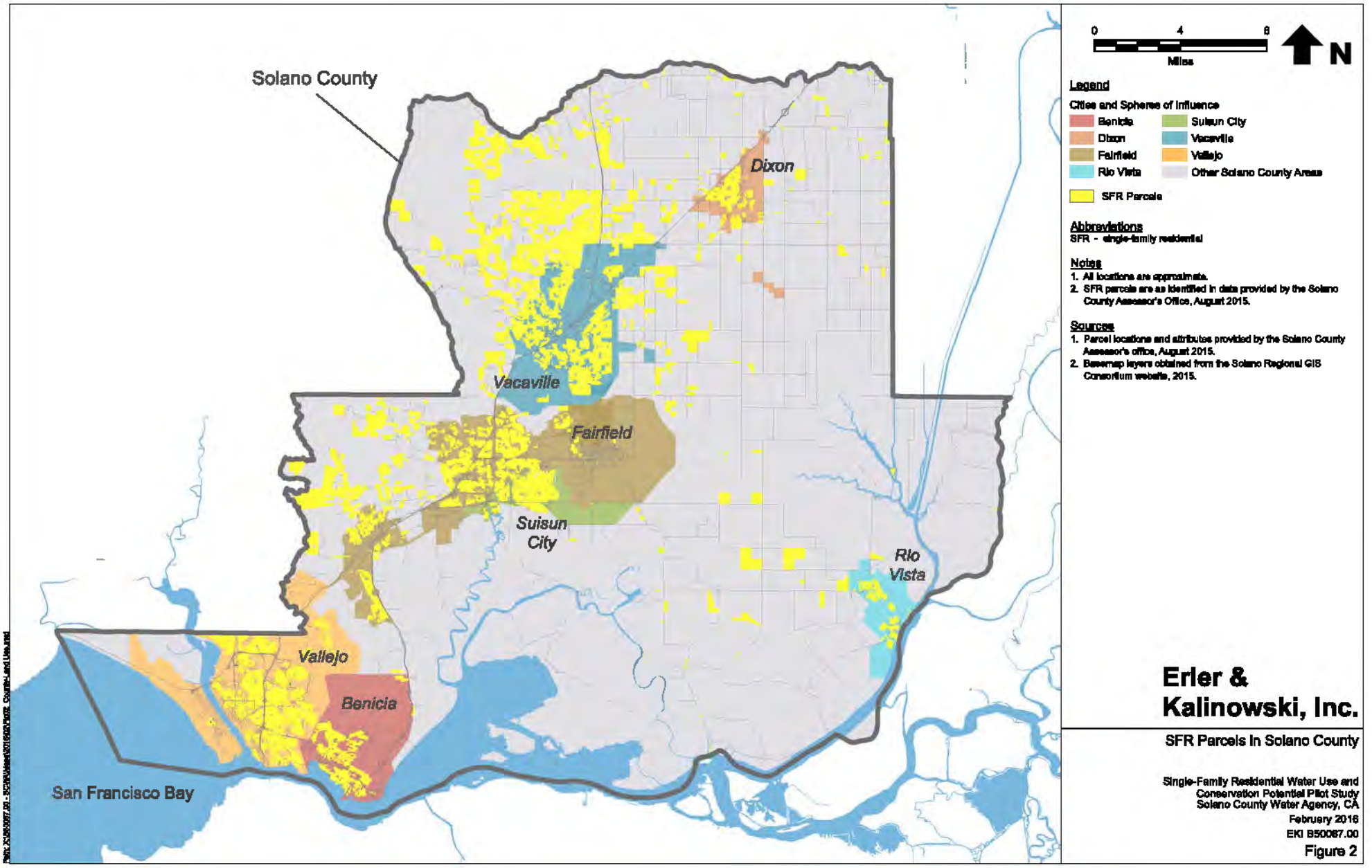
Table 15
Summary of Estimated SFR Rebate Program Savings and Costs - City of Vallejo
Solano County Water Agency, California

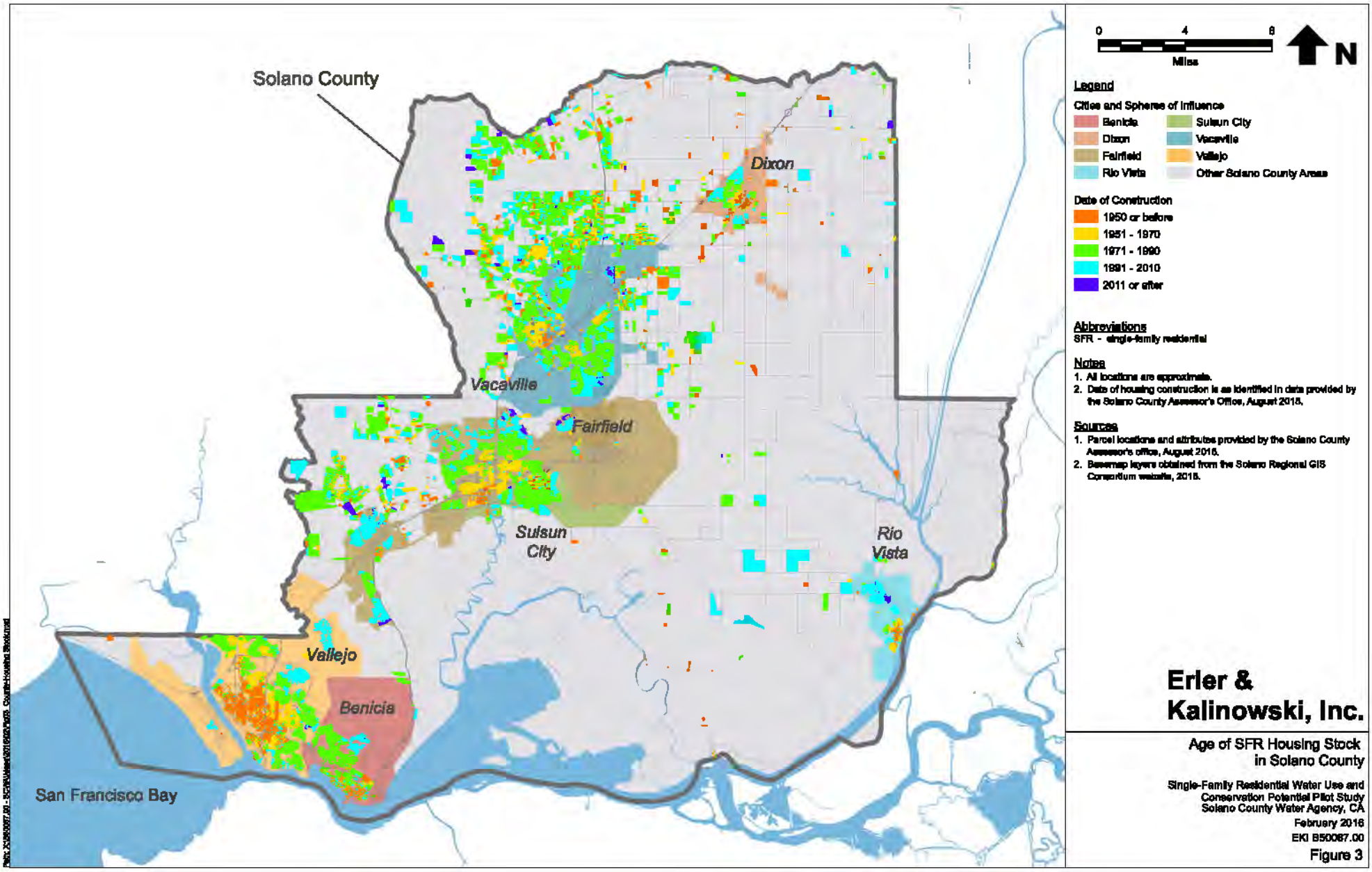
	Units	HE Toilet Rebate	HE Washer Rebate	Turf Replacement Rebate
Estimated Range of Annual Water Savings, per account (a)	HCF	14 - 26	10 - 13	25
	gal	10,000 - 19,000	7,500-9,800	18,700
Estimated Water Savings Over a 10-year Period, per account (b)	HCF	200	115	250
	gal	150,000	86,000	187,000
Estimated Range of Rebate Cost per 100 Gallons of Water Saved Over a 10-year Period (a)	$/100 gal	0.06 - 0.10	0.10-0.11	0.40

Abbreviations
gal = gallons
HCF = one hundred cubic feet
HE = high efficiency
SFR = single-family residential

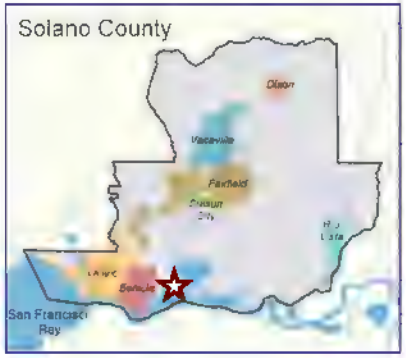
Notes
(a) Estimated water savings are summarized from Tables 6 through 12.
(b) Estimated water savings over a 10-year period are calculated based on the average of the range of water savings per note (a).


Solano County
Dixon
Allendale
Elmira
Vacaville
Mankas Corner
Fairfield
Travis AFB
Green Valley
Rockville
Suisun City
Cordelia
Rio Vista
Vallejo
Benicia
South Vallejo
Birds Landing
Montezuma
Collinsville
San Francisco Bay
0
4
8
Miles
N
Legend
Cities and Spheres of Influence
Benicia
Dixon
Fairfield
Rio Vista
Suisun City
Vacaville
Vallejo
Other Solano County Areas
Other Solano County Communities
Notes
1. All locations are approximate.
Sources
1. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
2. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
Solano County Water Agency (SCWA) Service Area
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00
Figure 1

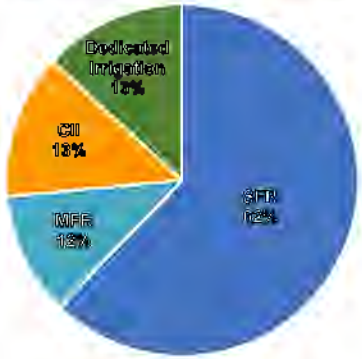

Solano County
Dixon
Vacaville
Fairfield
Suisun City
Rio Vista
Vallejo
Benicia
San Francisco Bay
0
4
8
Miles
N
Legend
Cities and Spheres of Influence
Benicia
Dixon
Fairfield
Rio Vista
Suisun City
Vacaville
Vallejo
Other Solano County Areas
SFR Parcels
Abbreviations
SFR - single-family residential
Notes
1. All locations are approximate.
2. SFR parcels are as identified in data provided by the Solano County Assessor's Office, August 2015.
Sources
1. Parcel locations and attributes provided by the Solano County Assessor's office, August 2015.
2. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
SFR Parcels in Solano County
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00
Figure 2


Solano County
Dixon
Vacaville
Fairfield
Suisun City
Rio Vista
Vallejo
Benicia
San Francisco Bay
0
4
8
Miles
N
Legend
Cities and Spheres of Influence
Benicia
Dixon
Fairfield
Rio Vista
Suisun City
Vacaville
Vallejo
Other Solano County Areas
Date of Construction
1950 or before
1951 - 1970
1971 - 1990
1991 - 2010
2011 or after
Abbreviations
SFR - single-family residential
Notes
1. All locations are approximate.
2. Date of housing construction is as identified in data provided by the Solano County Assessor's Office, August 2015.
Sources
1. Parcel locations and attributes provided by the Solano County Assessor's office, August 2015.
2. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
Age of SFR Housing Stock in Solano County
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00
Figure 3

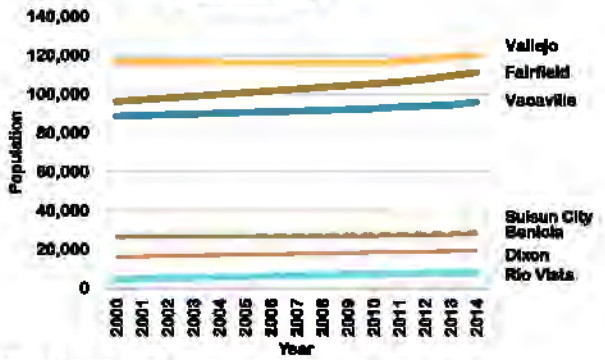
CITY OF BENICIA WATER USE PROFILE



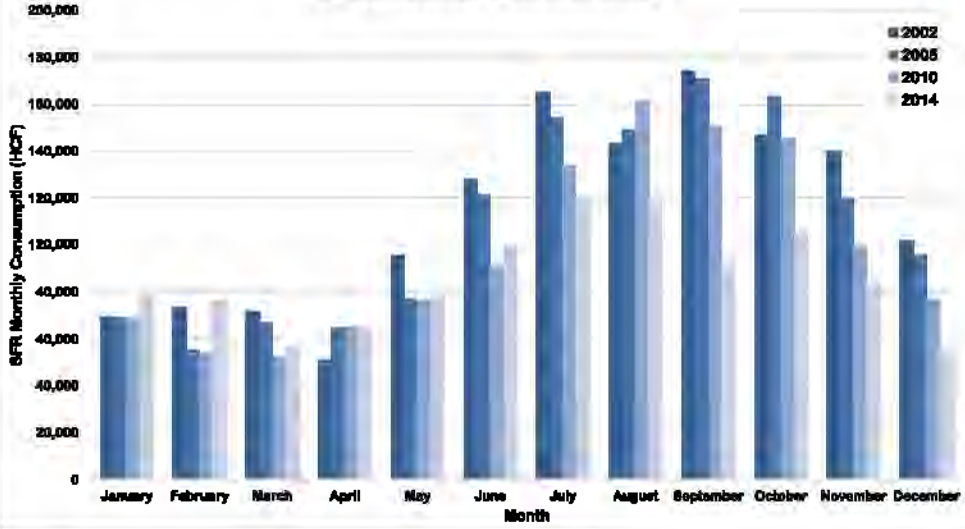
2014 Water Use by Sector



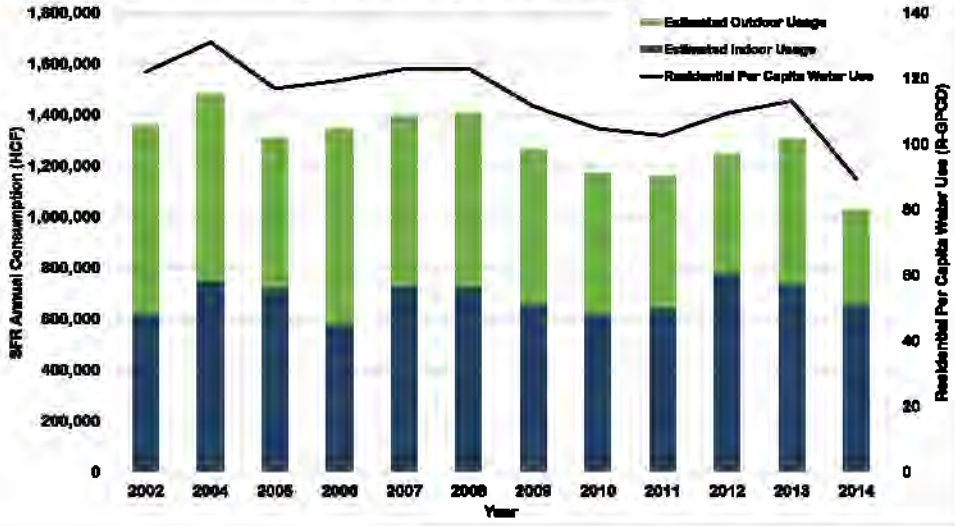
Population



SFR Monthly Consumption



SFR Annual Consumption



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential

Notes

1. Non-revenue water is not included in water use by sector calculations.
2. Water use data for 2003 are unavailable.
3. Annual indoor water use is estimated as the amount of water used during the lowest water use month, normalized by the number of days in the month and projected over the year. Annual outdoor water use was estimated to be the difference between total annual water use and the estimated annual indoor water use.
4. Residential per capita water use is calculated as the total water consumption by both SFR and MFR accounts divided by the total population.

Sources

1. Water use data provided by the City of Benicia on 10 December 2015.
2. Population data interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

Erler & Kalinowski, Inc.

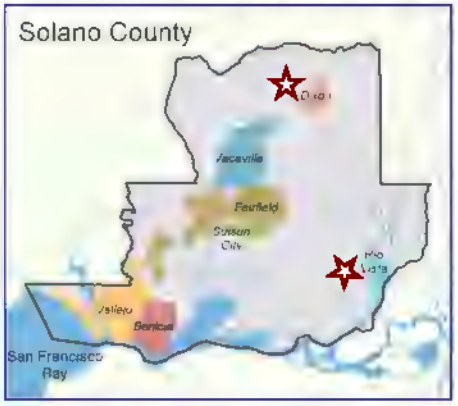
City of Benicia
Water Use Profile

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

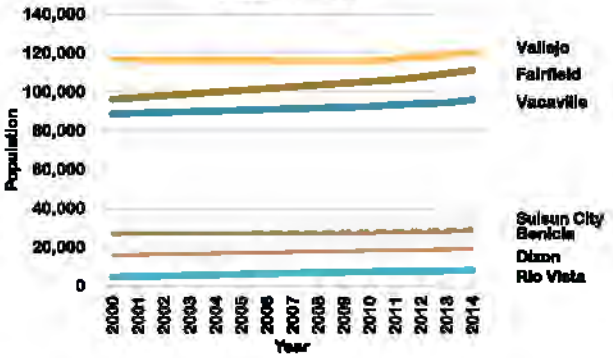
February 2016
EKI B50067.00

Figure 4

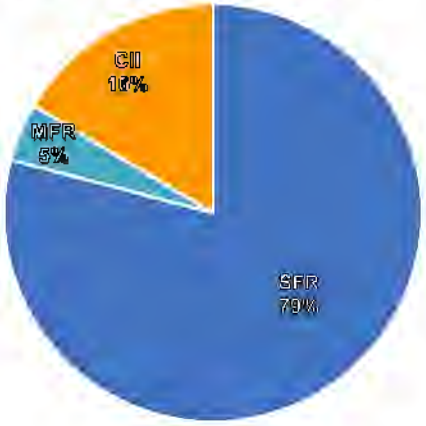
CITIES OF DIXON AND RIO VISTA WATER USE PROFILES



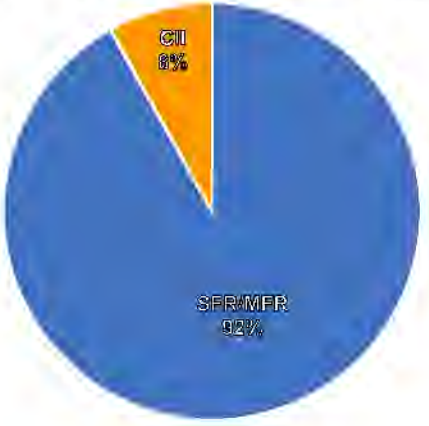
Population



City of Dixon 2010 Water Use by Sector



City of Rio Vista 2010 Water Use by Sector



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential
UWMP = Urban Water Management Plan

Notes

1. Non-revenue water is not included in water use by sector calculations.

Sources

1. Water use data obtained from 2010 UWMPs.
2. Population data interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

Erler & Kalinowski, Inc.

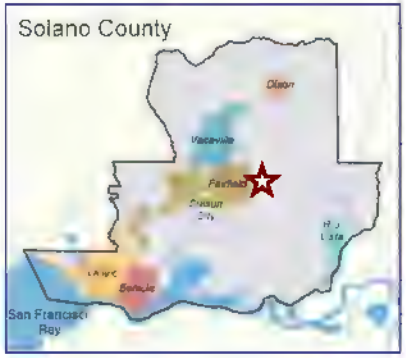
Cities of Dixon and Rio Vista
Water Use Profiles

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

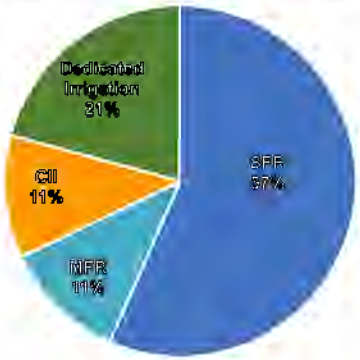
February 2016
EKI B50067.00

Figure 5

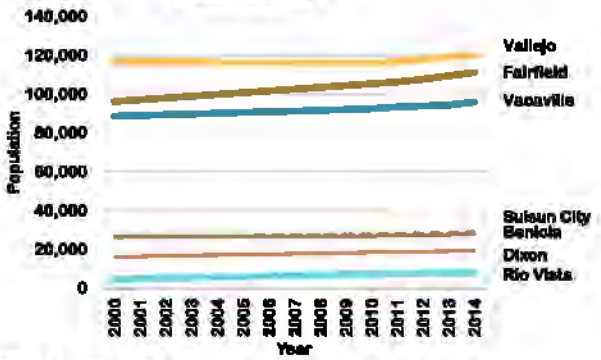
CITY OF FAIRFIELD WATER USE PROFILE



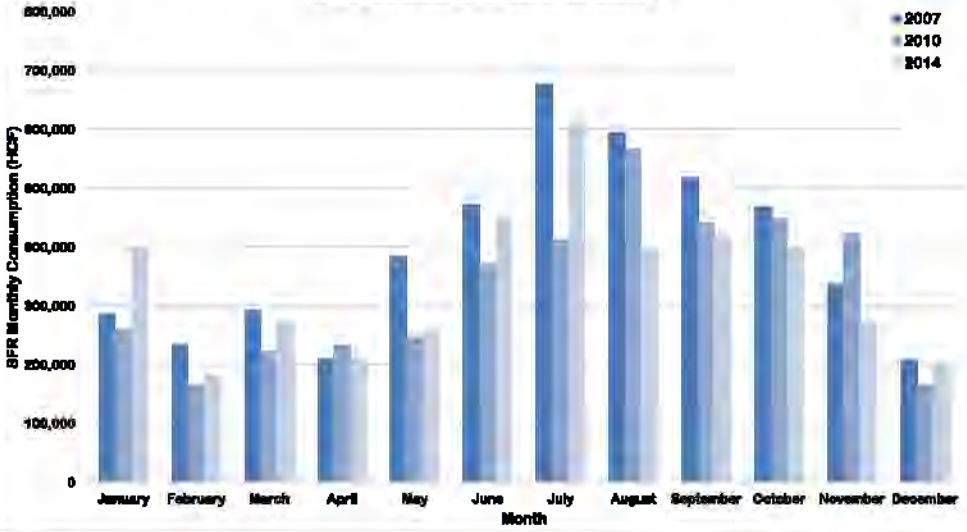
2014 Water Use by Sector



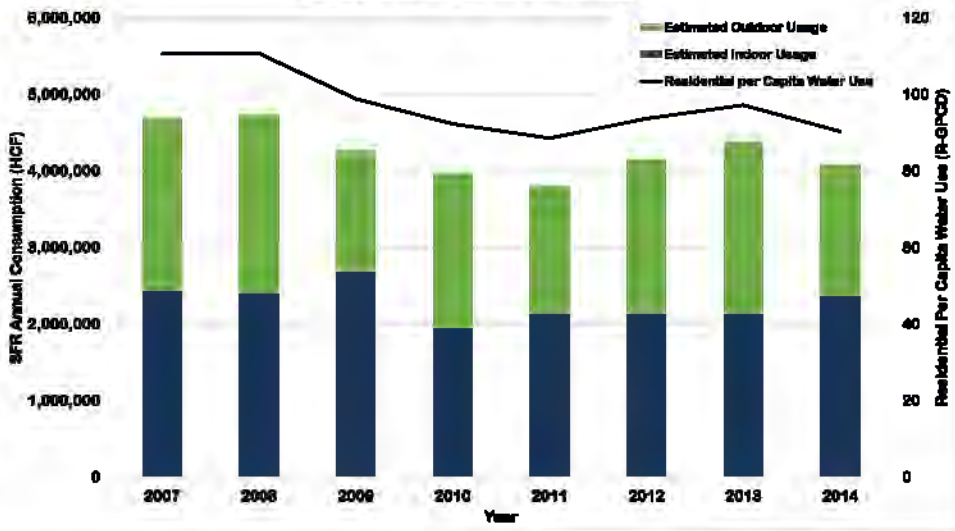
Population



SFR Monthly Consumption



SFR Annual Consumption



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential

Sources

1. Water use data provided by City of Fairfield on 20 January 2016.
2. Population data for interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

Notes

1. Non-revenue water is not included in water use by sector calculations.
2. Annual Indoor water use is estimated as the amount of water used during the lowest water use month, normalized by the number of days in the month and projected over the year. Annual outdoor water use was estimated to be the difference between total annual water use and the estimated annual indoor water use.
3. Residential per capita water use is calculated as the total water consumption by both SFR and MFR accounts divided by the total population.

Erler & Kalinowski, Inc.

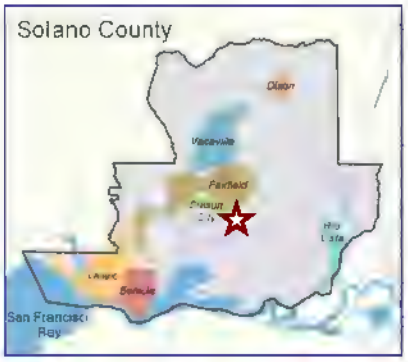
City of Fairfield
Water Use Profile

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

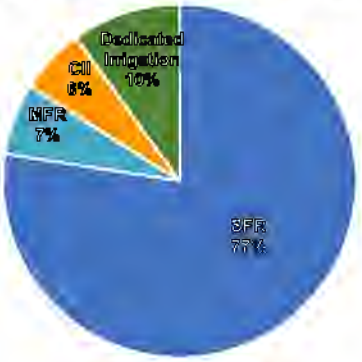
February 2016
EKI B50067.00

Figure 6

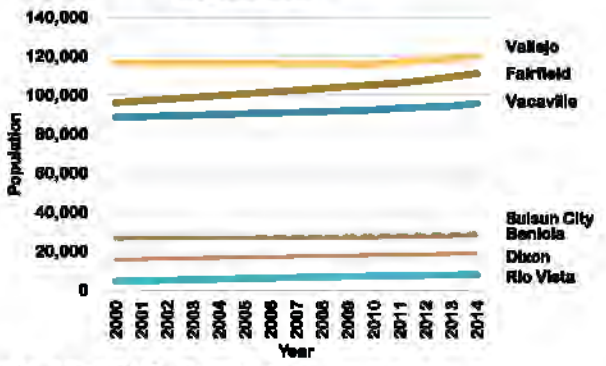
CITY OF SUISUN CITY WATER USE PROFILE



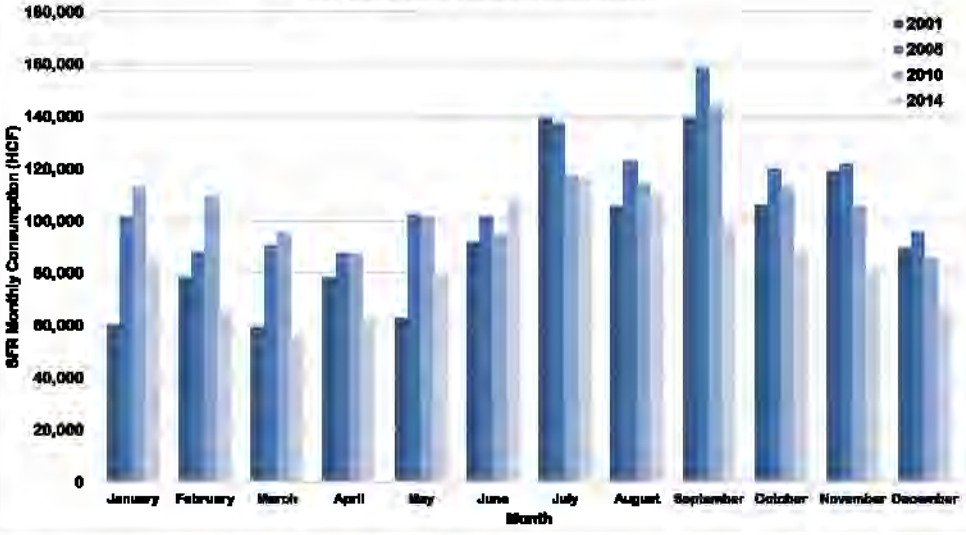
2014 Water Use by Sector



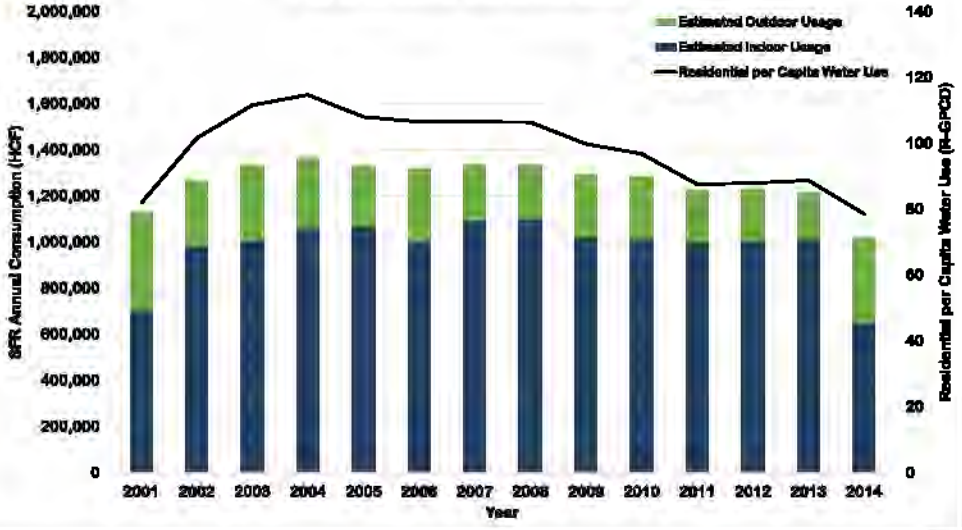
Population



SFR Monthly Consumption



SFR Annual Consumption



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential

Sources

1. Water use data provided by City of Suisun City on 24 September 2015.
2. Population data interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

Notes

1. Non-revenue water is not included in water use by sector calculations.
2. Annual indoor water use is estimated as the amount of water used during the lowest water use month, normalized by the number of days in the month and projected over the year. Annual outdoor water use was estimated to be the difference between total annual water use and the estimated annual indoor water use.
3. Residential per capita water use is calculated as the total water consumption by both SFR and MFR accounts divided by the total population.

Erler & Kalinowski, Inc.

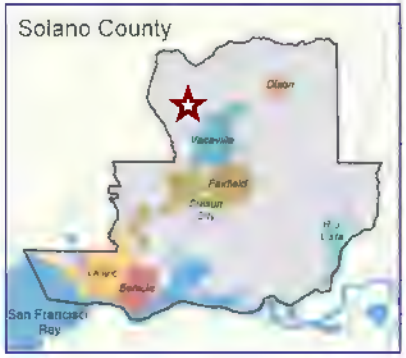
City of Suisun City
Water Use Profile

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

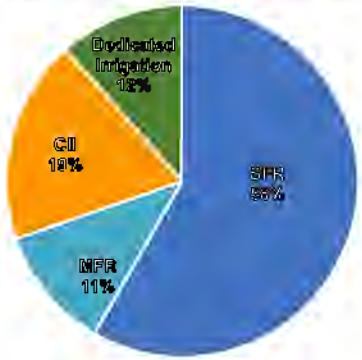
February 2016
EKI B50067.00

Figure 7

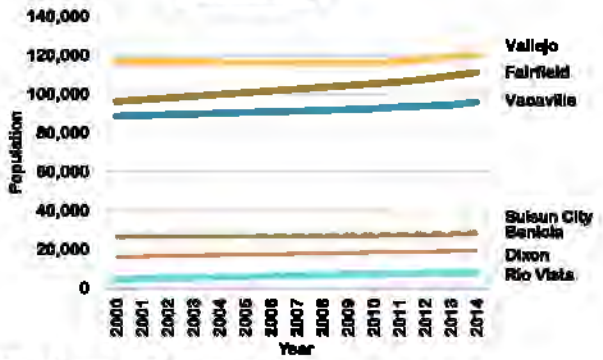
CITY OF VACAVILLE WATER USE PROFILE



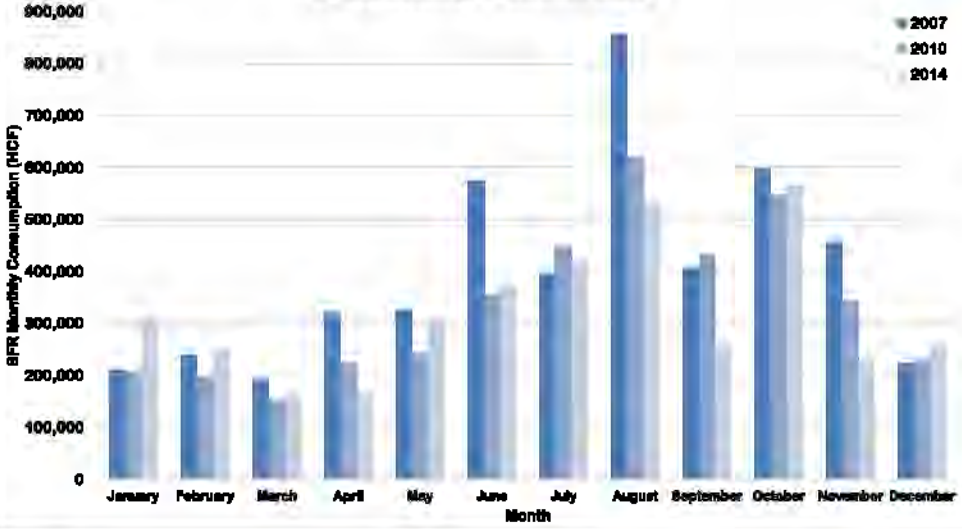
2014 Water Use by Sector



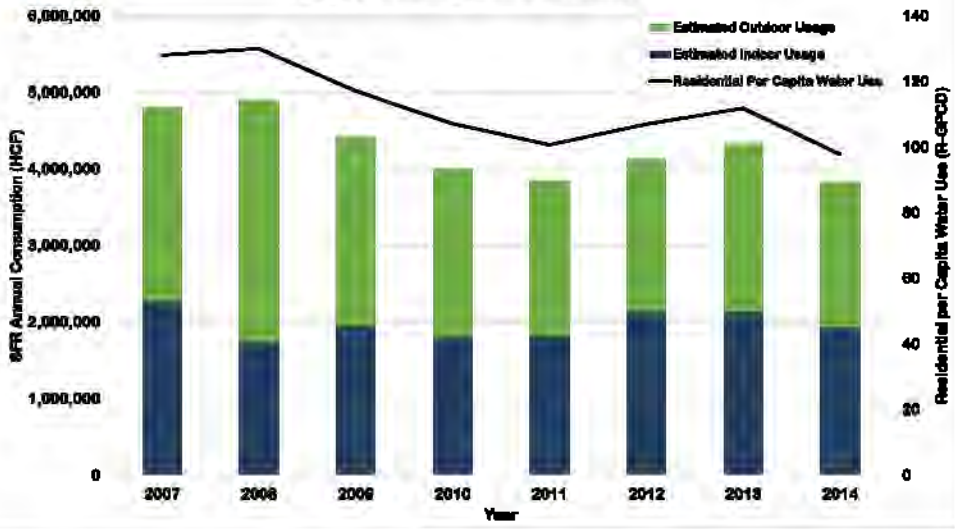
Population



SFR Monthly Consumption



SFR Annual Consumption



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential

Notes

1. Non-revenue water is not included in water use by sector calculations.
2. A small portion of the City of Vacaville's SFR accounts (approximately 0.3%) include separate dedicated meters for irrigation. The estimated indoor and outdoor water usage is based on usage by SFR meters, not including the dedicated irrigation meters, which may result in a slight underestimation of outdoor water use relative to indoor water use.
3. Annual indoor water use is estimated as the amount of water used during the lowest water use month, normalized by the number of days in the month and projected over the year. Annual outdoor water use was estimated to be the difference between total annual water use and the estimated annual indoor water use.
4. Residential per capita water use is calculated as the total water consumption by both SFR and MFR accounts divided by the total population.

Sources

1. Water use data provided by the City of Vacaville on 21 October 2015.
2. Population data interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

Erler & Kalinowski, Inc.

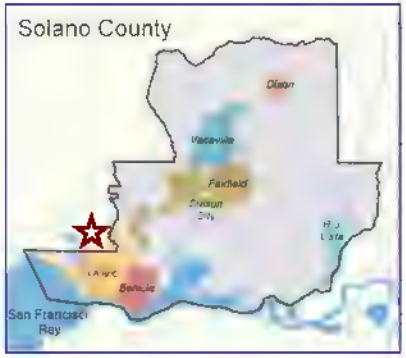
City of Vacaville
Water Use Profile

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

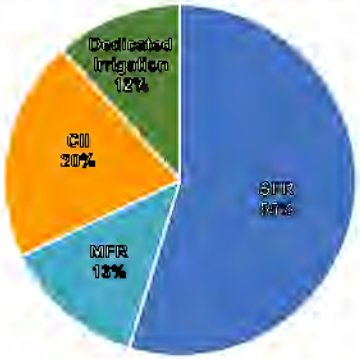
February 2016
EKI B50067.00

Figure 8

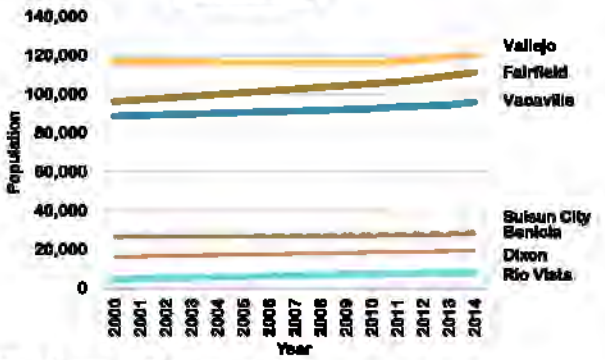
CITY OF VALLEJO WATER USE PROFILE



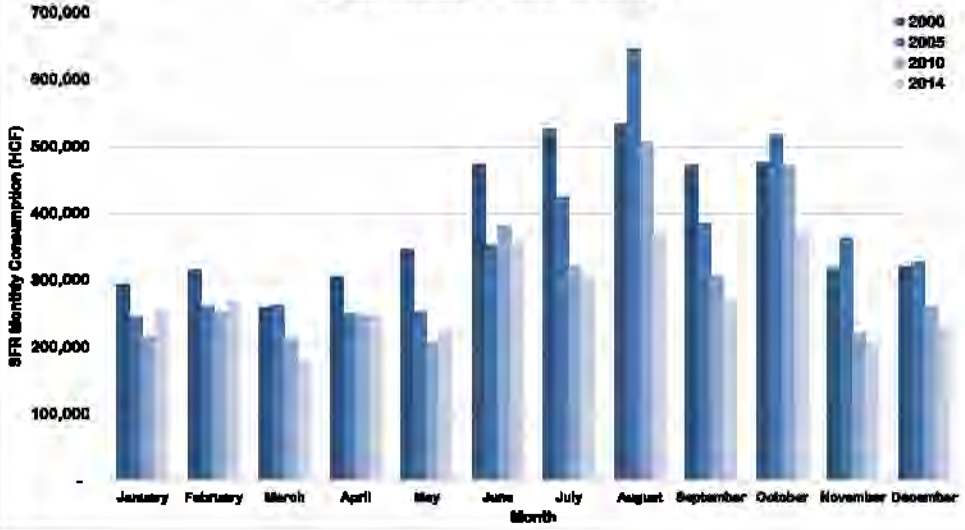
2010 Water Use by Sector



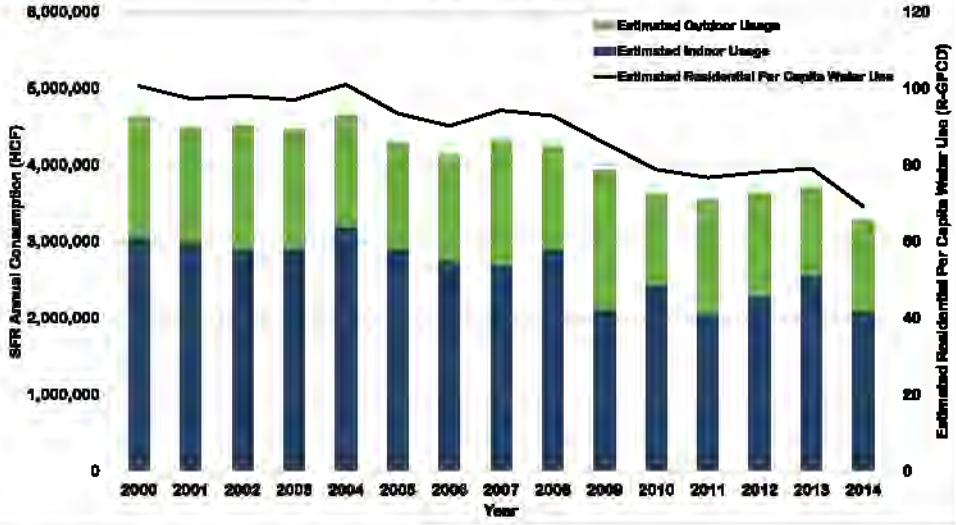
Population



SFR Monthly Consumption



SFR Annual Consumption



Abbreviations

CII = commercial, industrial, and institutional
HCF = one hundred cubic feet
MFR = multi-family residential
SFR = single-family residential
UWMP = Urban Water Management Plan

Notes

1. Non-revenue water is not included in water use by sector calculations.
2. Annual indoor water use is estimated as the amount of water used during the lowest water use month, normalized by the number of days in the month and projected over the year. Annual outdoor water use was estimated to be the difference between total annual water use and the estimated annual indoor water use.
3. Residential per capita water use is estimated by summing SFR water use with estimated MFR water use, which is approximated based upon the percentage of SFR and MFR water use in 2010, and dividing by population.

Sources

1. Data for water use by sector from Draft 2010 UWMP. All other water use data provided by the City of Vallejo on 3 November 2015.
2. Population data interpolated linearly from US Census Bureau data for 2000 and 2010. Population data for 2011-2014 obtained from US Census Bureau Subcounty Total Resident Population Estimates.

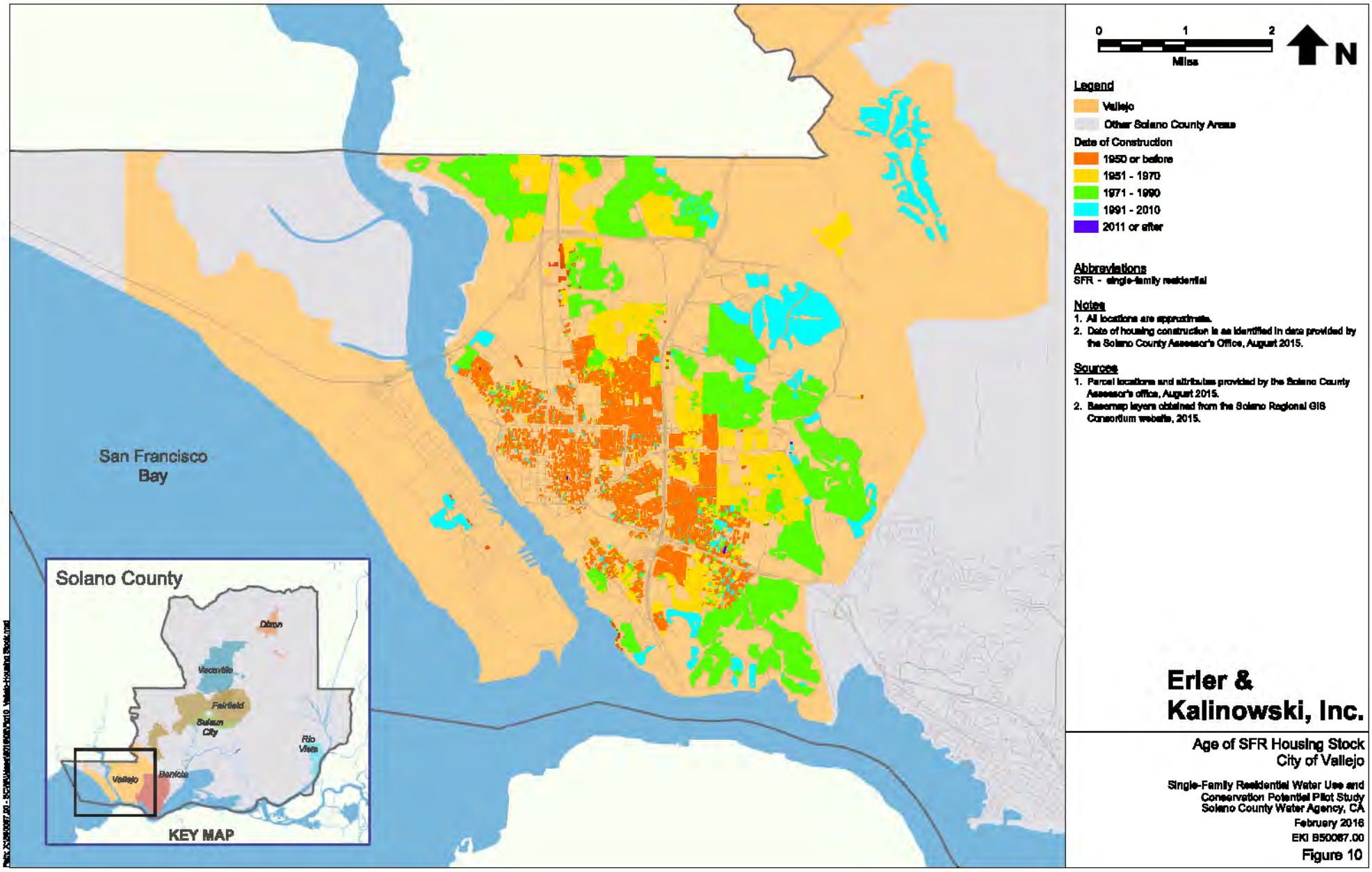
Erler & Kalinowski, Inc.

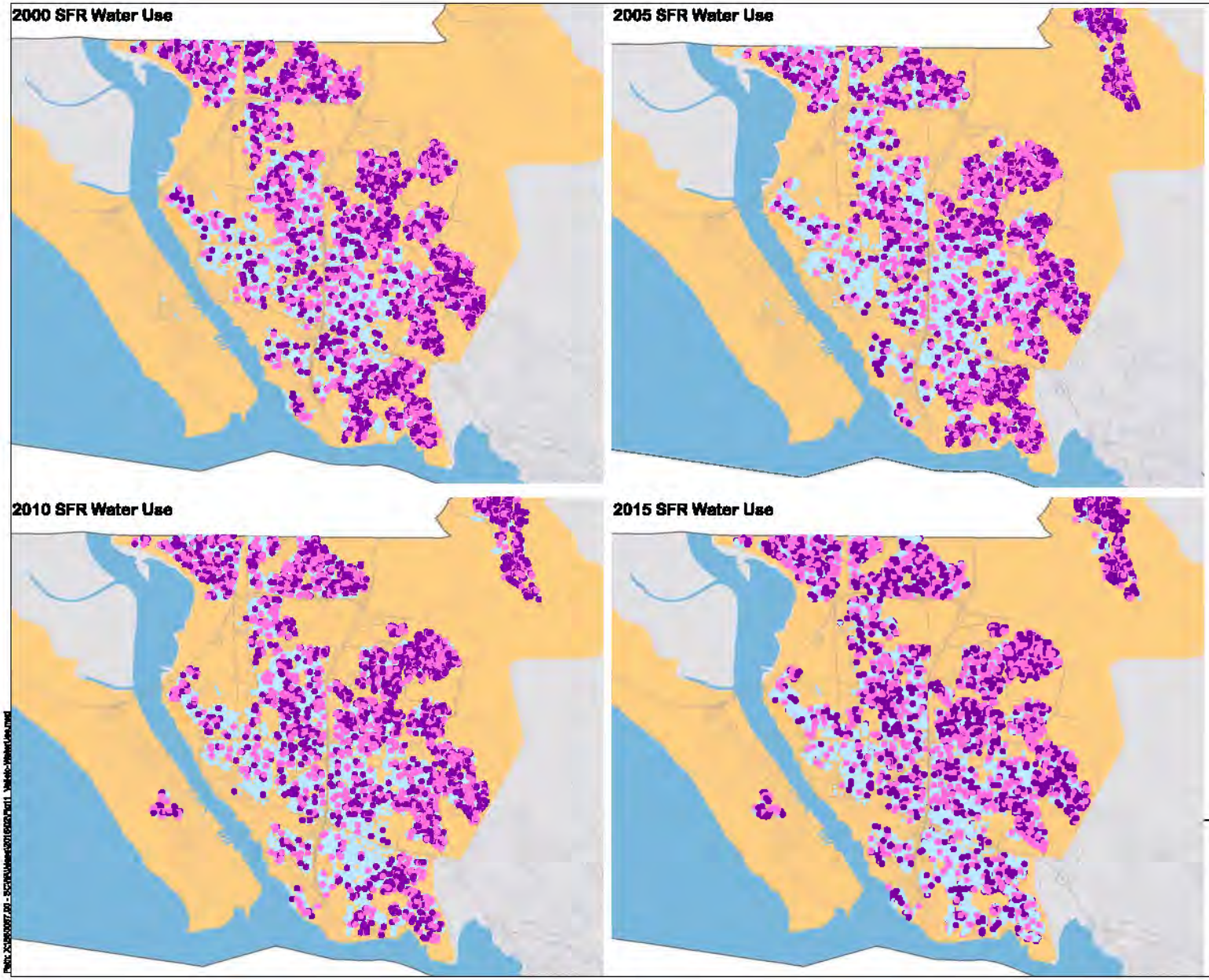
City of Vallejo
Water Use Profile

SFR Water Use and Conservation
Potential Pilot Study
Solano County Water Agency, CA

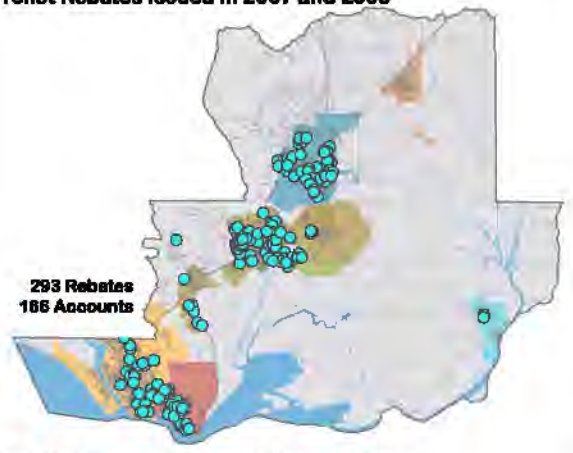
February 2016
EKI B50067.00

Figure 9


0
1
2
Miles
N
Legend
Vallejo
Other Solano County Areas
Date of Construction
1950 or before
1951 - 1970
1971 - 1990
1991 - 2010
2011 or after
Abbreviations
SFR - single-family residential
Notes
1. All locations are approximate.
2. Date of housing construction is as identified in data provided by the Solano County Assessor's Office, August 2015.
Sources
1. Parcel locations and attributes provided by the Solano County Assessor's office, August 2015.
2. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
San Francisco Bay
Solano County
Dixon
Vacaville
Fairfield
Suisun City
Rio Vista
Benicia
Vallejo
KEY MAP
Erler & Kalinowski, Inc.
Age of SFR Housing Stock
City of Vallejo
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 10

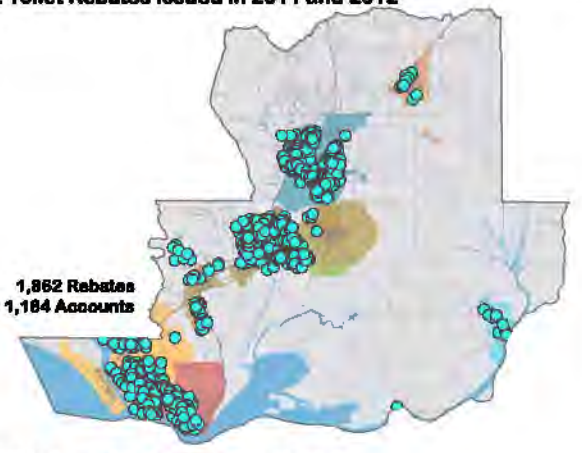

2000 SFR Water Use
2005 SFR Water Use
2010 SFR Water Use
2015 SFR Water Use
0
1.5
3
Miles
N
Legend
Vallejo
Other Solano County Areas
Top SFR Water Use Accounts
Highest 5% of SFR Water Use
Highest 10% to 5% of SFR Water Use
Lower 90% of SFR Water Use
Abbreviations
SFR - single-family residential
Notes
1. All locations are approximate.
2. SFR water use provided by the City of Vallejo, November 2015, and includes water use billing records through October 2015.
Sources
1. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
2. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
Distribution of High Water Use Accounts During Selected Years - City of Vallejo
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00
Figure 11

HE Toilet Rebates Issued in 2007 and 2008

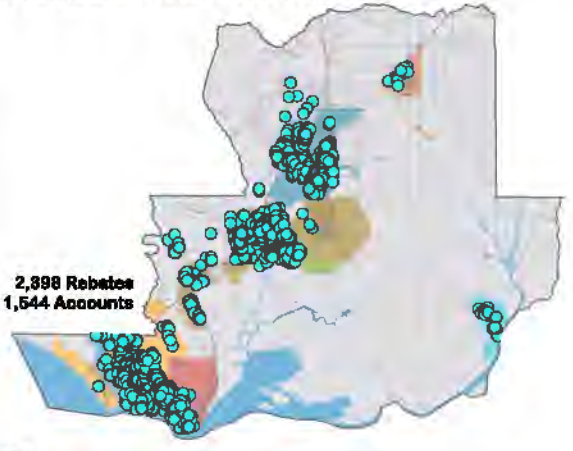


HE Toilet Rebates Issued in 2009 and 2010

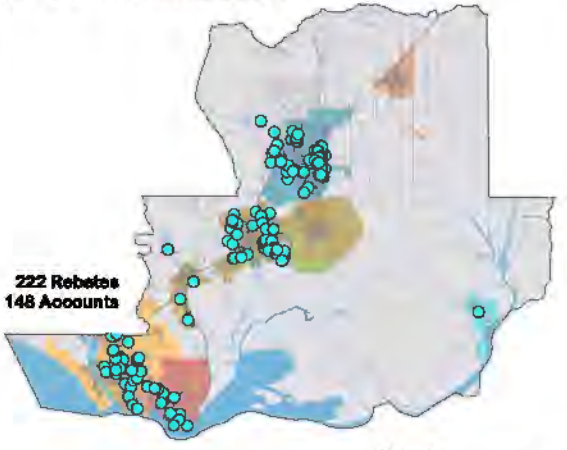
HE Toilet Rebates Issued in 2011 and 2012



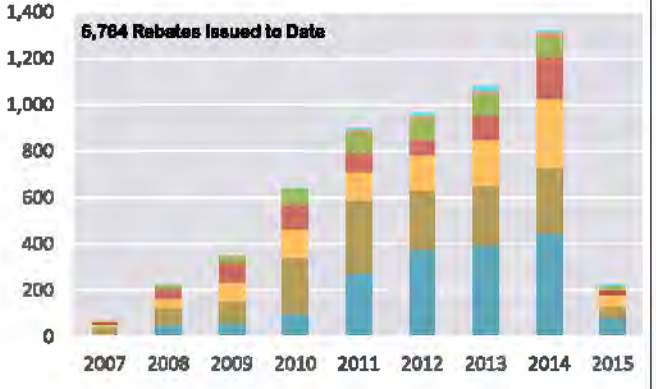
HE Toilet Rebates Issued in 2013 and 2014



HE Toilet Rebates Issued in 2015



Total HE Toilet Rebates Issued by City



Legend

Cities and Spheres of Influence

- Benicia
- Dixon
- Fairfield
- Rio Vista
- Suisun City
- Vacaville
- Vallejo
- Other Solano County Areas

HE Toilet Rebate Issued

Abbreviations

HE - high efficiency
SFR - single-family residential

Notes

1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's Office data.
3. The HE Toilet Rebate Program was suspended in January 2015, with rebates processed and issued through March 2015. All 2015 records are included.

N

0 10 20

Miles

Sources

1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

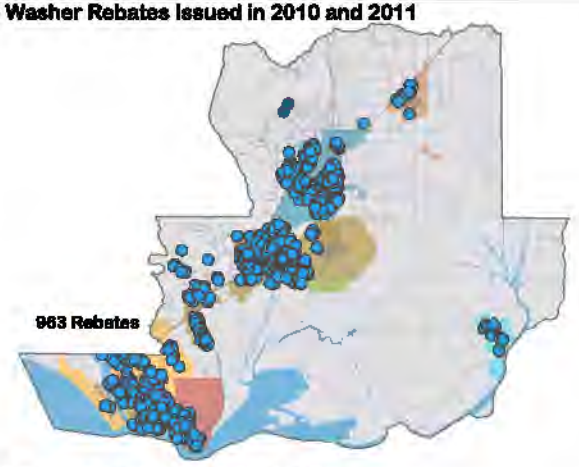
Erler & Kalinowski, Inc.

SFR HE Toilet Rebates Issued
Solano County

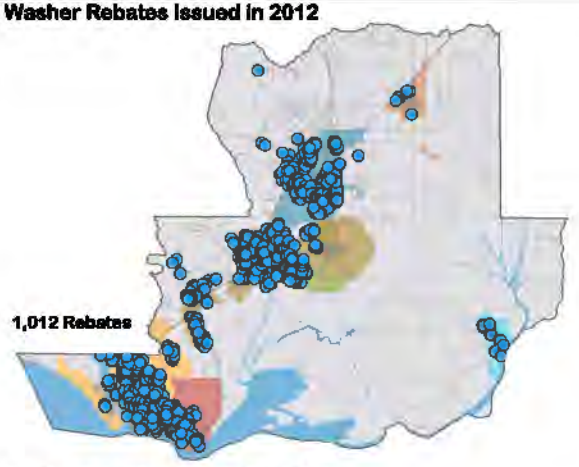
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B60067.00
Figure 12

Path: X:\B60067.00 - SCWA\Maps\2016\02\Fig12_County-HE Toilets.mxd

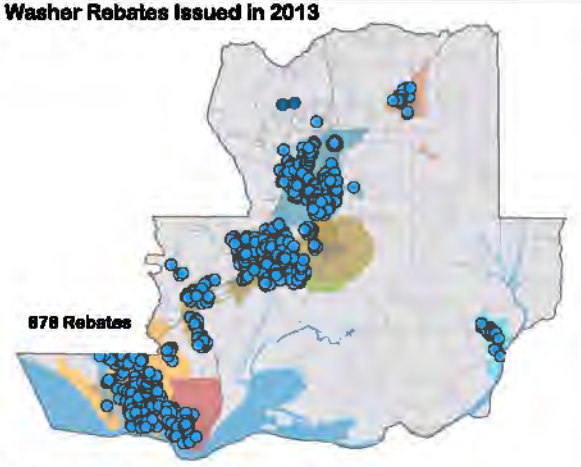
HE Washer Rebates Issued in 2010 and 2011



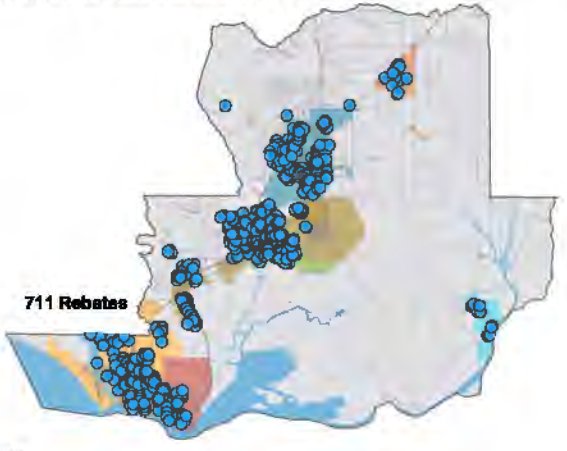
HE Washer Rebates Issued in 2012



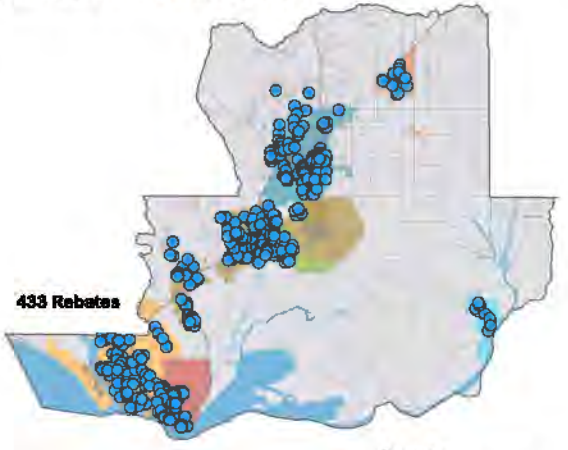
HE Washer Rebates Issued in 2013



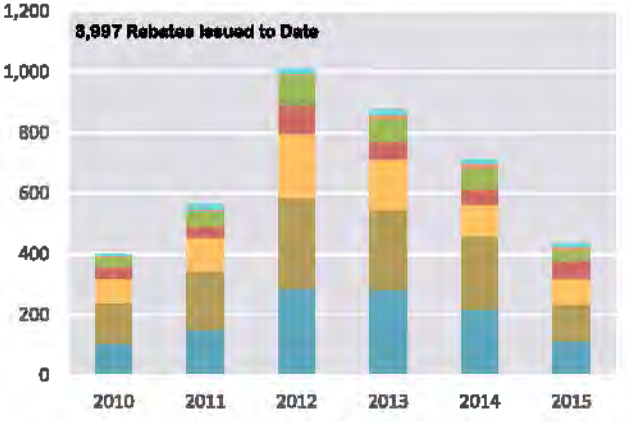
HE Washer Rebates Issued in 2014



HE Washer Rebates Issued in 2015



Total HE Washer Rebates Issued by City



Legend

Cities and Spheres of Influence

- Benicia
- Dixon
- Fairfield
- Rio Vista
- Suisun City
- Vacaville
- Vallejo
- Other Solano County Areas

HE Washer Rebate Issued

Abbreviations

HE - high efficiency
SFR - single-family residential

Notes

1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's data.
3. HE washer rebates for 2015 represent a partial year only. Rebate records are included through 1 May 2015.

N

0 10 20

Miles

Sources

1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

Erler & Kalinowski, Inc.

SFR HE Washer Rebates Issued
Solano County

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B60067.00
Figure 13

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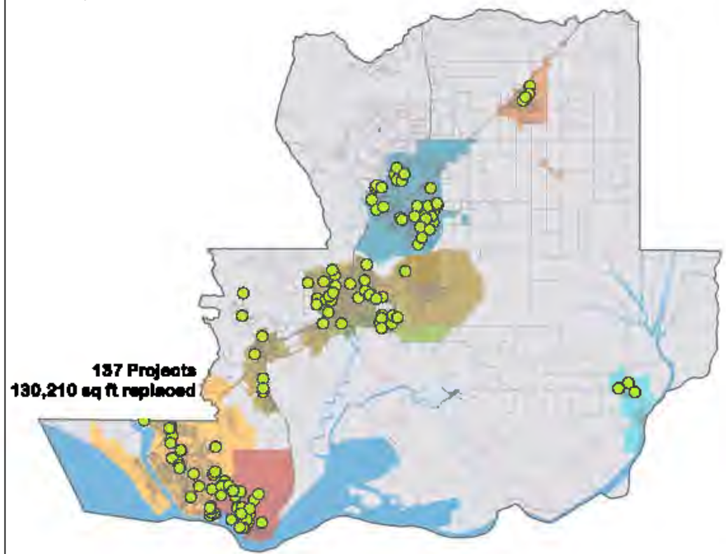
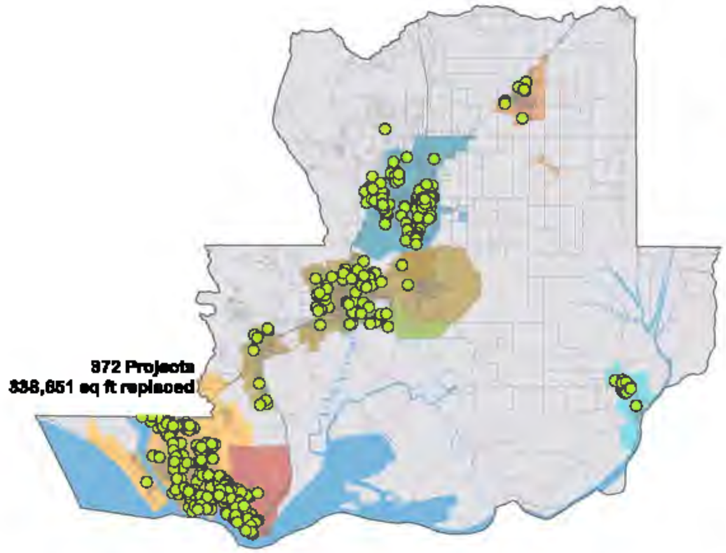
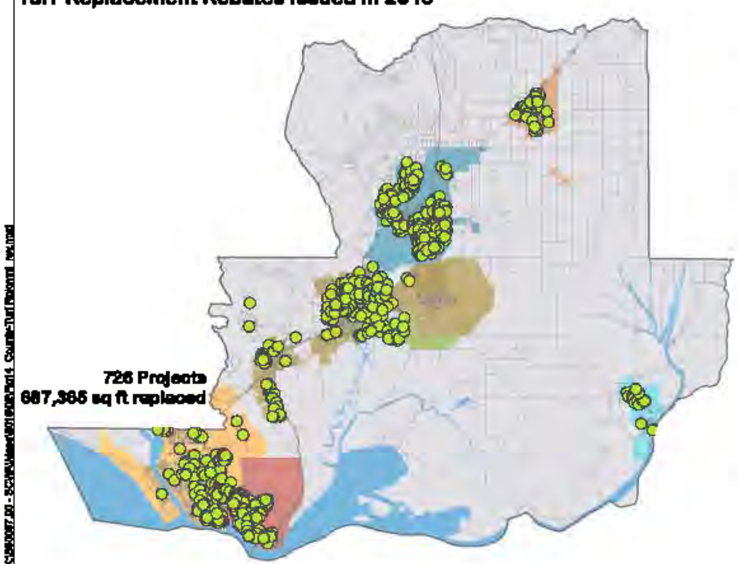
Turf Replacement Rebates Issued from 2010 to



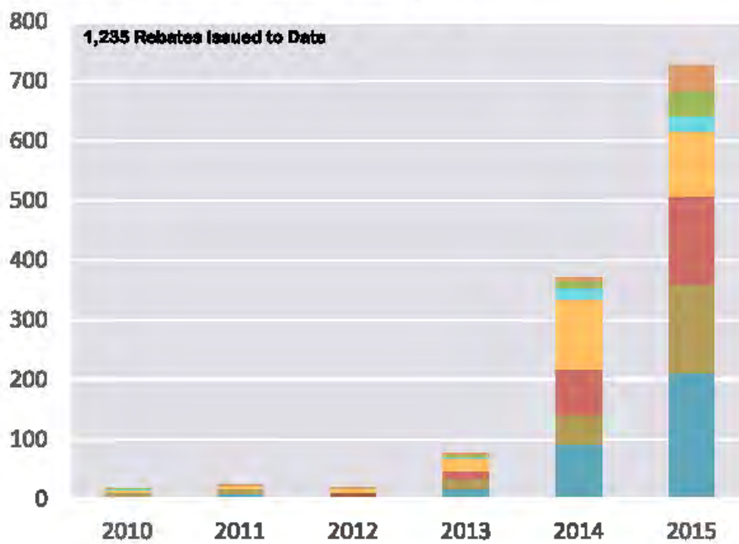
Turf Replacement Rebates Issued in 2014



Turf Replacement Rebates Issued in 2015



Total Turf Replacement Rebates Issued by City



0 8 16
Miles
N

Legend

Cities and Spheres of Influence

- Benicia
- Dixon
- Fairfield
- Rio Vista
- Suisun City
- Vacaville
- Vallejo
- Other Solano County Areas
- Turf Replacement Project

Abbreviations

SFR - single-family residential
sq ft - square feet

Notes

1. All locations are approximate.
2. Only program participation by single-family residential households is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's Office data.
3. Turf replacement rebate records are included through December 2015.

Sources

1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

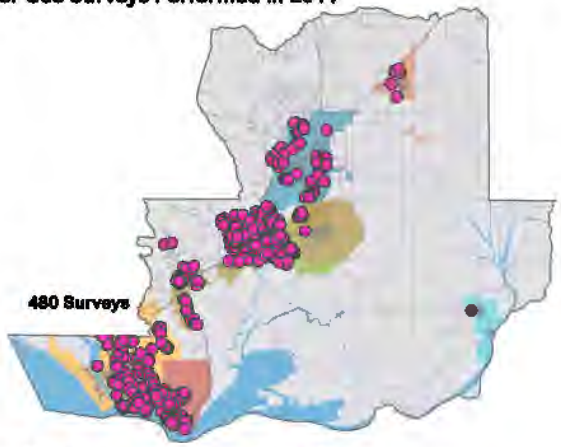
Erler & Kalinowski, Inc.

SFR Turf Replacement Rebates Issued
Solano County

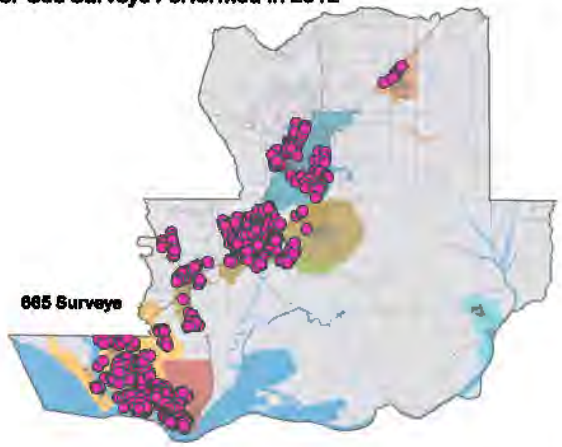
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00

Figure 14

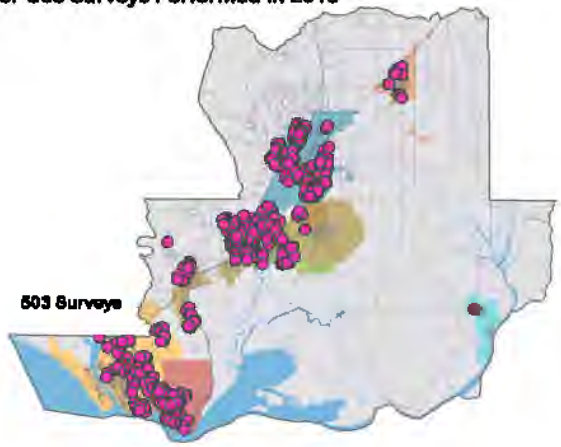
Water Use Surveys Performed in 2011



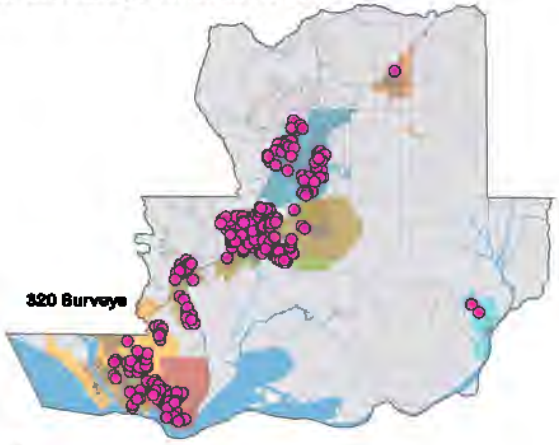
Water Use Surveys Performed in 2012



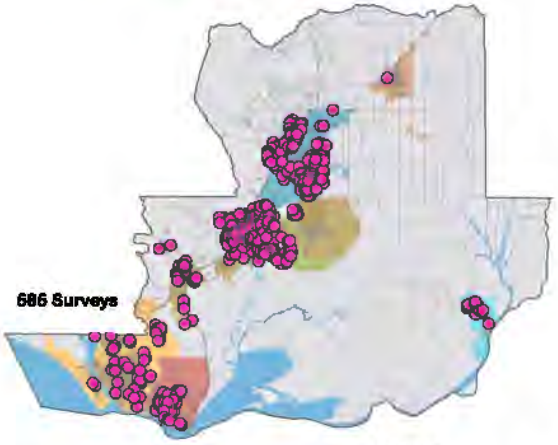
Water Use Surveys Performed in 2013



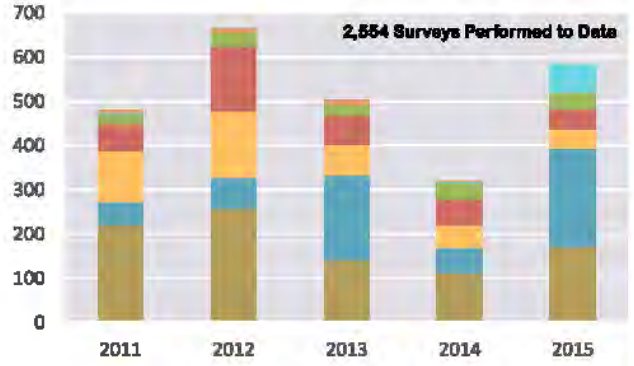
Water Use Surveys Performed in 2014



Water Use Surveys Performed in 2015



Total Water Use Surveys Performed by City



Legend

Cities and Spheres of Influence

- Benicia
- Dixon
- Fairfield
- Rio Vista
- Suisun City
- Vacaville
- Vallejo
- Other Solano County Areas

● Water Use Surveys Performed

Abbreviations

SFR - single-family residential

Notes

1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's data.
3. SFR water use surveys for 2015 represent a partial year only. Survey records are included through 9 November 2015.

N

0 10 20

Miles

Sources

1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

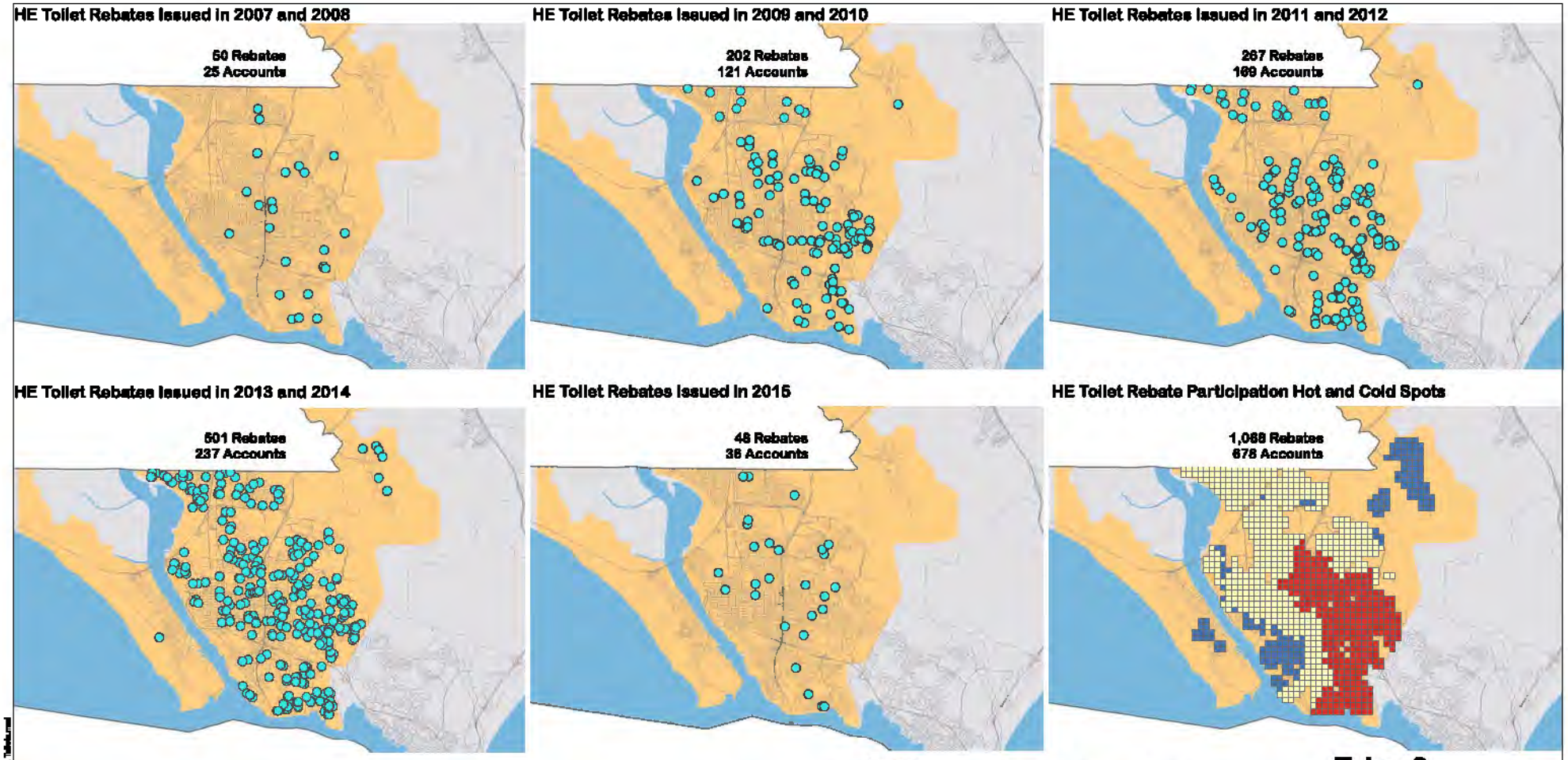
Erler & Kalinowski, Inc.

SFR Residential Water Use Surveys Conducted Solano County

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00

Figure 15

Path: X:\B50087.00 - SCWA\Maps\2016\Fig15_County-Wide Surveys.mxd



Abbreviations

HE - high efficiency

SFR - single-family residential

Notes

1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's Office data.
3. The HE Toilet Rebate Program ended in January 2015, with rebates processed and issued through March 2015. All 2015 records are included.
4. Rebate participation hot and cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., rebates) relative to a random, equally spaced distribution.

Sources

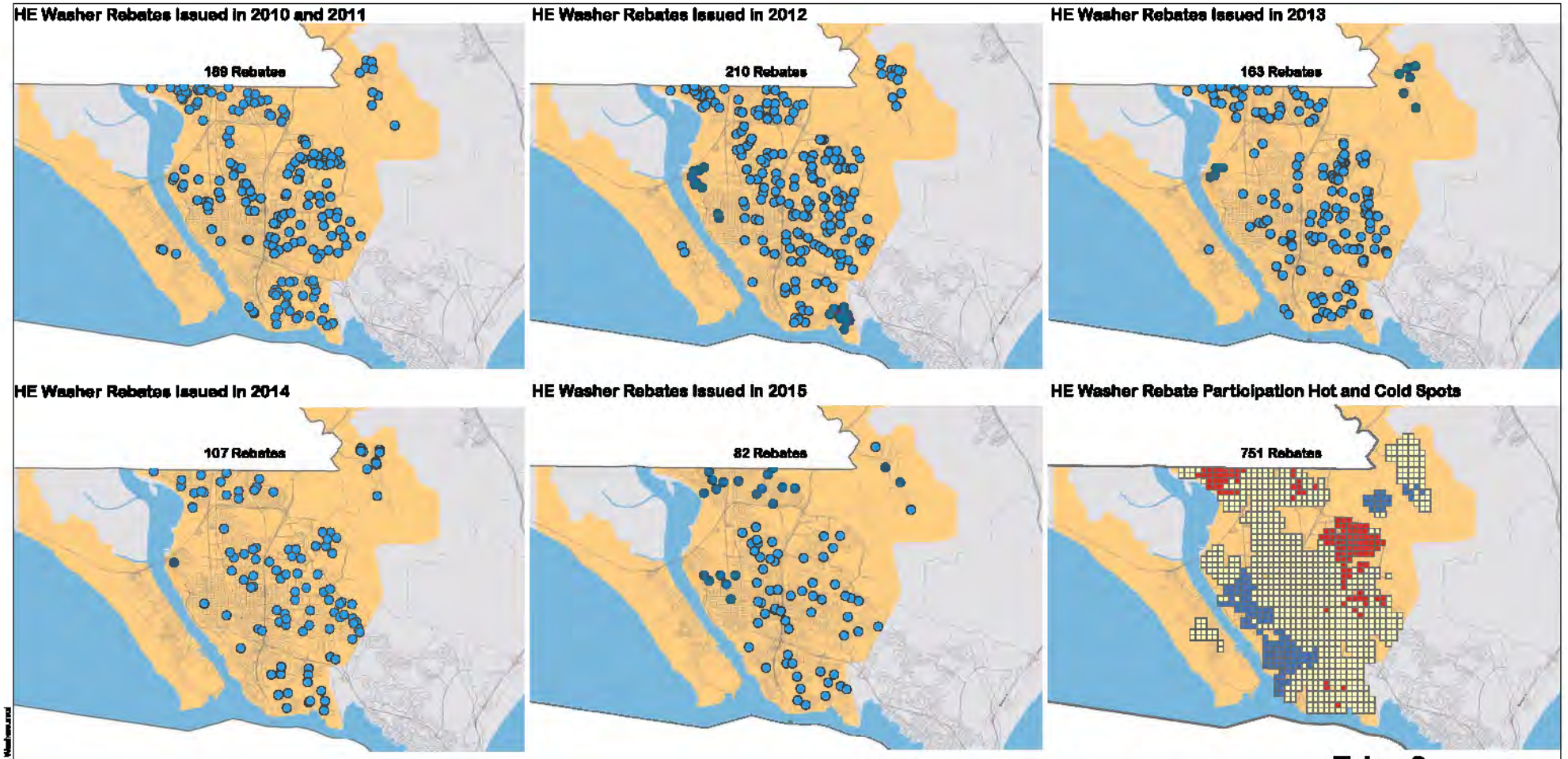
1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

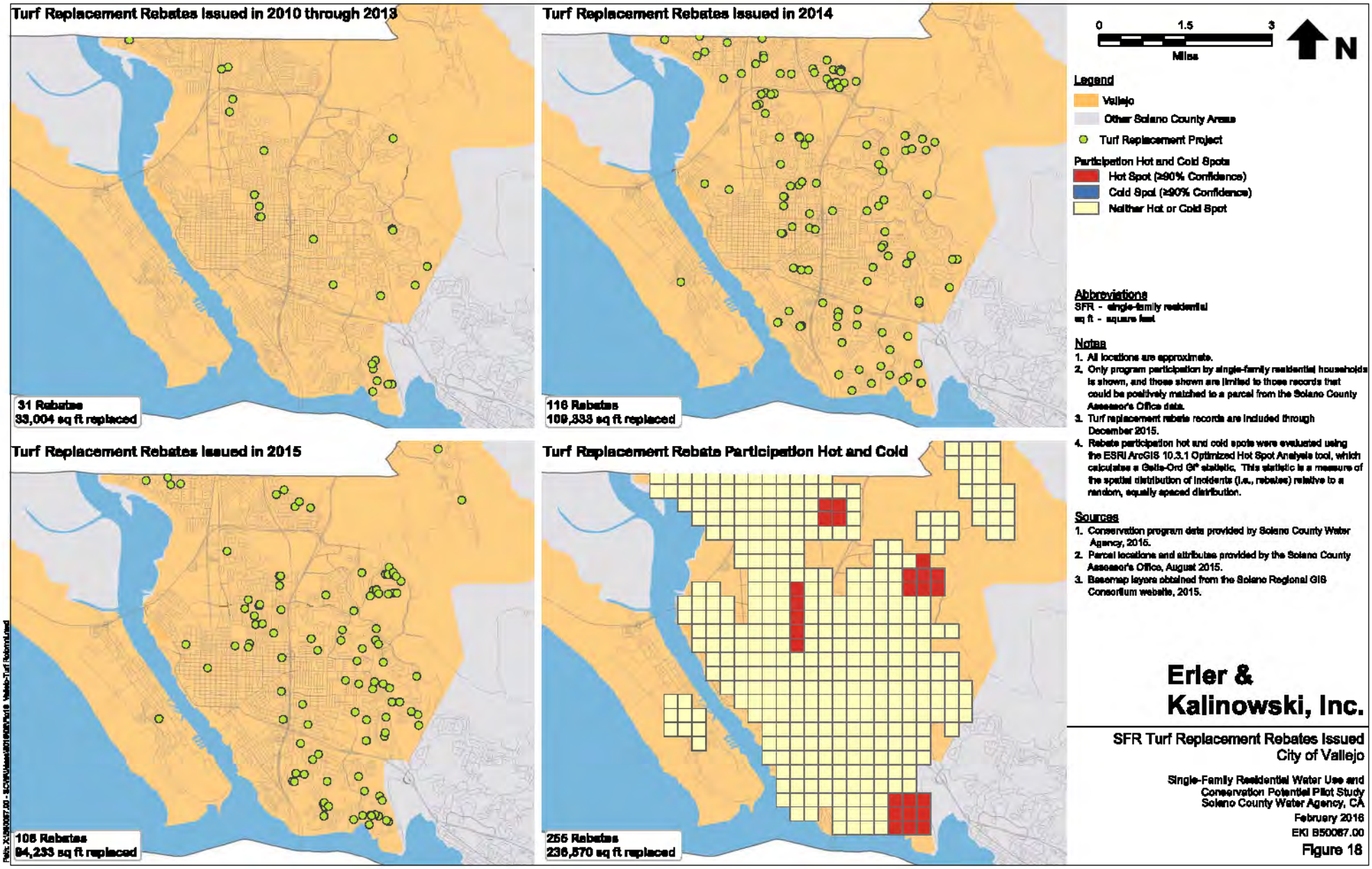
Erler & Kalinowski, Inc.

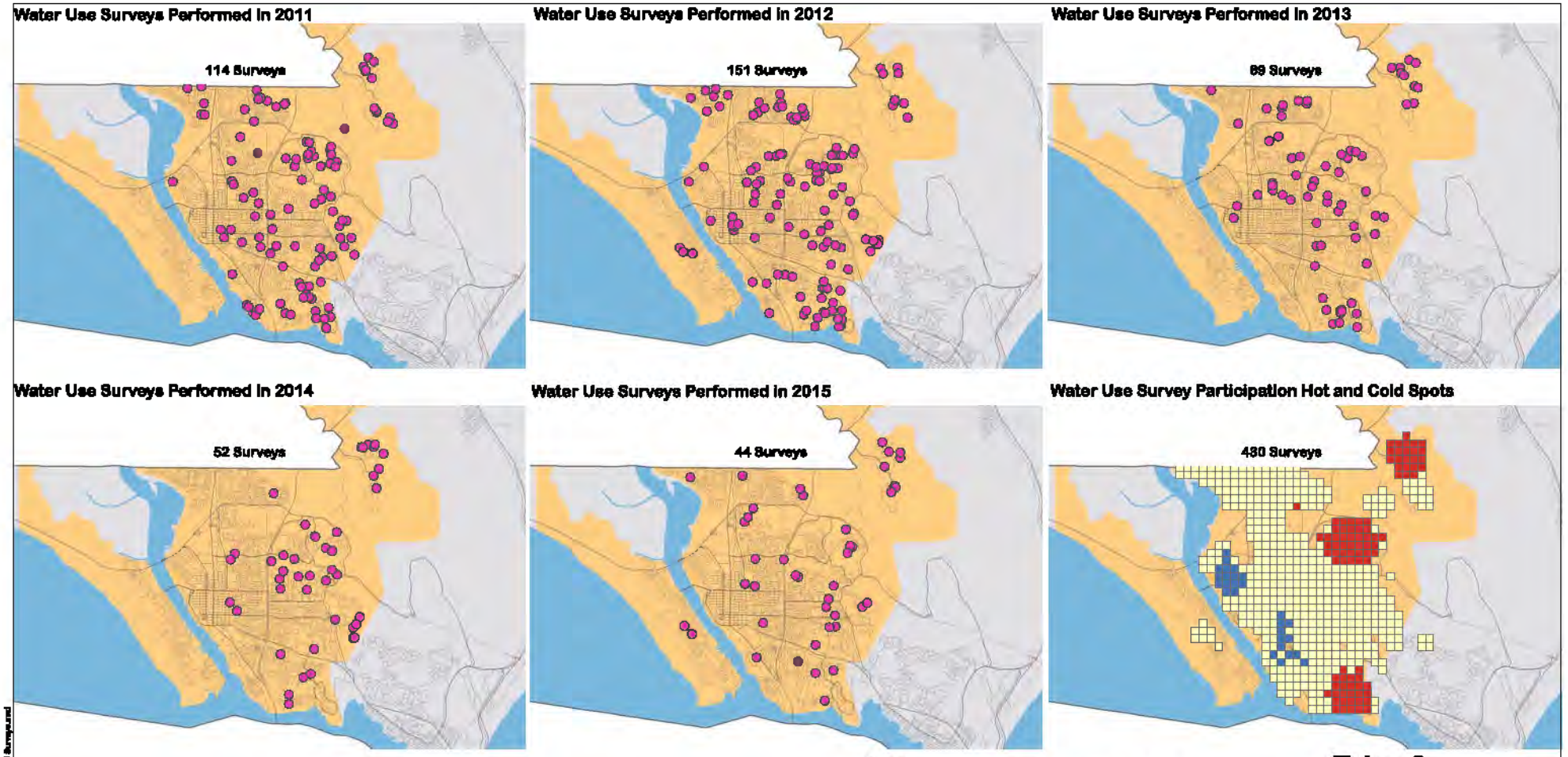
SFR HE Toilet Rebates Issued
City of Vallejo

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 16

Path: X:\B50067.00 - SCWA\Maps\MXD\B50067Fig16_Vallejo-HE_Toilets.mxd


HE Washer Rebates Issued in 2010 and 2011
189 Rebates
HE Washer Rebates Issued in 2012
210 Rebates
HE Washer Rebates Issued in 2013
163 Rebates
HE Washer Rebates Issued in 2014
107 Rebates
HE Washer Rebates Issued in 2015
82 Rebates
HE Washer Rebate Participation Hot and Cold Spots
751 Rebates
Legend
Vallejo
Other Solano County Areas
HE Washer Rebate Issued
Participation Hot and Cold Spots
Hot Spot (≥90% Confidence)
Cold Spot (≥90% Confidence)
Neither Hot or Cold Spot
Abbreviations
HE - high efficiency
SFR - single-family residential
Notes
1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor Office's data.
3. HE washer rebates for 2015 represent a partial year only. Rebate records are included through 1 May 2015. HE washer rebate records prior to 2010 were not available.
4. Rebate participation hot and cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., rebates) relative to a random, equally spaced distribution.
N
0
2.5
5
Miles
Sources
1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
SFR HE Washer Rebates Issued
City of Vallejo
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 17


Turf Replacement Rebates Issued in 2010 through 2013
31 Rebates
33,004 sq ft replaced
Turf Replacement Rebates Issued in 2014
116 Rebates
109,333 sq ft replaced
Turf Replacement Rebates Issued in 2015
108 Rebates
94,233 sq ft replaced
Turf Replacement Rebate Participation Hot and Cold
256 Rebates
236,570 sq ft replaced
0
1.5
3
Miles
N
Legend
Vallejo
Other Solano County Areas
Turf Replacement Project
Participation Hot and Cold Spots
Hot Spot (≥90% Confidence)
Cold Spot (≥90% Confidence)
Neither Hot or Cold Spot
Abbreviations
SFR - single-family residential
sq ft - square feet
Notes
1. All locations are approximate.
2. Only program participation by single-family residential households is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's Office data.
3. Turf replacement rebate records are included through December 2015.
4. Rebate participation hot and cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., rebates) relative to a random, equally spaced distribution.
Sources
1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Erler & Kalinowski, Inc.
SFR Turf Replacement Rebates Issued
City of Vallejo
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 18



Legend

- Vallejo
- Other Solano County Areas
- Water Use Survey

Participation Hot and Cold Spots

- Hot Spot (≥90% Confidence)
- Cold Spot (≥90% Confidence)
- Neither Hot or Cold Spot

Abbreviations

SFR - single-family residential

Notes

1. All locations are approximate.
2. Only program participation by SFR accounts is shown, and those shown are limited to those records that could be positively matched to a parcel from the Solano County Assessor's Office data.
3. SFR water use surveys for 2015 represent a partial year only. Survey records are included through 9 November 2015.
4. Rebate participation hot and cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., surveys) relative to a random, equally spaced distribution.

N

0 2.5 5

Miles

Sources

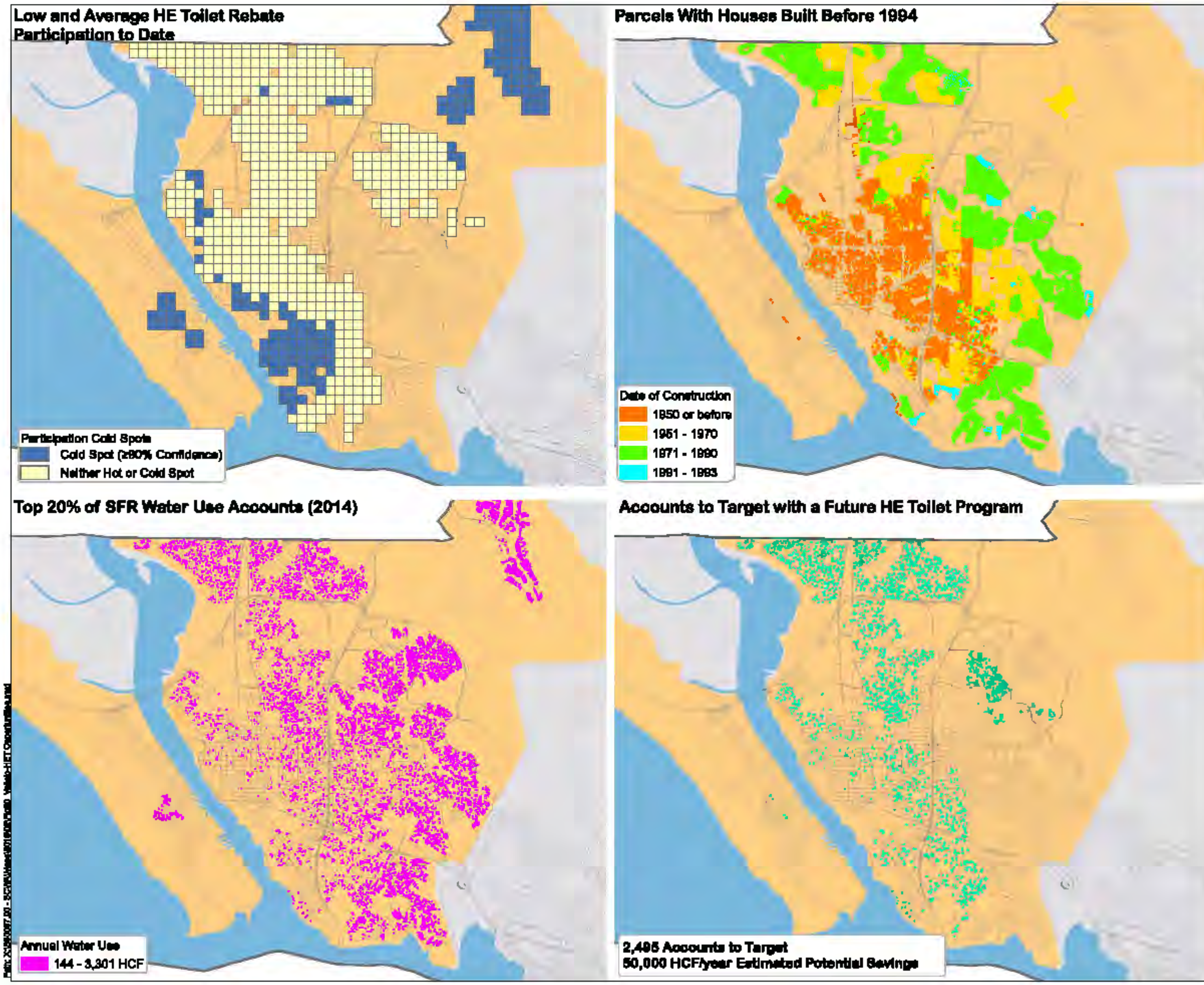
1. Conservation program data provided by Solano County Water Agency, 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

Erler & Kalinowski, Inc.

SFR Residential Water Use Surveys Conducted
City of Vallejo

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 19

Path: X:\B50067.00 - SCWA\Maps\MXD\Fig19_Vallejo-SFU Surveys.mxd



Legend

Vallejo

Other Solano County Areas

Abbreviations

HCF - one hundred cubic feet
HE - high-efficiency
SFR - single-family residential

Notes

1. All locations are approximate.
2. Accounts identified to target for future participation in an HE toilet program are those that 1) have not previously participated in the HE toilet rebate program, 2) are from areas of Vallejo that have had average or lower participation in the program, 3) have houses built prior to the 1992 Federal Energy Policy Act (effective 1994), and 4) are among the top 20% of SFR water use accounts in Vallejo.
3. Rebate participation cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., rebates) relative to a random, equally-spaced distribution.
4. The potential water savings is estimated based on an annual savings of 20 HCF per account (see Table 15).

Sources

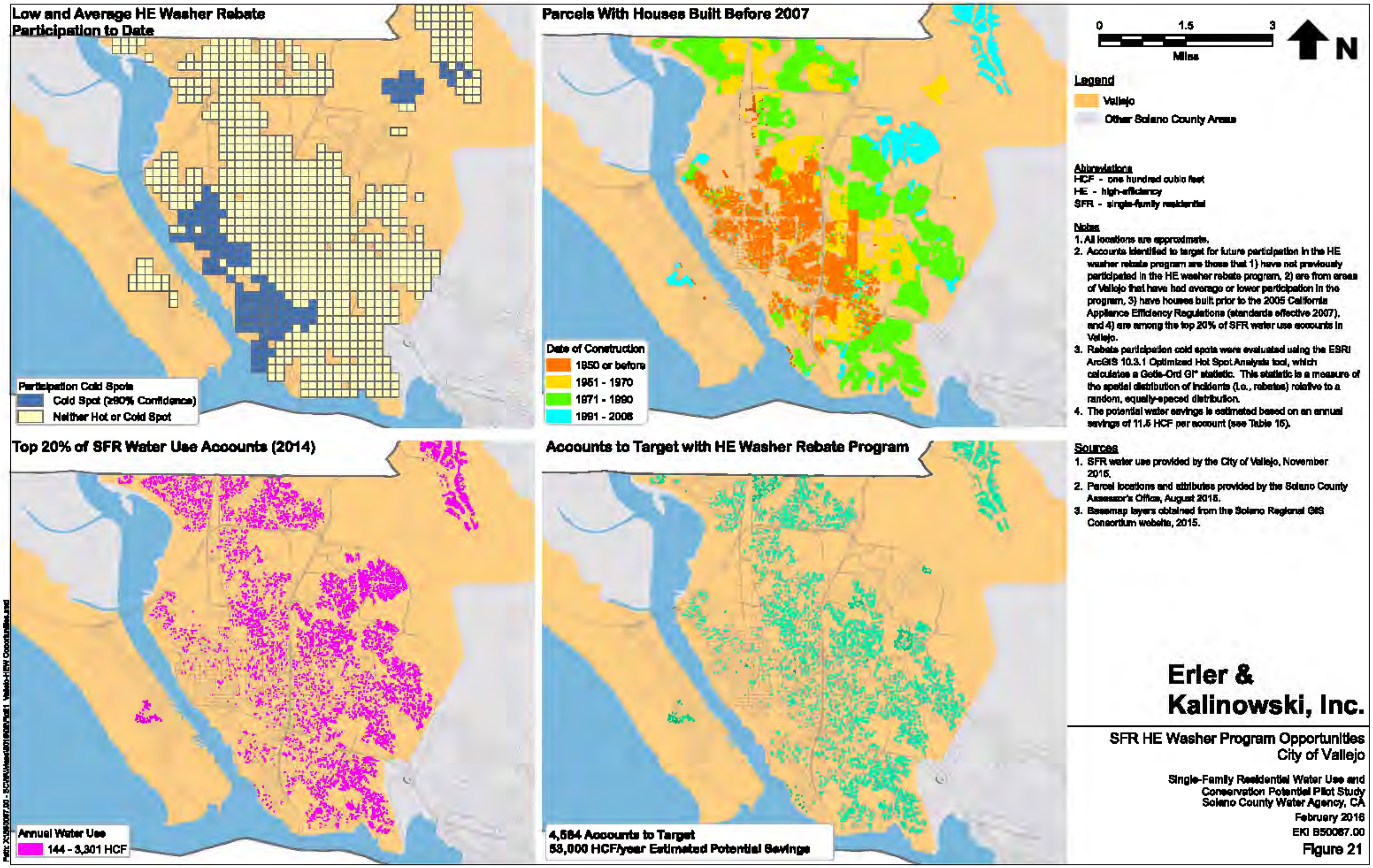
1. SFR water use provided by the City of Vallejo, November 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

Erler & Kalinowski, Inc.

SFR HE Toilet Program Opportunities
City of Vallejo

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00

Figure 20



Abbreviations

HCF - one hundred cubic feet

HE - high-efficiency

SFR - single-family residential

Notes

1. All locations are approximate.
2. Accounts identified to target for future participation in the HE washer rebate program are those that 1) have not previously participated in the HE washer rebate program, 2) are from areas of Vallejo that have had average or lower participation in the program, 3) have houses built prior to the 2005 California Appliance Efficiency Regulations (standards effective 2007), and 4) are among the top 20% of SFR water use accounts in Vallejo.
3. Rebate participation cold spots were evaluated using the ESRI ArcGIS 10.3.1 Optimized Hot Spot Analysis tool, which calculates a Getis-Ord Gi* statistic. This statistic is a measure of the spatial distribution of incidents (i.e., rebates) relative to a random, equally-spaced distribution.
4. The potential water savings is estimated based on an annual savings of 11.5 HCF per account (see Table 15).

Sources

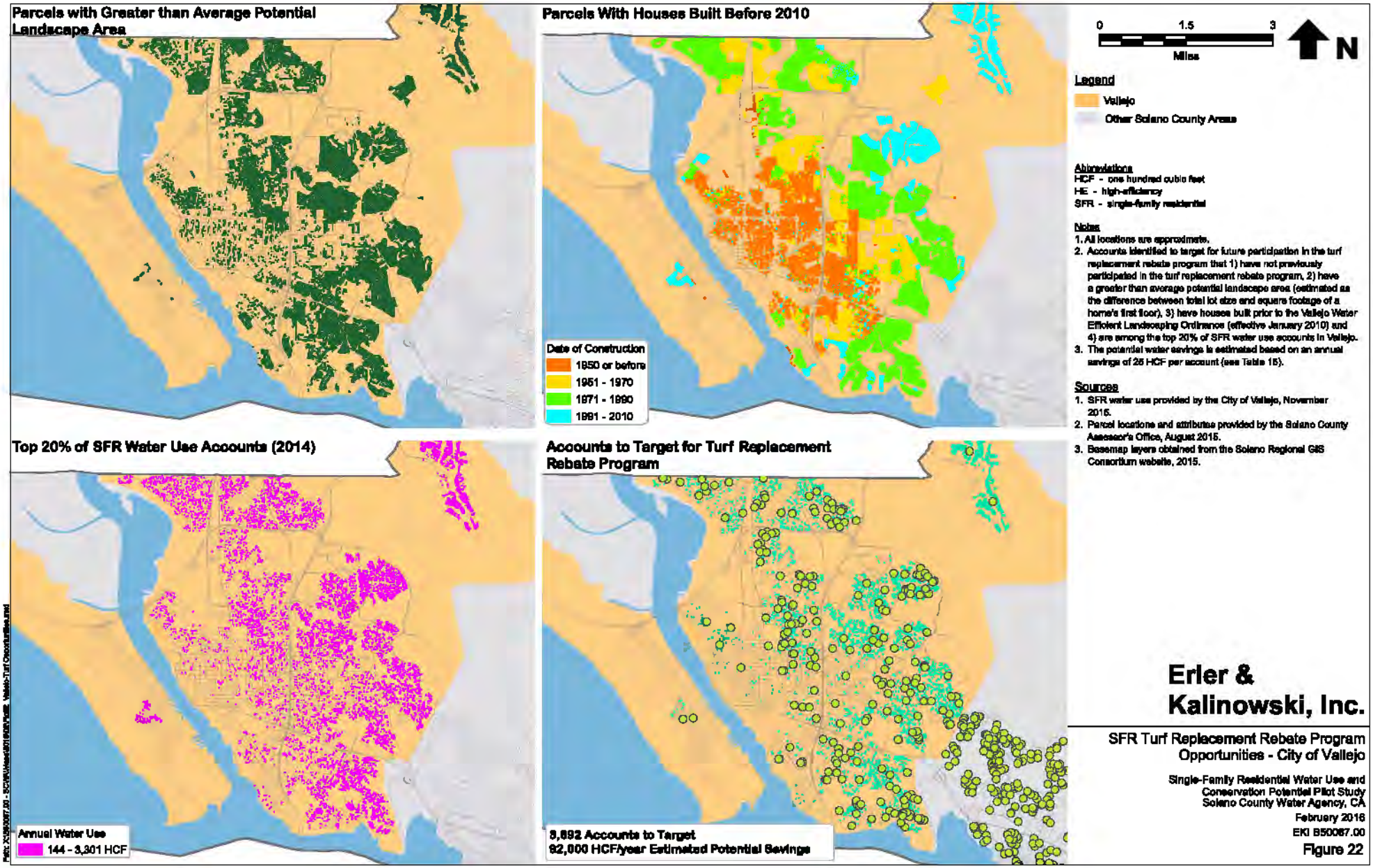
1. SFR water use provided by the City of Vallejo, November 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

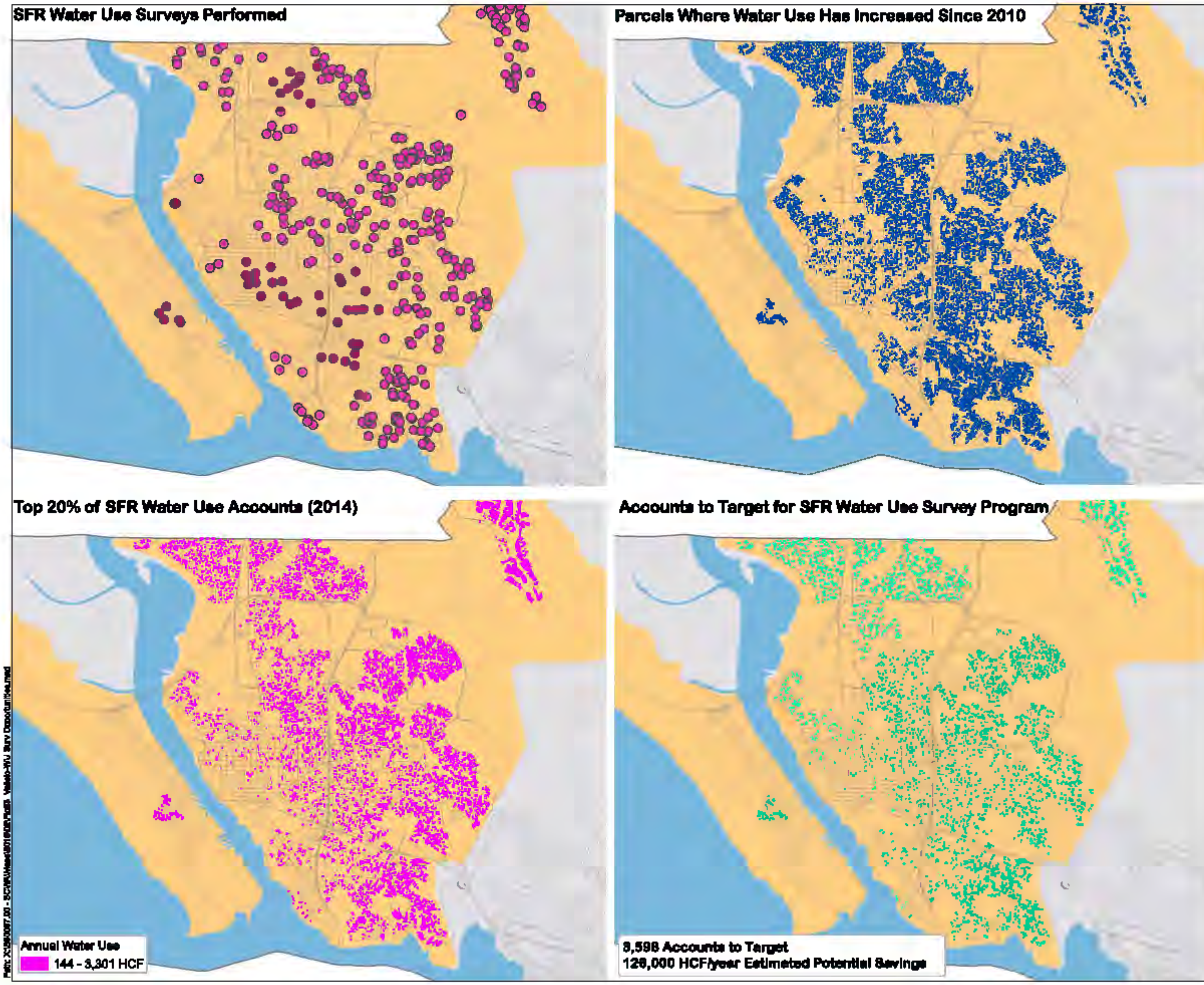
Erler & Kalinowski, Inc.

SFR HE Washer Program Opportunities
City of Vallejo

Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00

Figure 21


Parcels with Greater than Average Potential Landscape Area
Parcels With Houses Built Before 2010
Date of Construction
1950 or before
1951 - 1970
1971 - 1990
1991 - 2010
0
1.5
3
Miles
N
Legend
Vallejo
Other Solano County Areas
Abbreviations
HCF - one hundred cubic feet
HE - high-efficiency
SFR - single-family residential
Notes
1. All locations are approximate.
2. Accounts identified to target for future participation in the turf replacement rebate program that 1) have not previously participated in the turf replacement rebate program, 2) have a greater than average potential landscape area (estimated as the difference between total lot size and square footage of a home's first floor), 3) have houses built prior to the Vallejo Water Efficient Landscaping Ordinance (effective January 2010) and 4) are among the top 20% of SFR water use accounts in Vallejo.
3. The potential water savings is estimated based on an annual savings of 25 HCF per account (see Table 15).
Sources
1. SFR water use provided by the City of Vallejo, November 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.
Top 20% of SFR Water Use Accounts (2014)
Annual Water Use
144 - 3,301 HCF
Accounts to Target for Turf Replacement Rebate Program
3,692 Accounts to Target
92,000 HCF/year Estimated Potential Savings
Erler & Kalinowski, Inc.
SFR Turf Replacement Rebate Program Opportunities - City of Vallejo
Single-Family Residential Water Use and Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50067.00
Figure 22



0 1.5 3
Miles
N

Legend

Vallejo

Other Solano County Areas

Abbreviations

HCF - one hundred cubic feet
HE - high-efficiency
SFR - single-family residential

Notes

1. All locations are approximate.
2. Accounts identified to target for future participation in the SFR water use survey program are those that 1) have not previously participated in the SFR water use survey program, 2) have increased their water use since 2010 (adjusted for houses that were not occupied in 2010), and 3) are among the top 20% of SFR water use accounts in Vallejo.
3. The potential water savings is estimated based on an annual savings of 35 HCF per account (see Table 15).

Sources

1. SFR water use provided by the City of Vallejo, November 2015.
2. Parcel locations and attributes provided by the Solano County Assessor's Office, August 2015.
3. Basemap layers obtained from the Solano Regional GIS Consortium website, 2015.

Erler & Kalinowski, Inc.

SFR Residential Water Use Survey
Program Opportunities - City of Vallejo

Single-Family Residential Water Use and
Conservation Potential Pilot Study
Solano County Water Agency, CA
February 2016
EKI B50087.00

Figure 23

APPENDIX A

AWE Water Conservation Tracking Tool Documentation

Appendix A.1

AWE's Water Conservation Tracking Tool
8 November 2011 Webinar

Alliance *for* Water Efficiency

To promote the efficient and sustainable use of water

AWE's Water Conservation Tracking Tool

November 8, 2011

Goals for Webinar

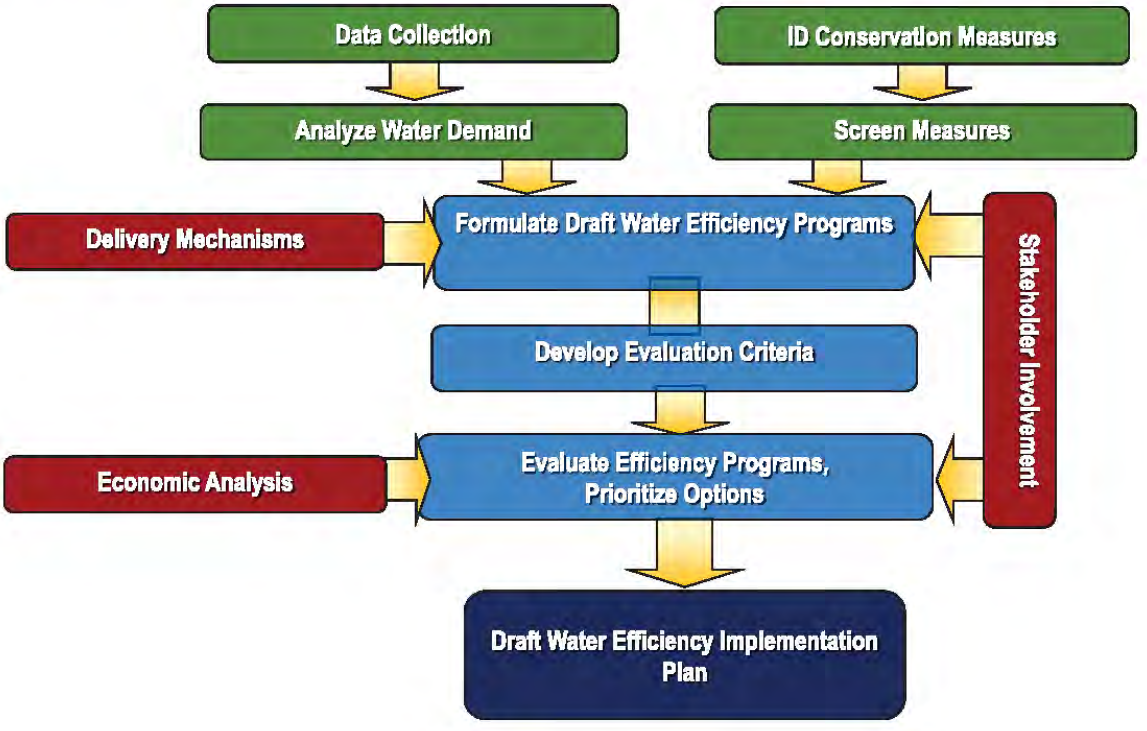
- Familiarize you with features of the Tracking Tool
- Answer any questions you may have

Webinar Instructors

- Mary Ann Dickinson, President/CEO, AWE
- David Mitchell, Tracking Tool Builder, MCubed

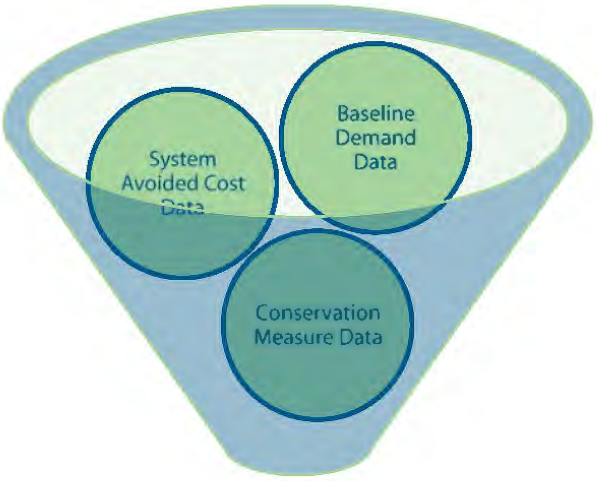
Alliance *for* Water Efficiency

Constructing a Water Efficiency Plan



Source: A & N Technical Services, Inc.
AWWARF Project 2935: Water Efficiency Programs for Integrated Water Management

Tracking Tool Inputs and Outputs



Model Outputs

Savings Analysis Benefit-Cost Analysis Revenue/Rate Impacts Energy Savings

Special Features of the Tool

- Customizable for your utility
- Ability to build unlimited number of conservation planning scenarios
- Analyzes cost effectiveness of each scenario based on avoided short term and long term costs
- Evaluates the revenue impacts of each scenario
- Evaluates the energy and greenhouse gas emission savings

Alliance *for* Water Efficiency

Alliance for Water Efficiency

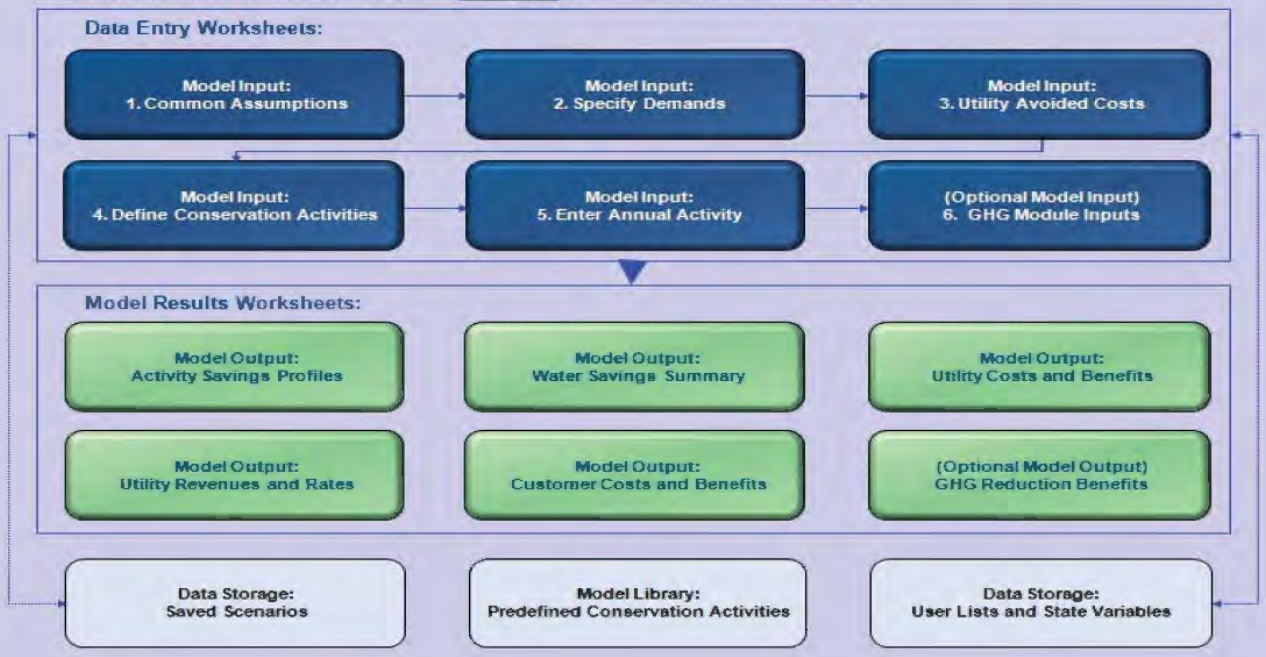
AWE CONSERVATION TRACKING TOOL

Version 2.0, Standard North American Edition

About Tracking Tool

Getting Started:

1. The model uses a simple worksheet tab color code:
   - Blue Tabs = User Data Entry
   - Green Tabs = Model Outputs/Results
   - Grey Tabs = Data Storage and Library
2. First provide informaton about your system, customers, and water demands. This is done on data entry worksheets 1 thru 3.
3. Next define or import conservation activities and set their annual activity levels. This is done on data entry worksheets 4 and 5.
4. You can save conservation activity scenarios at any time. You access the scenario manager on the Common Assumptions worksheet.
6. You can navigate to model worksheets by clicking on the model schematic below or by clicking on the worksheet tabs at the bottom of the screen.
7. Data entry cells on input worksheets look like this: xx,xxx Only enter data in cells with this color coding.



Common Assumptions

AWE CONSERVATION TRACKING TOOL: COMMON ASSUMPTIONS WORKSHEET

ENTER COMMON ASSUMPTIONS: Manage Scenarios

Last Loaded Scenario: *"Sample Scenario (English)"*

Last Saved Scenario: *"Sample Scenario (English)"*

Return to Navigation Sheet

Report Error

		2010	2020	2030	2040
Analysis Start Year	2008				
Service Area Population	350,000	355,000	365,000	380,000	395,000
Service Area Population in 1990	300,000				
Peak-Season Start Date ('month/day')	31-May				
Peak-Season End Date ('month/day')	31-Oct				
Nominal Interest Rate	6.00%				
Inflation Rate	3.00%				
Year in which to Denominate Costs & Benefits	2010				
Persons Per Household - SF	2.25				
Persons Per Household - MF	1.50				
Full Bathrooms Per Household - SF	1.75				
Half Bathrooms Per Household - SF	0.75				
Full Bathrooms Per Household - MF	1.00				
Half Bathrooms Per Household - MF	0.25				
SF Housing Units Built *before 1994*	100,000				
MF Housing Units Built *before 1994*	50,000				
Reference ET (inches/yr)	57.33				
Avg. Annual Rainfall (inches/yr)	7.67				

CHOOSE VOLUME UNITS:

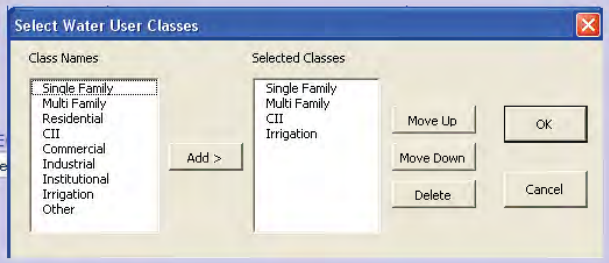
Water Volume Units
- ○ Million Gallons (MG)
- ◉ Acre-Feet (AF)
- ○ Million Cubic Meters (MCM)

Flow Units Will Be: MGD

Show Bathroom Lookup Table

SELECT CUSTOMER CLASSES:

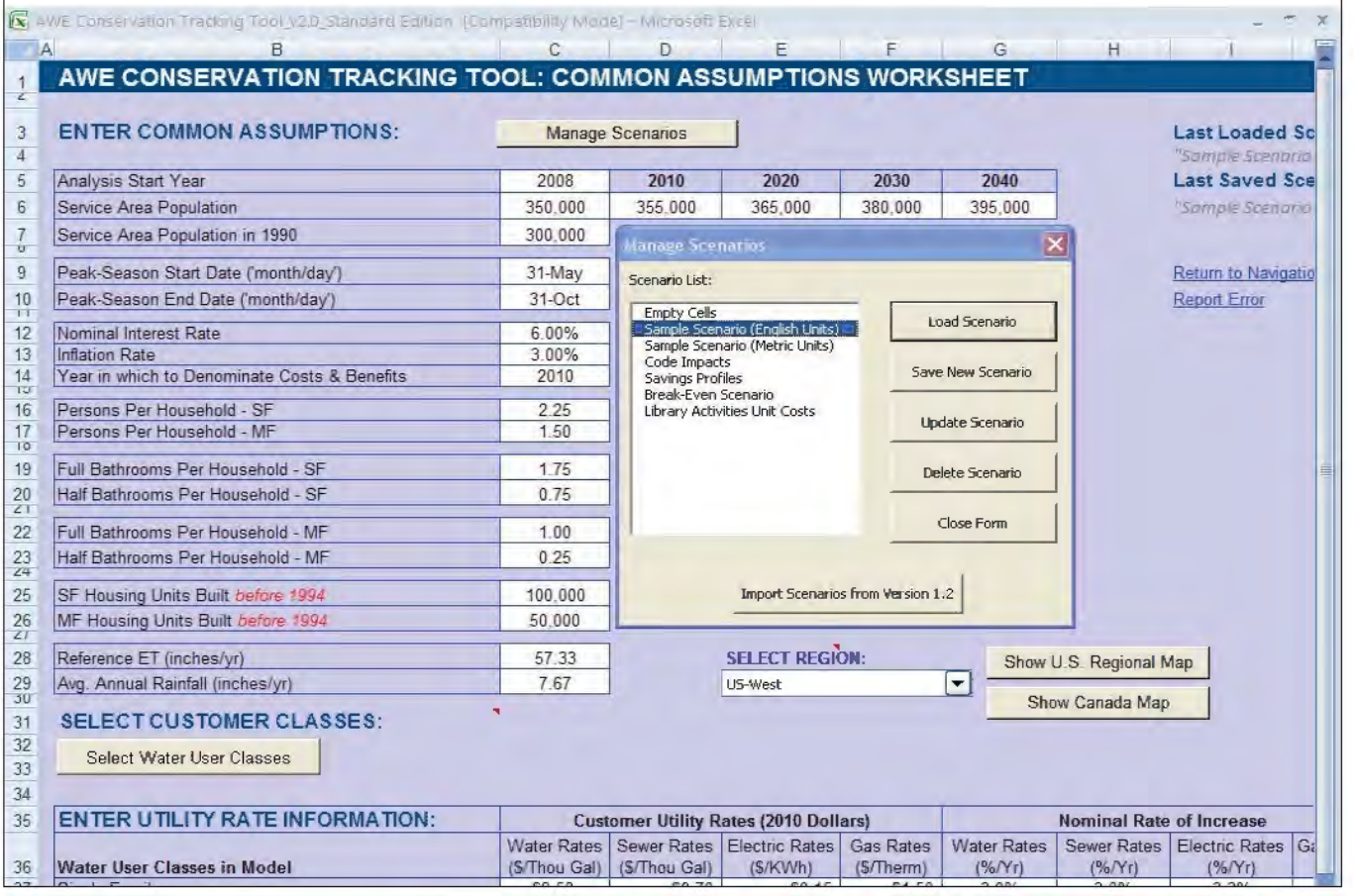
Select Water User Classes



ENTER UTILITY RATE INFORMATION:

Water User Classes in Model	Customer Utility Rates (2010 Dollars)				Nominal Rate of Increase			
	Water Rates ($/Thou Gal)	Sewer Rates ($/Thou Gal)	Electric Rates ($/KWh)	Gas Rates ($/Therm)	Water Rates (%/Yr)	Sewer Rates (%/Yr)	Electric Rates (%/Yr)	Gas Rates (%/Yr)
Single Family	$2.50	$0.70	$0.15	$1.50	3.0%	3.0%	3.3%	3.3%
Multi Family	$2.30	$0.70	$0.15	$1.50	3.0%	3.0%	3.3%	3.3%
CII	$2.00	$0.70	$0.15	$1.50	3.0%	3.0%	3.3%	3.3%
Irrigation	$2.30	$0.70	$0.15	$1.50	3.0%	3.0%	3.3%	3.3%

Managing Scenarios



Baseline Demands

Two Data Entry Options

- *Enter or link to an existing demand forecast*
- *Use model to grow current demand by population*

Plumbing/Energy Code Adjustment

- *Model can adjust for impact of existing plumbing/energy codes as necessary*

Demand Disaggregation

- *Peak/Off Peak Seasonal Demands*
- *Customer Class Disaggregation*

Alliance for Water Efficiency

Baseline Demands

AWE CONSERVATION TRACKING TOOL: SPECIFY DEMANDS WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 7/15/2011 10:09:34 AM

Return to Navigation Sheet | Report

○ Enter Demands Manually ◉ Grow Demands with Population ☐ Demand projection accounts for plumbing code.

SERVICE AREA DEMAND:

Service Area Demands	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	20
Peak Season	MGD	75	76	76	76	76	77	77	77	77	78	
Off Peak Season	MGD	50	50	51	51	51	51	51	51	52	52	
Average	**MGD**	**60**	**61**	**61**	**62**	**62**	**62**	**62**	**62**	**62**	**63**	
Peak to Average Ratio		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	

Volumes	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	20
Peak Season	AF	35,215	35,466	35,719	35,818	35,918	36,017	36,118	36,218	36,319	36,420	36,5
Off Peak Season	AF	32,530	32,762	32,995	33,087	33,179	33,271	33,364	33,456	33,549	33,643	33,7
Total	**AF**	**67,746**	**68,228**	**68,713**	**68,905**	**69,096**	**69,289**	**69,481**	**69,675**	**69,868**	**70,063**	**70,2**

CUSTOMER DEMAND SHARES:

○ Enter Customer Class Shares (%) ◉ Enter Customer Class Demands

Customer Class	Share (%)	Demand (AF)	Accounts
Single Family	35.0%	23,711	80,000
Multi Family	15.0%	10,162	350
CII	25.0%	16,936	1,000
Irrigation	20.0%	13,549	200
Non Revenue Water	5.0%	3,387	
Total	**100.0%**	**67,746**	**81,550**

Avoided Costs

Two Data Entry Options

- *Enter or link to an existing avoided cost forecast*
- *Use model's avoided cost calculator*

Model's Avoided Cost Calculator

- *Short-run avoided O&M for water supply and wastewater treatment*
- *Long-run avoided or deferred capacity*

Alliance for Water Efficiency

Avoided Cost Manual Entry

AWE CONSERVATION TRACKING TOOL: ENTER UTILITY AVOIDED COSTS WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 7/15/2011 10:09:34 AM

Return to Navigation Sheet Report Error

(•) Use manually entered avoided costs to calculate utility benefits ( ) Use model's avoided cost calculator to calculate utility benefits

User Entered Utility Avoided Cost of Water Supply (2010 Dollars)

$/Unit	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Peak Season	AF											
Off Peak Season	AF											
Average	AF	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Enter peak season avoidable water supply costs for each forecast year.

User Entered Utility Avoided ...ewater Treatment (2010 Dollars)

$/Unit	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Peak Season	AF											
Off Peak Season	AF											
Average	AF	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Enter Other Benefits of Reduced Water Demands (2010 Dollars)

$/Unit	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Peak Season	AF											
Off Peak Season	AF											
Average	AF	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Simple Avoided Cost Calculator

AWE CONSERVATION TRACKING TOOL: ENTER UTILITY AVOIDED COSTS WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 7/15/2011 10:09:34 AM

Return to Navigation Sheet Report Error

( ) Use manually entered avoided costs to calculate utility benefits (•) Use model's avoided cost calculator to calculate utility benefits

Simple Utility Avoided Cost Calculator

WATER SUPPLY: Variable O&M Costs (2010 Dollars)	$/AF	Nominal Rate of Increase %/Yr
Water Purchase Cost:	$450.00	3.0%
Energy for Transmission,Treatment,Distribution:	$80.00	3.3%
Chemicals:	$45.00	3.3%
Other Variable O&M:	$5.00	3.0%
Total Variable O&M:	$ 580.00	3.1%

WASTEWATER: Variable O&M Costs (2010 Dollars)	$/AF	Nominal Rate of Increase %/Yr
Energy for Transmission,Treatment,Discharge:	$40.00	3.3%
Chemicals:	$10.00	3.3%
Other Variable O&M:	$5.00	3.0%
Total Variable O&M:	$ 55.00	3.2%

Current peak season capacity (MGD):	80.00	Min Peak Demand:	75 MGD
Amount of new capacity that will be added (MGD):	6.49	☑ Check to Use Model Default	
Year new capacity needed under current demand projection:	2025		

Avoidable System Expansion Cost (2010 Dollars)	$/MGD	Year New Capacity Required	Capacity Required (MGD)
System Expansion Cost	$7,000,000	2025	6.49

Variable O&M (2010 Dollars)	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Water Supply	AF	$ 579	$ 580	$ 580	$ 580	$ 581	$ 581	$ 581	$ 582	$ 582	$ 582	$ 583
Wastewater	AF	$ 55	$ 55	$ 55	$ 55	$ 55	$ 55	$ 56	$ 56	$ 56	$ 56	$ 56

Setting Up Conservation Measures

Two Specification Options

- *Build from scratch*
- *Import pre-defined measures from library*
- *Pre-defined measures can be customized*

Library currently includes 25 measures

- *13 residential measures*
- *8 CII measures*
- *4 large landscape measures*

Alliance *for* Water Efficiency

Defining a New Conservation Measure

AWE CONSERVATION TRACKING TOOL: DEFINE CONSERVATION ACTIVITIES WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 9/16/2011 11:58:00 AM

Return to Navigation Sheet | Report Error

Define Conservation Program Activities

Define/Edit/Delete Conservation Activities | Hide Table of Activities in Model

Warning: Only use the form to edit or delete activities. Editing/deleting activities directly in the table may result in model errors!

Activity ID	Activity Name	Class	Savings, Per Unit (gpy)	Savings, Annual Rate of Decay (%)	Savings, Peak Period (% of Annual Savings)	Savings, Useful Life (yrs)	Savings, Participant Free Riders (% of Participants)	Utility Costs, Year Denominated	Utility Costs, Initial Fixed ($)	Utility Costs, Initial Variable ($/unit)	Utility Costs, Years of Follow-up (yrs)	Utility Follo Fixed
1	Residential Surveys, SF	Single Family	12373	20%	68%	5	0%	2011	$2,000.00	$95.00		
2	Residential HE Toilets, SF											
3	CII Tank-Type HE Toilet											
4	Residential Irrigation Controller, SF											
5	Large Land. Irrigation Controller											
6	Residential LF Showerhead, SF											
7	Residential LF Showerhead, MF											
8	Residential HE Washer, SF											
9	Residential HE Washer, MF											
10	CII Spray Rinse Valve											
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												

Define Conservation Activities

Activity Name: Residential HE Toilets, SF

Affected Customer Class: Single Family

Import an Activity from the Library

Unit Water Savings | Utility Costs | Participant Costs | Participant Non Water Benefits | Plumbing Code

Close Form

Unit Water Savings (Gal/Yr): 9,072.0

Annual Rate of Savings Decay (%/Year): 0.00%

Peak Period Savings (% of Annual): 41.92% Peak days = 42% of days in a year.

Useful Life (Years):

Participant Freeriders (% of Participants): 0.00%

Previous Activity

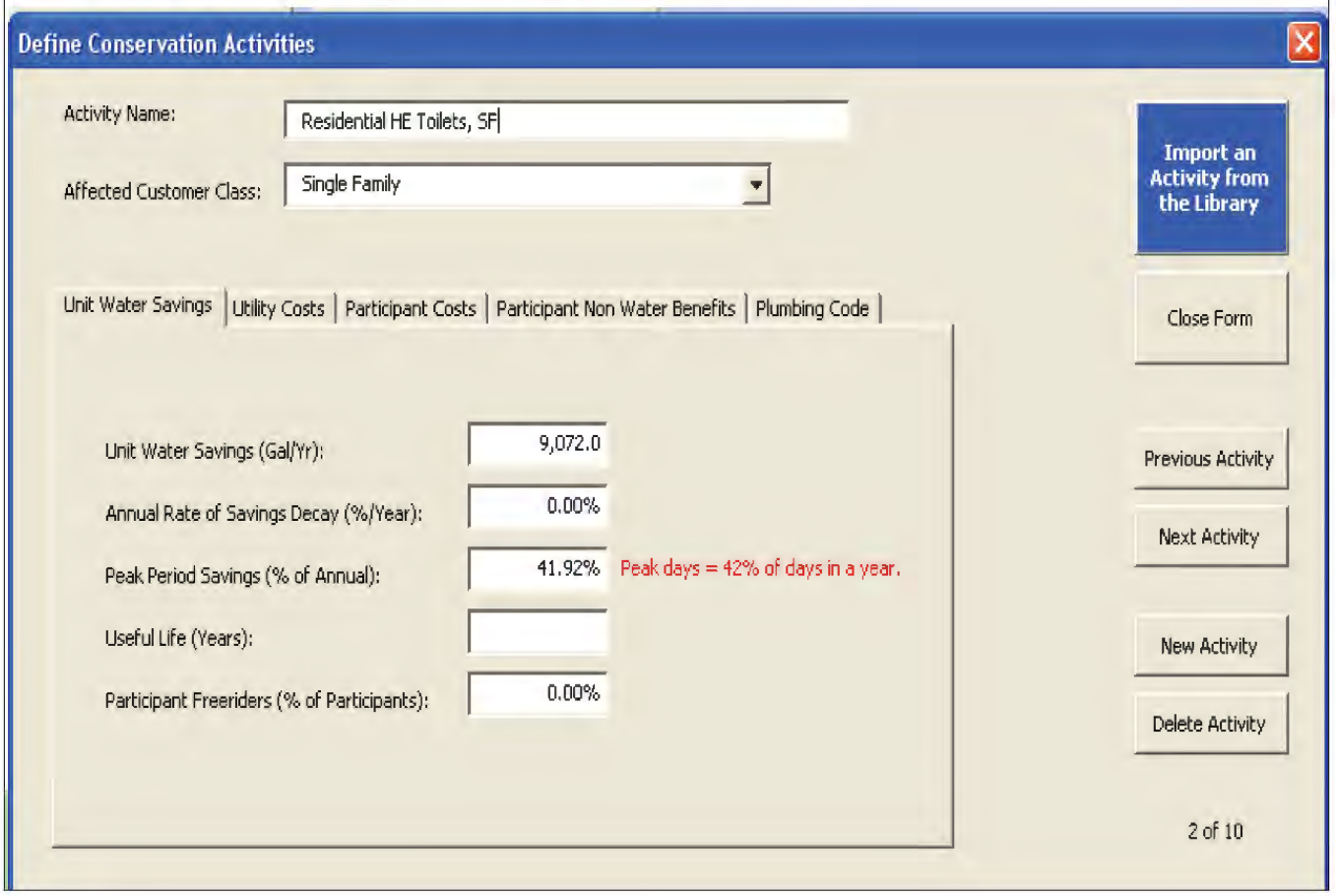
Next Activity

New Activity

Delete Activity

2 of 10

Importing a Library Measure



Entering Annual Activity Levels

AWE CONSERVATION TRACKING TOOL: ENTER ANNUAL CONSERVATION ACTIVITY WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 9/16/2011 11:58:00 AM Return to Navigation Sheet Report Error

Enter Annual Conservation Activity

Class	Activity Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Single Family	Residential Surveys, SF	1000	1000	1000									
Single Family	Residential HE Toilets, SF	1000	1000	1000	1000	1000	1000	1000	1000	1000			
CII	CII Tank-Type HE Toilet	1000	1000	1000	1000	1000	1000	1000	1000	1000			
Single Family	Residential Irrigation Controller, SF	1000	1000	1000	1000	1000	1000	1000	1000				
Irrigation	Large Land. Irrigation Controller	100	100										
Single Family	Residential LF Showerhead, SF				500	500	500	500	500				
Multi Family	Residential LF Showerhead, MF				500	500	500	500	500				
Single Family	Residential HE Washer, SF				200	200	200	200	200				
Multi Family	Residential HE Washer, MF				200	200	200	200	200				
CII	CII Spray Rinse Valve				100	100	100	100	100				

Effective Conservation Activity

Class	Activity Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Single Family	Residential Surveys, SF	1,000	1,800	2,440	2,952	2,362	1,562	922	410	0	0	0	0
Single Family	Residential HE Toilets, SF	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	10,000	10,000	10,000
CII	CII Tank-Type HE Toilet	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	10,000	10,000	10,000
Single Family	Residential Irrigation Controller, SF	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,000	8,000	7,000	6,000	5,000
Irrigation	Large Land. Irrigation Controller	100	200	200	200	200	200	200	200	200	200	100	0	0
Single Family	Residential LF Showerhead, SF	0	0	0	500	1,000	1,500	2,000	2,500	2,500	2,500	2,500	2,500	2,500
Multi Family	Residential LF Showerhead, MF	0	0	0	500	1,000	1,500	2,000	2,500	2,500	2,500	2,500	2,500	2,500
Single Family	Residential HE Washer, SF	0	0	0	200	400	600	800	1,000	1,000	1,000	1,000	1,000	1,000
Multi Family	Residential HE Washer, MF	0	0	0	200	400	600	800	1,000	1,000	1,000	800	600	600
CII	CII Spray Rinse Valve	0	0	0	100	200	300	400	500	500	500	500	500	500

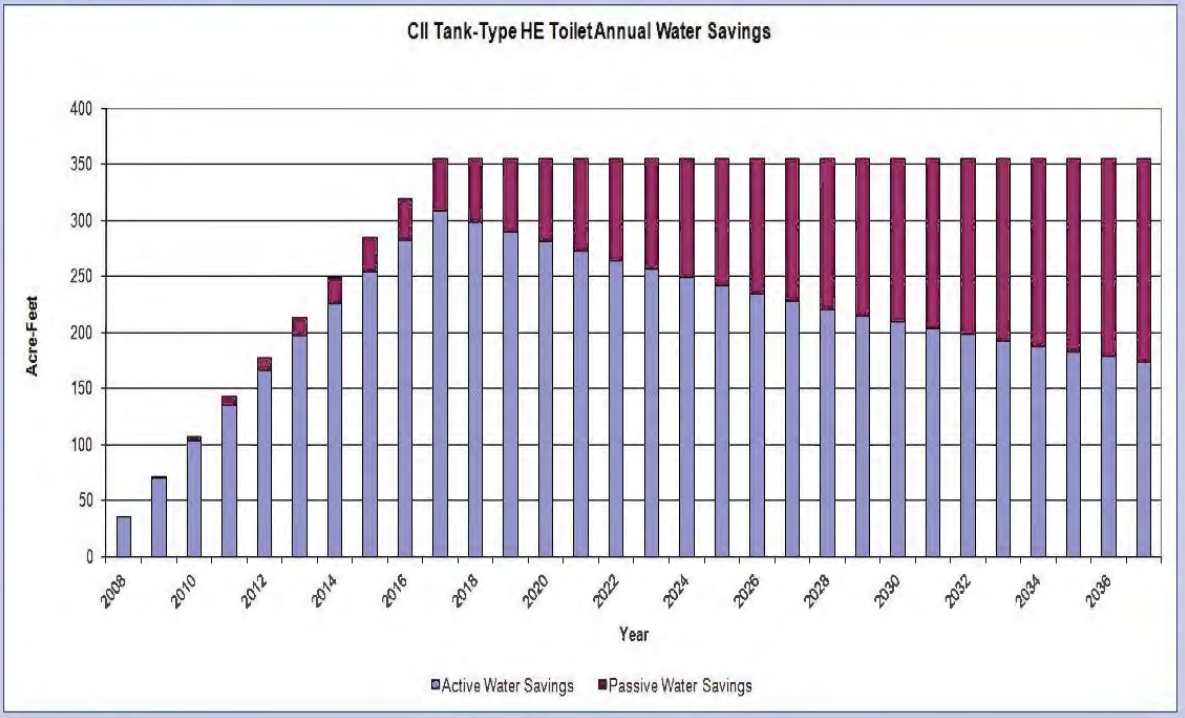
Gross Water Savings (AF)

Class	Activity Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Single Family	Residential Surveys, SF	37.971343	68.3	92.7	112.1	89.7	59.3	35.0	15.6	0.0	0.0	0.0	0.0	0.0
Single Family	Residential HE Toilets, SF	27.8	55.7	83.5	111.4	139.2	167.0	194.9	222.7	250.6	278.4	278.4	278.4	278.4
CII	CII Tank-Type HE Toilet	35.5	71.0	106.5	142.1	177.6	213.1	248.6	284.1	319.6	355.1	355.1	355.1	355.1
Single Family	Residential Irrigation Controller, SF	58.6	117.1	175.7	234.3	292.9	351.4	410.0	468.6	468.6	468.6	410.0	351.4	292.9
Irrigation	Large Land. Irrigation Controller	127.6	255.1	255.1	255.1	255.1	255.1	255.1	255.1	255.1	255.1	127.6	0.0	0.0
Single Family	Residential LF Showerhead, SF	0.0	0.0	0.0	3.2	6.3	9.5	12.7	15.8	15.8	15.8	15.8	15.8	15.8
Multi Family	Residential LF Showerhead, MF	0.0	0.0	0.0	2.9	5.8	8.7	11.6	14.6	14.6	14.6	14.6	14.6	14.6
Single Family	Residential HE Washer, SF	0.0	0.0	0.0	4.3	8.6	13.0	17.3	21.6	21.6	21.6	21.6	21.6	21.6
Multi Family	Residential HE Washer, MF	0.0	0.0	0.0	15.5	31.1	46.6	62.1	77.7	77.7	77.7	77.7	62.1	46.6

AWE CONSERVATION TRACKING TOOL: ACTIVITY SAVINGS PROFILES WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 9/16/2011 11:58:00 AM Return to Navigation Sheet Report Error

Activity Name CII Tank-Type HE Toilet



CII Tank-Type HE Toilet	Gross	Active	Passive
Lifetime Water Savings (AF)	19,711	10,150	9,561
Average Annual Water Savings (AF)	329	169	159

AWE CONSERVATION TRACKING TOOL: WATER SAVINGS SUMMARY WORKSHEET

Water Demand Summary

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Service Area Demands	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Baseline Demands	AF	67,822	68,112	68,404	68,633	68,863	69,093	69,325	69,557	69,790	70,023
Baseline - Code Savings	AF	67,822	67,876	67,942	67,955	67,921	67,902	67,897	67,906	67,927	67,961
Baseline - Code Savings - Program Savings	AF	67,517	67,275	67,160	67,000	66,799	66,677	66,564	66,326	66,158	66,133

Per Capita Demands	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Baseline Demands	GPD	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
Baseline - Code Savings	GPD	173.0	172.4	171.8	171.3	170.6	170.0	169.4	168.9	168.4	167.9
Baseline - Code Savings - Program Savings	GPD	172.2	170.9	169.8	168.9	167.8	166.9	166.1	165.0	164.0	163.4

Service Area Water Savings	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Code Water Savings	AF	0.0	236.9	461.7	677.6	942.1	1,191.7	1,427.5	1,650.4	1,862.2	2,062.6
Program Water Savings	AF	305.7	600.8	781.5	954.8	1,121.7	1,224.1	1,332.7	1,580.3	1,769.8	1,827.9
Total Water Savings	**AF**	**305.7**	**837.7**	**1,243.2**	**1,632.4**	**2,063.7**	**2,415.8**	**2,760.2**	**3,230.7**	**3,632.0**	**3,890.6**
% of Baseline Demands	**%**	**0.5%**	**1.2%**	**1.8%**	**2.4%**	**3.0%**	**3.5%**	**4.0%**	**4.6%**	**5.2%**	**5.6%**

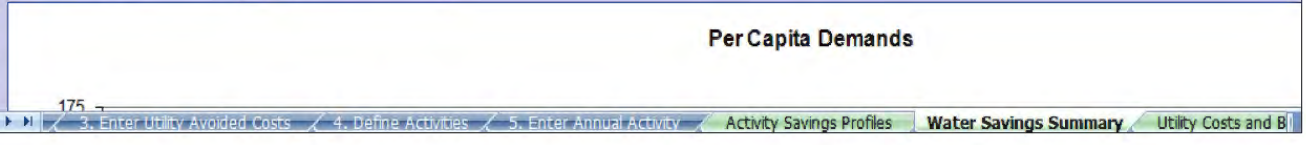
Class Water Savings	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Single Family	AF	127.4	405.0	667.3	917.8	1,205.6	1,428.1	1,647.4	1,862.6	2,012.3	2,157.1
Multi Family	AF	-	54.4	106.0	155.7	212.9	267.1	318.3	366.9	413.1	457.0
CII	AF	44.2	110.2	201.8	290.7	377.1	452.4	526.4	598.9	670.2	740.2
Irrigation	AF	134.1	268.2	268.2	268.2	268.2	268.2	268.2	402.3	536.4	536.4
Water Losses	AF	-	-	-	-	-	-	-	-	-	-
Total	**AF**	**305.7**	**837.7**	**1,243.2**	**1,632.4**	**2,063.7**	**2,415.8**	**2,760.2**	**3,230.7**	**3,632.0**	**3,890.6**

Year forecasted peak season demand equals existing peak season delivery capacity		Deferred Expansion (Years)	Deferred Capacity (MGD)	Benefit of Deferred Expansion ($)	Avoided Capacity (MGD)	Benefit of Avoided Expansion ($)
Baseline Demands	2020	N/A	N/A	N/A	N/A	N/A
Baseline - Code Savings	2031	11	6.4	$9,144,908	0.0	$0
Baseline - Code Savings - Program Savings	2039	19	6.4	$14,198,213	0.0	$0

Select Chart to View

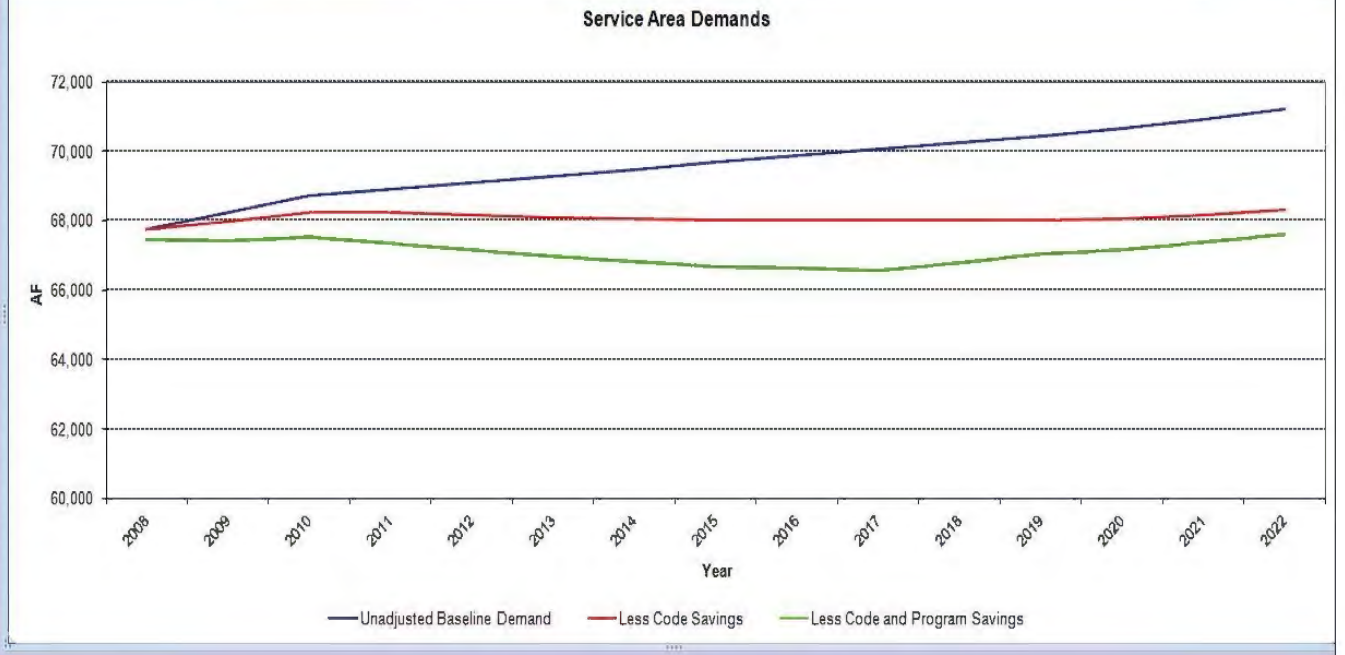
Per Capita Demands

Chart Explanations



Year forecasted peak season demand equals existing peak season delivery capacity		Deferred Expansion (Years)	Deferred Capacity (MGD)	Benefit of Deferred Expansion ($)	Avoided Capacity (MGD)	Benefit of Avoided Expansion ($)
Baseline Demands	2014	N/A	N/A	N/A	N/A	N/A
Baseline - Code Savings	2025	11	5.8	$9,764,491	0.0	$0
Baseline - Code Savings - Program Savings	2027	13	5.8	$11,231,717	0.0	$0

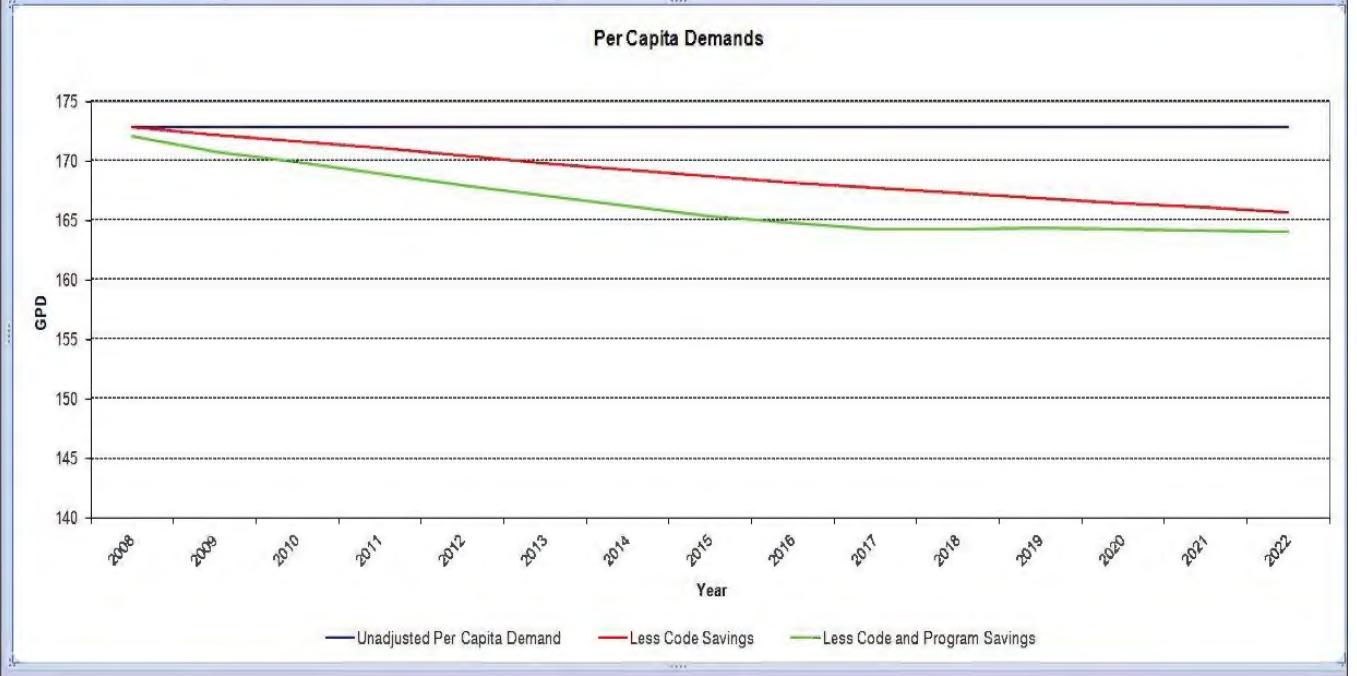
Select Chart to View: Service Area Demands | No. of Years to Display: 15 yrs | Chart Explanations



6. GHG Module Inputs | Activity Savings Profiles | **Water Savings Summary** | Utility Costs and Benefits | Utility Revenues and Rates | Customer C

Year forecasted peak season demand equals existing peak season delivery capacity		Deferred Expansion (Years)	Deferred Capacity (MGD)	Benefit of Deferred Expansion ($)	Avoided Capacity (MGD)	Benefit of Avoided Expansion ($)
Baseline Demands	2014	N/A	N/A	N/A	N/A	N/A
Baseline - Code Savings	2025	11	5.8	$9,764,491	0.0	$0
Baseline - Code Savings - Program Savings	2027	13	5.8	$11,231,717	0.0	$0

Select Chart to View: Per Capita Demands | No. of Years to Display: 15 yrs | Chart Explanations

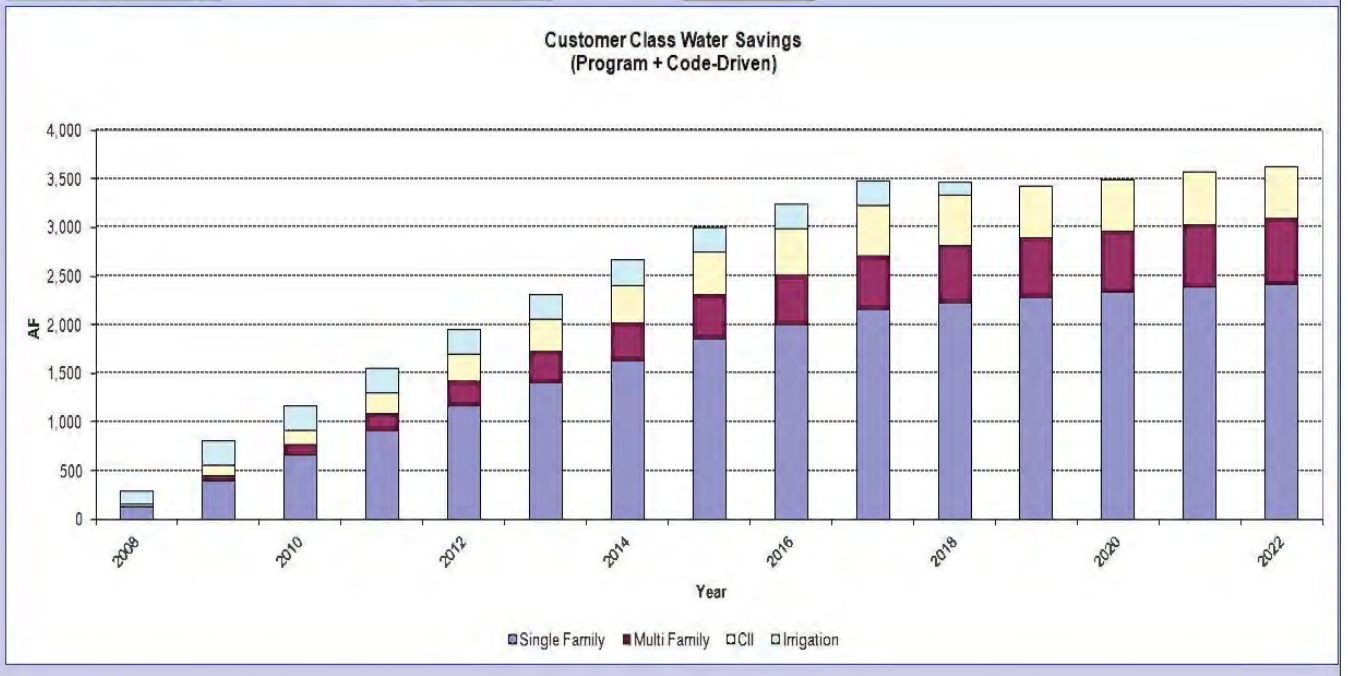


6. GHG Module Inputs | Activity Savings Profiles | **Water Savings Summary** | Utility Costs and Benefits | Utility Revenues and Rates | Customer C

Year forecasted peak season demand equals existing peak season delivery capacity		Deferred Expansion (Years)	Deferred Capacity (MGD)	Benefit of Deferred Expansion ($)	Avoided Capacity (MGD)	Benefit of Avoided Expansion ($)
Baseline Demands	2014	N/A	N/A	N/A	N/A	N/A
Baseline - Code Savings	2025	11	5.8	$9,764,491	0.0	$0
Baseline - Code Savings - Program Savings	2027	13	5.8	$11,231,717	0.0	$0

Select Chart to View

Total Class Savings | No. of Years to Display: 15 yrs | Chart Explanations

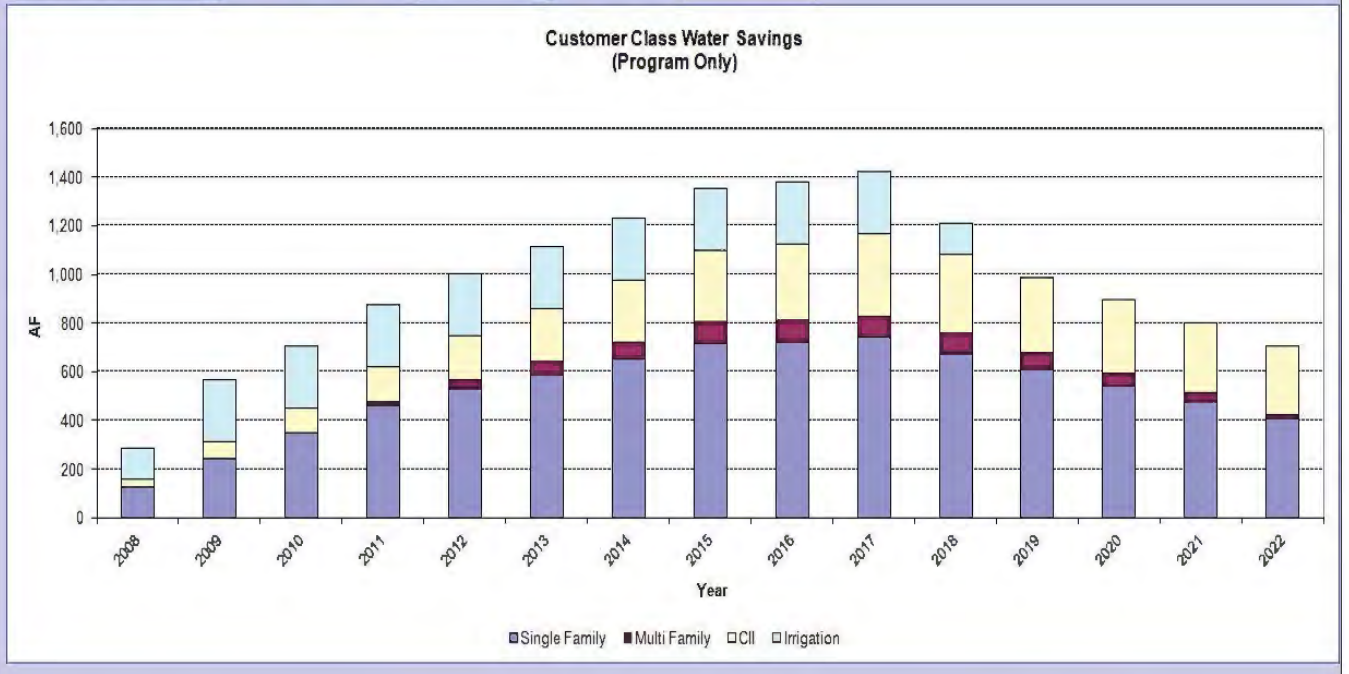


6. GHG Module Inputs | Activity Savings Profiles | **Water Savings Summary** | Utility Costs and Benefits | Utility Revenues and Rates | Customer

Year forecasted peak season demand equals existing peak season delivery capacity		Deferred Expansion (Years)	Deferred Capacity (MGD)	Benefit of Deferred Expansion ($)	Avoided Capacity (MGD)	Benefit of Avoided Expansion ($)
Baseline Demands	2014	N/A	N/A	N/A	N/A	N/A
Baseline - Code Savings	2025	11	5.8	$9,764,491	0.0	$0
Baseline - Code Savings - Program Savings	2027	13	5.8	$11,231,717	0.0	$0

Select Chart to View

Program Class Savings | No. of Years to Display: 15 yrs | Chart Explanations



6. GHG Module Inputs | Activity Savings Profiles | **Water Savings Summary** | Utility Costs and Benefits | Utility Revenues and Rates | Customer

Benefit-Cost Analysis

AWE CONSERVATION TRACKING TOOL: UTILITY COSTS & BENEFITS WORKSHEET

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Show Budget Table

Conservation Program Cost Analysis (2010 Dollars)

Amort. Years: 20

Class	Activity Name	Unit Cost ($/AF)	PV Cost	Amortized Cost
Single Family	Residential Surveys, SF	$ 759	$ 355,505	$ 23,703
Single Family	Residential HE Toilets, SF	$ 408	$ 1,714,162	$ 114,290
CII	CII Tank-Type HE Toilet	$ 320	$ 1,714,162	$ 114,290
Single Family	Residential Irrigation Controller, SF	$ 564	$ 2,113,840	$ 140,938
Irrigation	Large Land. Irrigation Controller	$ 180	$ 398,387	$ 26,562
Single Family	Residential LF Showerhead, SF	$ 130	$ 12,303	$ 820
Multi Family	Residential LF Showerhead, MF	$ 141	$ 12,303	$ 820
Single Family	Residential HE Washer, SF	$ 954	$ 171,020	$ 11,403
Multi Family	Residential HE Washer, MF	$ 643	$ 314,116	$ 20,943
CII	CII Spray Rinse Valve	$ 217	$ 64,912	$ 4,328
Subtotal Conservation Activities		**$ 401**	**$ 6,870,710**	**$ 458,097**
Total With Overhead & Public Information		**$ 401**	**$ 6,870,710**	**$ 458,097**

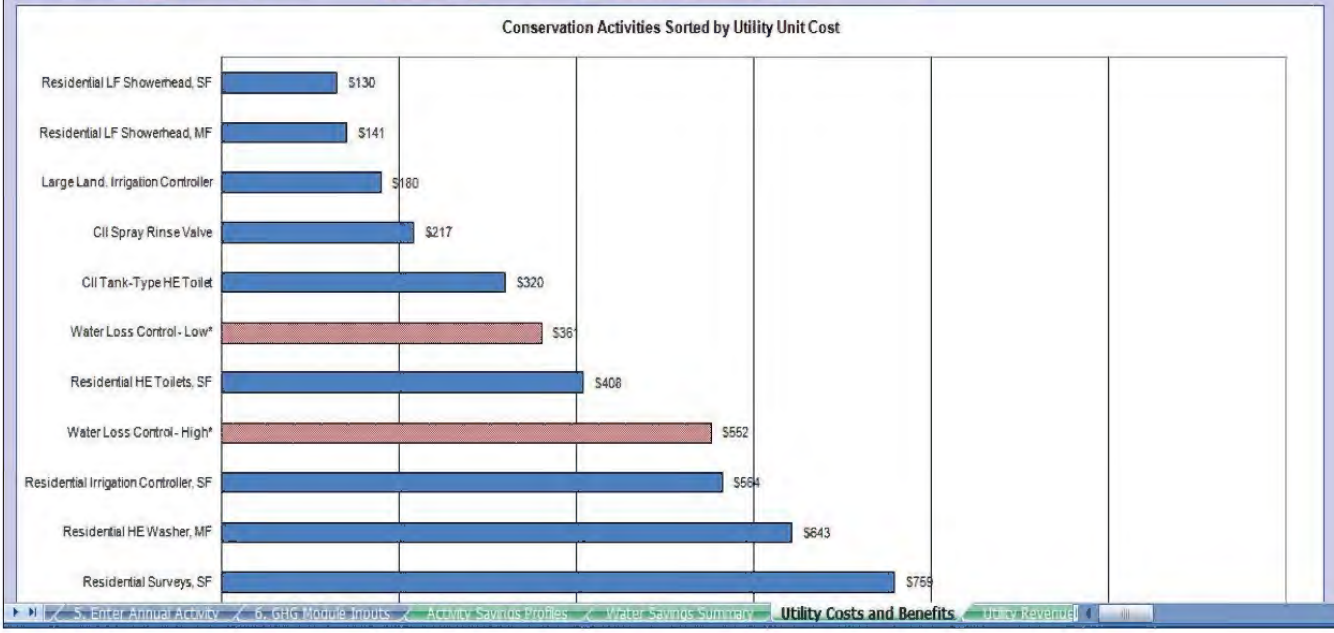
Conservation Benefit Analysis (2010 Dollars)

Class	Activity Name	Unit Benefit ($/AF)	PV Benefit	Avoided Supply	Avoided Wastewater	Capacity Benefit
Single Family	Residential Surveys, SF	$ 682	$ 319,337	$ 271,696	$ 10,323	$ 37,318
Single Family	Residential HE Toilets, SF	$ 728	$ 3,058,997	$ 2,460,038	$ 240,463	$ 358,496
CII	CII Tank-Type HE Toilet	$ 728	$ 3,902,124	$ 3,138,078	$ 306,740	$ 457,306
Single Family	Residential Irrigation Controller, SF	$ 676	$ 2,531,158	$ 2,178,613	$ -	$ 352,545
Irrigation	Large Land. Irrigation Controller	$ 667	$ 1,480,272	$ 1,288,312	$ -	$ 191,961
Single Family	Residential LF Showerhead, SF	$ 702	$ 66,404	$ 55,158	$ 5,311	$ 5,935
Multi Family	Residential LF Showerhead, MF	$ 702	$ 61,116	$ 50,765	$ 4,889	$ 5,462
Single Family	Residential HE Washer, SF	$ 698	$ 125,174	$ 104,427	$ 10,035	$ 10,712
Multi Family	Residential HE Washer, MF	$ 695	$ 339,409	$ 284,169	$ 27,243	$ 27,997
CII	CII Spray Rinse Valve	$ 704	$ 211,115	$ 174,760	$ 16,860	$ 19,494
Total		**$ 706**	**$ 12,095,106**	**$ 10,006,016**	**$ 621,864**	**$ 1,467,226**

Utility Conservation Program NPV and B/C Ratio (2010 Dollars)

Class	Activity Name	NPV ($)	B/C Ratio
Single Family	Residential Surveys, SF	$ (36,168)	0.90
Single Family	Residential HE Toilets, SF	$ 1,344,835	1.78
CII	CII Tank-Type HE Toilet	$ 2,187,962	2.28
Single Family	Residential Irrigation Controller, SF	$ 417,318	1.20
Irrigation	Large Land. Irrigation Controller	$ 1,081,885	3.72
Single Family	Residential LF Showerhead, SF	$ 54,101	5.40
Multi Family	Residential LF Showerhead, MF	$ 48,813	4.97
Single Family	Residential HE Washer, SF	$ (45,846)	0.73
Multi Family	Residential HE Washer, MF	$ 25,293	1.08
CII	CII Spray Rinse Valve	$ 146,203	3.25
Subtotal Conservation Activities		**$ 5,224,396**	**1.76**
Total With Overhead & Public Information		**$ 5,224,396**	**1.76**

Select Chart to View: Unit Costs Sorted | Chart Explanations



5. Enter Annual Activity | 6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Costs and Benefits | UC v. Revenue

AWE CONSERVATION TRACKING TOOL: UTILITY REVENUES & RATES WORKSHEET

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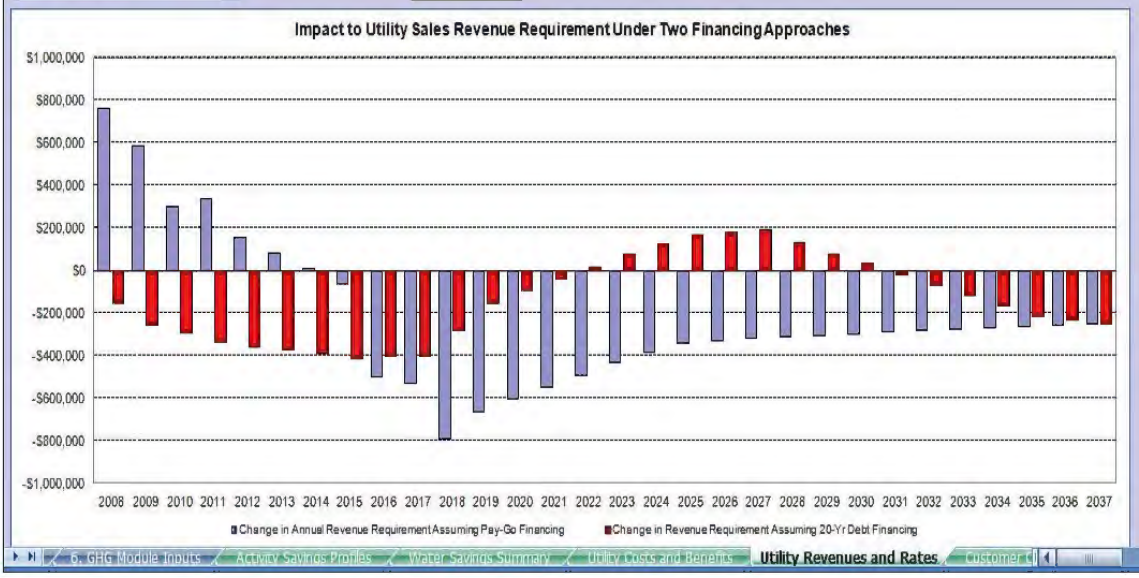
Utility Revenue Requirement and Rate Impacts

Program Impact on...	Baseline	With Conserv.	Change to Baseline
Water Utility Annual Sales Revenue Requirement	49,742,591	$49,562,581	($180,010)
	% change from baseline		-0.36%
Avg. Water Rate ($/Thou Gal)	$2.17	$2.29	$0.13
	% change from baseline		5.86%
Annualized Bill Impact ($/Mo.)	46.86	$46.69	($0.16)
	% change from baseline		-0.35%

Select Impact Chart to View

Revenue Requirement

Chart Explanations



6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Costs and Benefits | Utility Revenues and Rates | Customer C

AWE CONSERVATION TRACKING TOOL: UTILITY REVENUES & RATES WORKSHEET

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Utility Revenue Requirement and Rate Impacts

Program Impact on...	Baseline	With Conserv.	Change to Baseline
Water Utility Annual Sales Revenue Requirement	49,742,591	$49,562,581	($180,010)
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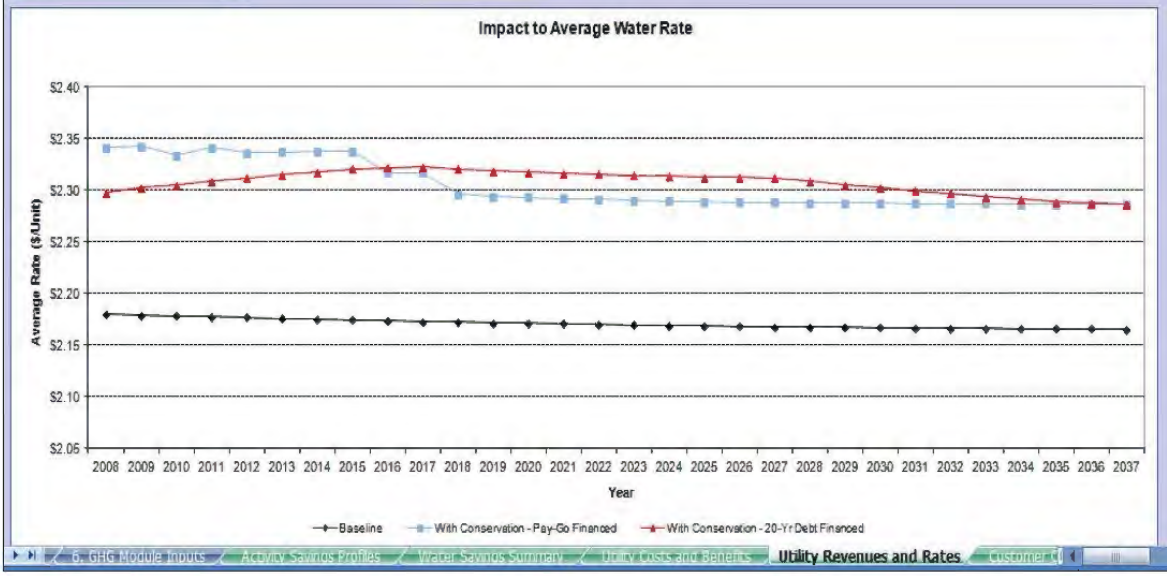
	% change from baseline		5.86%
Annualized Bill Impact ($/Mo.)	46.86	$46.69	($0.16)
	% change from baseline		-0.35%

Select Impact Chart to View

Avg. Water Rate

Chart Explanations



6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Costs and Benefits | Utility Revenues and Rates | Customer C

AWE CONSERVATION TRACKING TOOL: UTILITY REVENUES & RATES WORKSHEET

Last Loaded Scenario: "Sample Scenario (English Units)" loaded on 9/16/2011 11:58:00 AM

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Utility Revenue Requirement and Rate Impacts

Program Impact on...	Baseline	With Conserv.	Change to Baseline
Water Utility Annual Sales Revenue Requirement	49,742,591	$49,562,581	($180,010)
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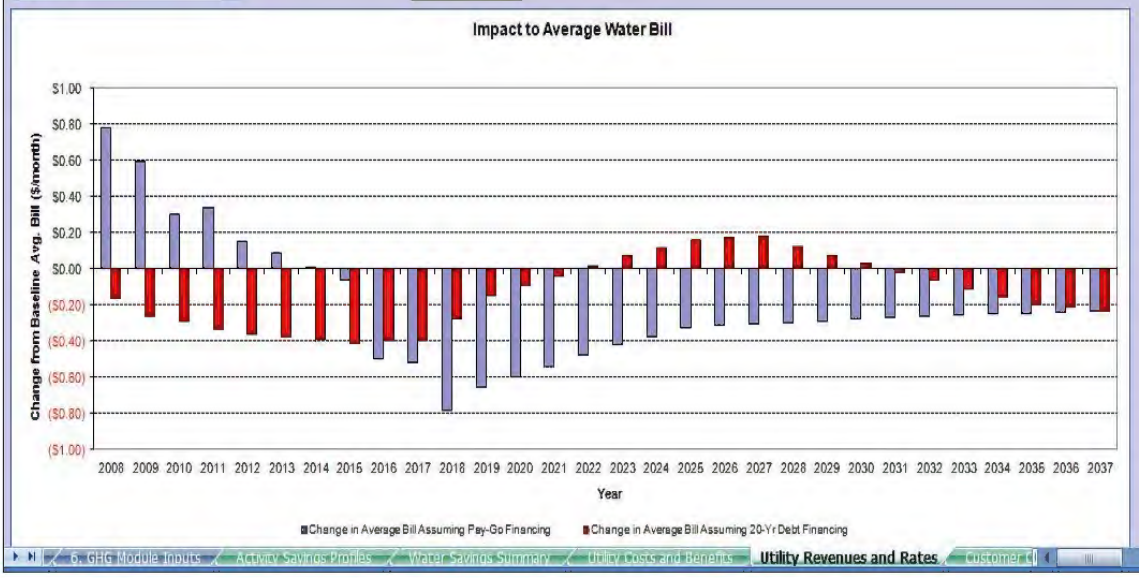
Avg. Water Rate ($/Thou Gal)	$2.17	$2.29	$0.13
	% change from baseline		5.86%
Annualized Bill Impact ($/Mo.)	46.86	$46.69	($0.16)
	% change from baseline		-0.35%

Select Impact Chart to View

Avg. Water Bill

Chart Explanations



6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Costs and Benefits | Utility Revenues and Rates | Customer C

AWE Conservation Tracking Tool_v2.0_Standard Edition [Compatibility Mode] - Microsoft Excel

AWE CONSERVATION TRACKING TOOL: GHG MODULE INPUTS WORKSHEET

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Select eGRID Region or Enter Your Own Emission Factors:

Note: Model will use eGRID factors if User Entered Factors left blank.

In which eGRID Region are you located? (See map)	MROW

Average Generation Emission Factors	eGRID Factors (lb/MWhr)	User Entered Factors (lb/MWhr)
CO_2	1,822	
CH_4	0.02800	
SO_2	5.6476	
NO_x	3.7138	
N_2O	0.03071	
Hg	0.0000410	

Model will use eGRID factor if User Entered Factor is blank.

eGRID Subregion Representational Map

Energy Used for Water Supply and Wastewater Treatment:

Enter the average rate ($/kWh) your utility pays for electricity:	$0.15/KWh

○ User Entered Energy Intensity Values ◉ AWE Energy Intensity Calculator Values

1. Click the first radio button if you already know the energy intensity of your water and wastewater services.

2. Click the second radio button if you want to use the **AWE Energy Intensity Calculator** to estimate these values.

AWE Water and Wastewater Energy Intensity Calculator

Water Supply, Treatment, and Distribution Energy Intensity Default Values

Local Water Supply Sources	KWh/AF	% of Local Supply
Local Surface Water	222	40%
Groundwater	624	40%
Brackish Desalination	528	0%
Recycled Water	730	10%
Seawater Desalination	4,497	10%
	Total:	100%

Average Energy Intensity of Local Water Supply	861	KWh/AF

Imported Water Supply Sources	KWh/AF	Default Value
Select the imported water energy intensity level	High	
Average Energy Intensity of Imported Water Supply		2,473 KWh/AF
Imported Water Supply as % of Total Supply	40%	
Local Water Supply as % of Total Supply	60%	

Average Energy Intensity per AF of Total Supply	**1,506**	**KWh/AF**

Imported Water Energy Intensity Key

Low - Transmission mostly via gravity with limited pumping. More likely raw than treated water.

Moderate - Some transmission pumping required. Source may be groundwater. Delivered water may be raw or trea

High - Transmission involves significant pumping. Source may be groundwater. Delivered water more likely treated

Water Treatment	KWh/AF	% of Total Supply Receiving This Treatment
Coagulation, Flocculation, Filtration	82	80%

5. Enter Annual Activity | 6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Cos

AWE Conservation Tracking Tool_v2.0_Standard Edition [Compatibility Mode] - Microsoft Excel

Imported Water Supply Sources	KWh/AF	Default Value	
Select the imported water energy intensity level	High		
Average Energy Intensity of Imported Water Supply		2,473	KWh/AF
Imported Water Supply as % of Total Supply	40%		
Local Water Supply as % of Total Supply	60%		

Imported Water Energy Intensity Key

Low - Transmission mostly via gravity with limited pumping. More likely raw than treated water.
Moderate - Some transmission pumping required. Source may be groundwater. Delivered water may be raw or trea
High - Transmission involves significant pumping. Source may be groundwater. Delivered water more likely treated

Average Energy Intensity per AF of Total Supply	1,506	KWh/AF

Water Treatment	KWh/AF	% of Total Supply Receiving This Treatment
Coagulation, Flocculation, Filtration	82	80%
Microfiltration	153	60%
Disinfection (Ozone)	72	50%

Average Treatment Energy Intensity per AF of Delivered Water	193	KWh/AF

Water Distribution	KWh/AF
Choose a terrain that best describes your service area	Flat
Average Booster Pump Energy Intensity per AF of Delivered Water	18
Average Pressure System Pumps per AF of Delivered Water	477

Average Distribution Energy Intensity per AF of Delivered Wat	495	KWh/AF

Average Energy Intensity of Delivered Water	KWh/AF
Supply	1,506
Treatment	193
Distribution	495
Total	**2,194** KWh/AF

<< This is the calculated energy intensity for water supply, treatment, and distribution

Wastewater Collection and Treatment Energy Intensity Default Values

Wastewater Collection and Treatment Function	KWh/AF	% of Wastewater Receiving This Treatment
Wastewater Collection Pumps	74	N/A
Primary + Secondary	344	25%
Primary + Secondary + Tertiary	915	75%
Microfiltration (incremental energy)	266	0%
Reverse Osmosis (incremental energy)	517	0%
UV (incremental energy)	104	0%

Wastewater Collection and Treatment Energy Intensity per AF	847	KWh/AF

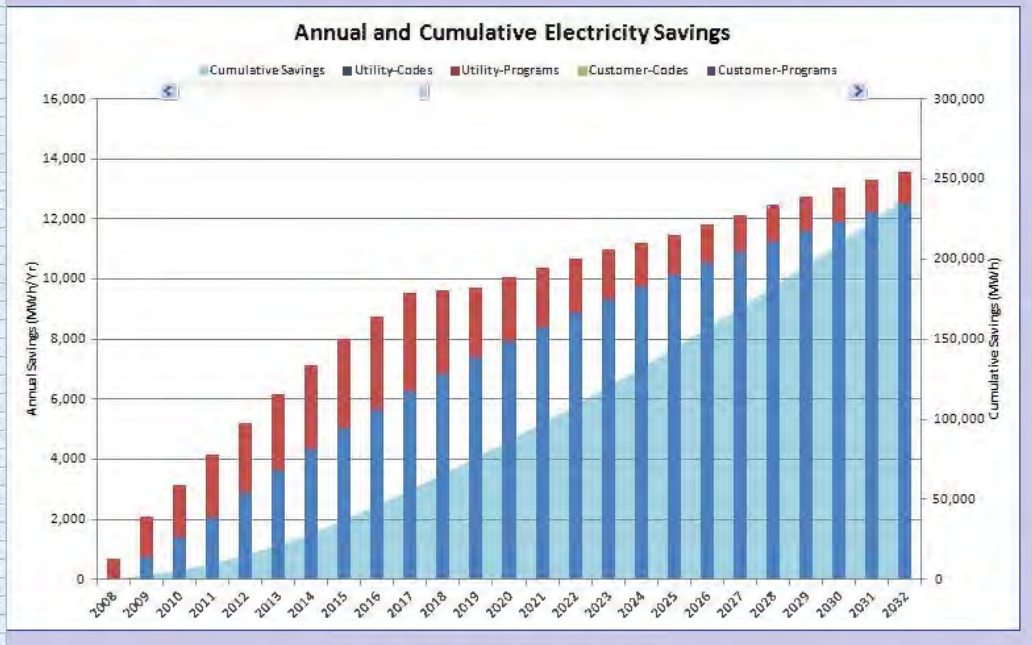
<< This is the calculated energy intensity for wastewater collection and treatment

Source of Local Water Supply, Treatment, and Wastewater Energy Intensity Default Values: "Embedded Energy in Water Studies, Study 2: Water Agency and Function Component Study and Embedded Energy-Water Load Profiles." Prepared for California Public Utilities Commission by GEI Consultants/Navigant Consulting. August 31, 2010. Midpoint or Statewide estimates in Table 4-6, page 85.

Source of Imported Water Supply Energy Intensity Default Values: "Embedded Energy in Water Studies, Study 1: Statewide and Regional Water-Energy Relationship." Prepared for California Public Utilities Commission by GEI Consultants/Navigant Consulting. August 31, 2010.

5. Enter Annual Activity | 6. GHG Module Inputs | Activity Savings Profiles | Water Savings Summary | Utility Cost

AWE Conservation Tracking Tool_v2.0_Standard Edition [Compatibility Mode] - Microsoft Excel

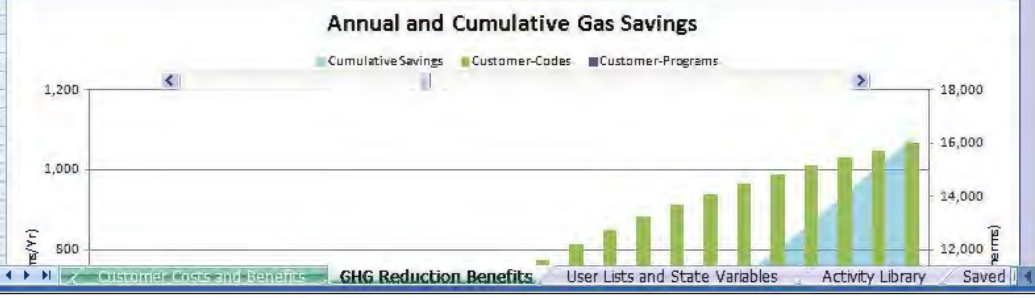


Show Series
- ☑ Utility-Codes
- ☑ Utility-Programs
- ☐ Customer-Codes
- ☐ Customer-Program
- ☑ Cumulative Savings-All

Go to Summary Tables
Go to Annual Tables

Use the slider in the chart to set the number of years to display. Or enter a whole number between 5 and 60 in the box below.

Years to Display: 25

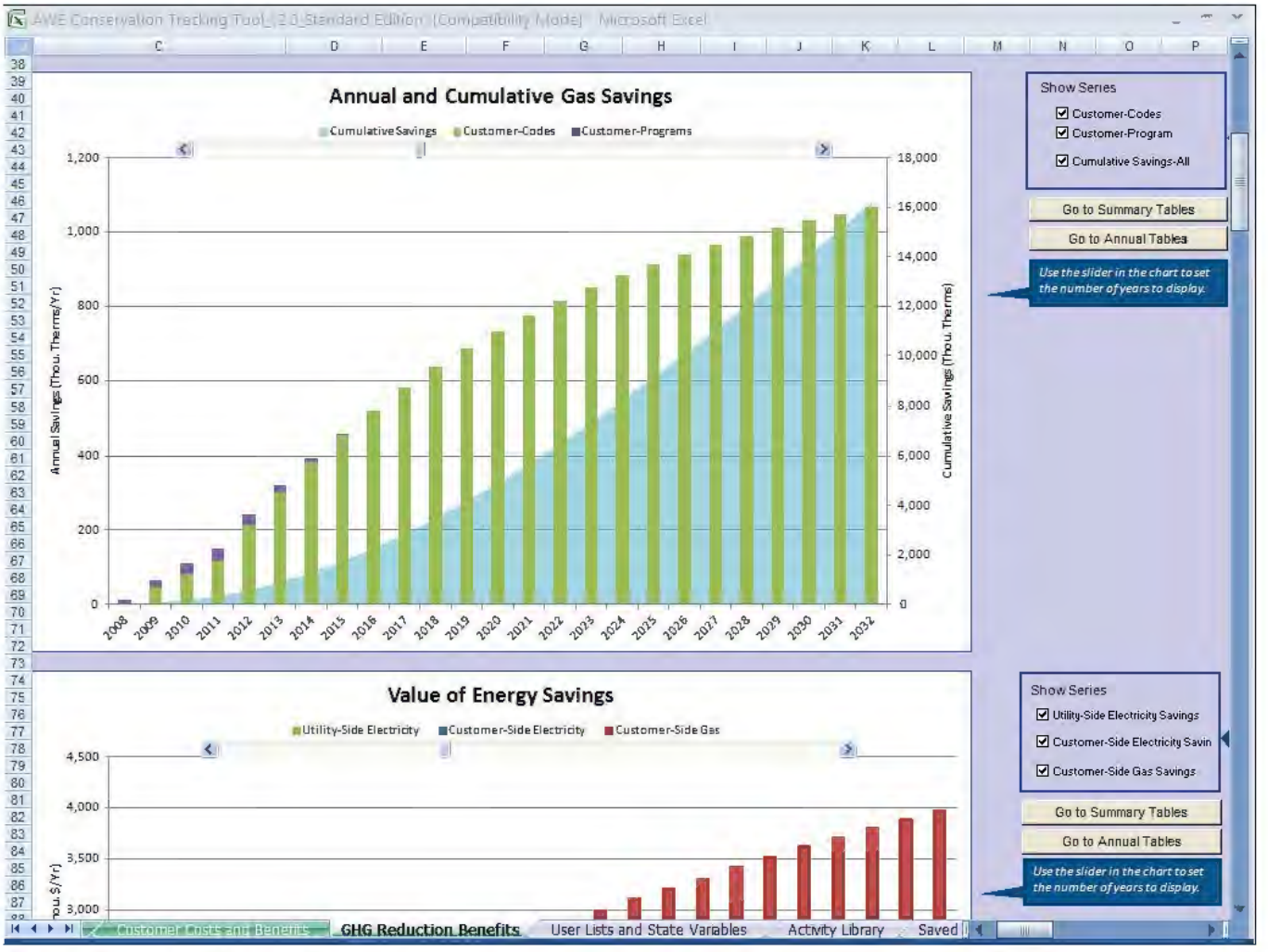


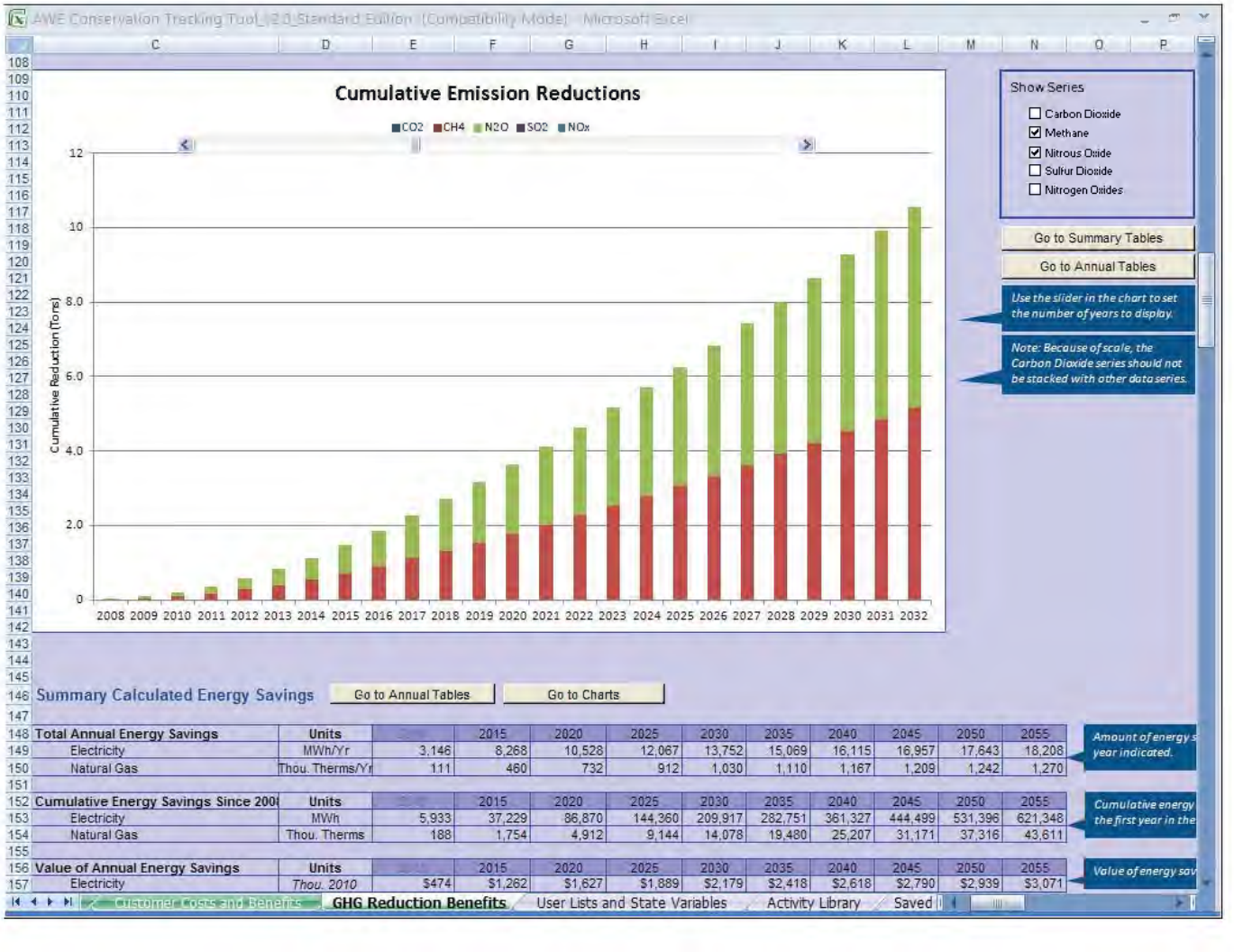
Show Series
- ☑ Customer-Codes
- ☑ Customer-Program
- ☑ Cumulative Savings-All

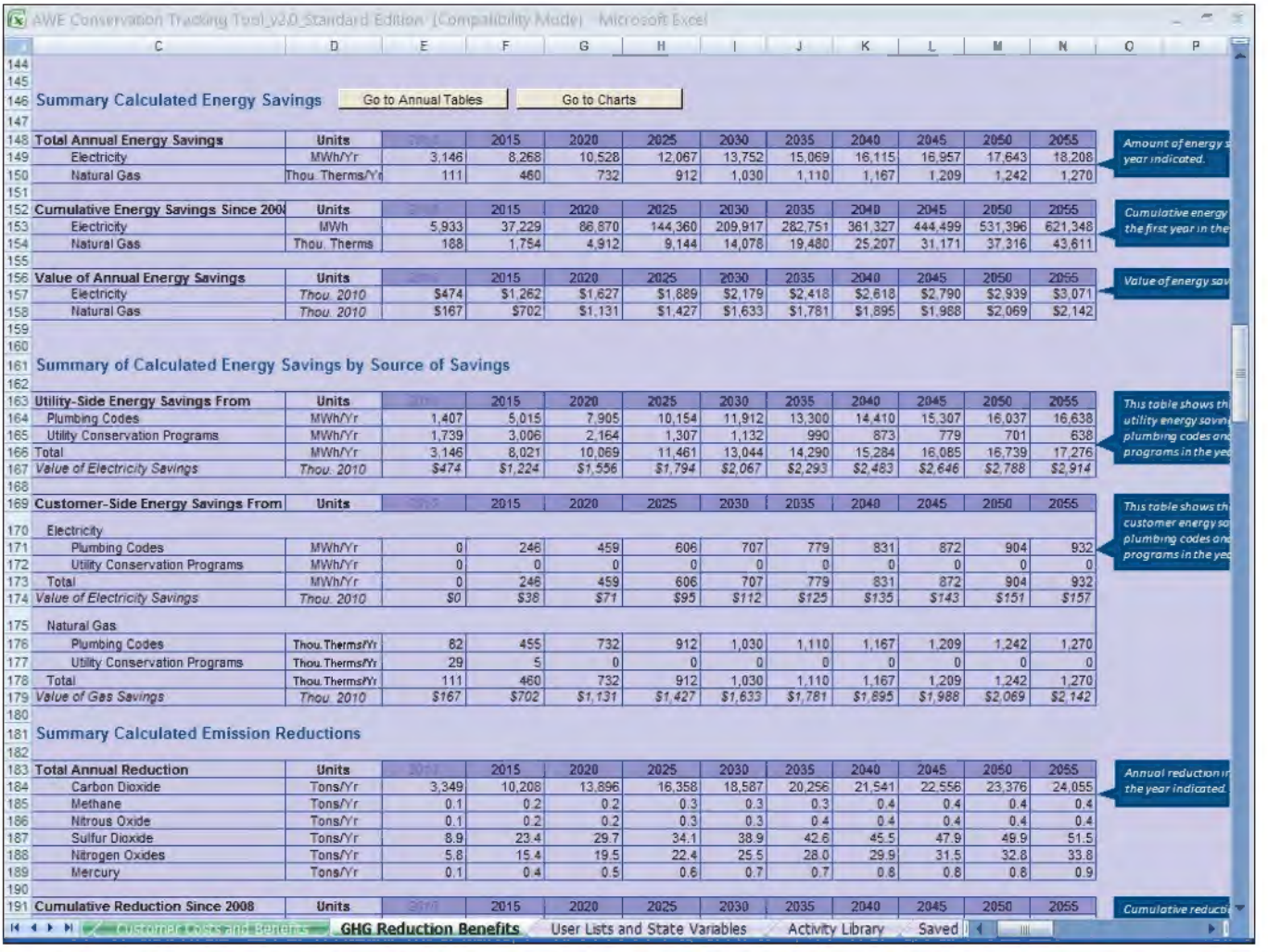
Go to Summary Tables
Go to Annual Tables

Use the slider in the chart to set the number of years to display.

Customer Costs and Benefits | GHG Reduction Benefits | User Lists and State Variables | Activity Library | Saved


AWE Conservation Tracking Tool_2.0_Standard Edition [Compatibility Mode] - Microsoft Excel
Annual and Cumulative Gas Savings
Cumulative Savings
Customer-Codes
Customer-Programs
Annual Savings (Thou. Therms/Yr)
Cumulative Savings (Thou. Therms)
Show Series
Customer-Codes
Customer-Program
Cumulative Savings-All
Go to Summary Tables
Go to Annual Tables
Use the slider in the chart to set the number of years to display.
Value of Energy Savings
Utility-Side Electricity
Customer-Side Electricity
Customer-Side Gas
Show Series
Utility-Side Electricity Savings
Customer-Side Electricity Savin
Customer-Side Gas Savings
Go to Summary Tables
Go to Annual Tables
Use the slider in the chart to set the number of years to display.
Customer Costs and Benefits
GHG Reduction Benefits
User Lists and State Variables
Activity Library
Saved


AWE Conservation Tracking Tool_2.0_Standard Edition [Compatibility Mode] - Microsoft Excel
Cumulative Emission Reductions
CO2
CH4
N2O
SO2
NOx
Cumulative Reduction (Tons)
Show Series
Carbon Dioxide
Methane
Nitrous Oxide
Sulfur Dioxide
Nitrogen Oxides
Go to Summary Tables
Go to Annual Tables
Use the slider in the chart to set the number of years to display.
Note: Because of scale, the Carbon Dioxide series should not be stacked with other data series.
Summary Calculated Energy Savings
Go to Annual Tables
Go to Charts
Total Annual Energy Savings | Units | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055
Electricity | MWh/Yr | 3,146 | 8,268 | 10,528 | 12,067 | 13,752 | 15,069 | 16,115 | 16,957 | 17,643 | 18,208
Natural Gas | Thou. Therms/Yr | 111 | 460 | 732 | 912 | 1,030 | 1,110 | 1,167 | 1,209 | 1,242 | 1,270
Cumulative Energy Savings Since 200 | Units | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055
Electricity | MWh | 5,933 | 37,229 | 86,870 | 144,360 | 209,917 | 282,751 | 361,327 | 444,499 | 531,396 | 621,348
Natural Gas | Thou. Therms | 188 | 1,754 | 4,912 | 9,144 | 14,078 | 19,480 | 25,207 | 31,171 | 37,316 | 43,611
Value of Annual Energy Savings | Units | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055
Electricity | Thou. 2010 | $474 | $1,262 | $1,627 | $1,889 | $2,179 | $2,418 | $2,618 | $2,790 | $2,939 | $3,071
Customer Costs and Benefits
GHG Reduction Benefits
User Lists and State Variables
Activity Library
Saved



AWE Conservation Tracking Tool_v2.0_Standard Edition [Compatibility Mode] - Microsoft Excel

Summary Calculated Energy Savings [Go to Annual Tables] [Go to Charts]

Total Annual Energy Savings	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Electricity	MWh/Yr	3,146	8,268	10,528	12,067	13,752	15,069	16,115	16,957	17,643	18,208
Natural Gas	Thou. Therms/Yr	111	460	732	912	1,030	1,110	1,167	1,209	1,242	1,270

Cumulative Energy Savings Since 2008	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Electricity	MWh	5,933	37,229	86,870	144,360	209,917	282,751	361,327	444,499	531,396	621,348
Natural Gas	Thou. Therms	168	1,754	4,912	9,144	14,078	19,480	25,207	31,171	37,316	43,611

Value of Annual Energy Savings	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Electricity	*Thou. 2010*	$474	$1,262	$1,627	$1,889	$2,179	$2,418	$2,618	$2,790	$2,939	$3,071
Natural Gas	*Thou. 2010*	$167	$702	$1,131	$1,427	$1,633	$1,781	$1,895	$1,988	$2,069	$2,142

Summary of Calculated Energy Savings by Source of Savings

Utility-Side Energy Savings From	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Plumbing Codes	MWh/Yr	1,407	5,015	7,905	10,154	11,912	13,300	14,410	15,307	16,037	16,638
Utility Conservation Programs	MWh/Yr	1,739	3,006	2,164	1,307	1,132	990	873	779	701	638
Total	MWh/Yr	3,146	8,021	10,069	11,461	13,044	14,290	15,284	16,085	16,739	17,276
Value of Electricity Savings	*Thou. 2010*	*$474*	*$1,224*	*$1,556*	*$1,794*	*$2,067*	*$2,293*	*$2,483*	*$2,646*	*$2,788*	*$2,914*

Customer-Side Energy Savings From	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Electricity										
Plumbing Codes	MWh/Yr	0	246	459	606	707	779	831	872	904	932
Utility Conservation Programs	MWh/Yr	0	0	0	0	0	0	0	0	0	0
Total	MWh/Yr	0	246	459	606	707	779	831	872	904	932
Value of Electricity Savings	*Thou. 2010*	*$0*	*$38*	*$71*	*$95*	*$112*	*$125*	*$135*	*$143*	*$151*	*$157*
Natural Gas										
Plumbing Codes	Thou.Therms/Yr	82	455	732	912	1,030	1,110	1,167	1,209	1,242	1,270
Utility Conservation Programs	Thou.Therms/Yr	29	5	0	0	0	0	0	0	0	0
Total	Thou.Therms/Yr	111	460	732	912	1,030	1,110	1,167	1,209	1,242	1,270
Value of Gas Savings	*Thou. 2010*	*$167*	*$702*	*$1,131*	*$1,427*	*$1,633*	*$1,781*	*$1,895*	*$1,988*	*$2,069*	*$2,142*

Summary Calculated Emission Reductions

Total Annual Reduction	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055
Carbon Dioxide	Tons/Yr	3,349	10,208	13,896	16,358	18,587	20,256	21,541	22,556	23,376	24,055
Methane	Tons/Yr	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Nitrous Oxide	Tons/Yr	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Sulfur Dioxide	Tons/Yr	8.9	23.4	29.7	34.1	38.9	42.6	45.5	47.9	49.9	51.5
Nitrogen Oxides	Tons/Yr	5.8	15.4	19.5	22.4	25.5	28.0	29.9	31.5	32.8	33.8
Mercury	Tons/Yr	0.1	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9

Cumulative Reduction Since 2008	Units	2015	2020	2025	2030	2035	2040	2045	2050	2055

Sheet tabs: Customer Costs and Benefits | GHG Reduction Benefits | User Lists and State Variables | Activity Library | Saved

Availability of Model

- Available free to members
- AWE provides free all future updates and one free hour of technical assistance
- Version 2.0 released August 2011
- 250 registered tracking tool users
- Versions of tool for states with different codes
- Continuous technical assistance available

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Appendix A.2

AWE Tracking Tool - Version 2.0
User Inputs

AWE Tracking Tool - Version 2.0
User Inputs

COMMON ASSUMPTIONS WORKSHEET

1. Analysis Start Year
2. Service Area Population (Projections through the analysis period)
3. Service Area Population in 1990
4. Peak-Season Start Date ('month/day')
5. Peak-Season End Date ('month/day')
6. Choose Volume Units (Million Gallons, Acre-Feet, Million Cubic Meters)
7. Nominal Interest Rate
8. Inflation Rate
9. Year in which to Denominate Costs & Benefits
10. Persons Per Household - SF
11. Persons Per Household - MF
12. Full Bathrooms Per Household - SF
13. Half Bathrooms Per Household - SF
14. Full Bathrooms Per Household - MF
15. Half Bathrooms Per Household - MF
16. SF Housing Units Built before 1994
17. MF Housing Units Built before 1994
18. Choose Water Volume Units (MG, AF, or MCM)
19. Reference ET (inches/yr)
20. Avg. Annual Rainfall (inches/yr)
21. Select Region
22. Select Water User Classes
23. Current Customer Utility Rates for Selected Water User Classes
    a. Water
    b. Sewer
    c. Electric
    d. Gas
24. Nominal Rate of Increase for Selected Water User Classes
    a. Water
    b. Sewer
    c. Electric
    d. Gas

SPECIFY DEMANDS WORKSHEET

1. Service Area Demands – Base Year Peak Season and Off Peak Season. The Tracking Tool can create a simple demand forecast or user can manually enter an existing demand forecast.
    a. Select whether or not the demand projection accounts for plumbing code.
2. Customer Demand Shares
    a. User has option to enter Customer Class Shares (%) or Customer Class Demands
    b. Number of Accounts per customer class

ENTER UTILITY AVOIDED COSTS WORKSHEET

1. The User can either manually enter avoided costs or use the Tracking Tool's built in Simple Utility Avoided Cost Model, which requires the following inputs:
    a. Water Supply: Variable O&M Costs in $/AF and Nominal Rate of Increase %/Year
        i. Water Purchase Cost
        ii. Energy for Transmission, Treatment, & Distribution
        iii. Chemicals
        iv. Other Variable O&M
    b. Wastewater: Variable O&M Costs in $/AF and Nominal Rate of Increase %/Year
        i. Energy for Transmission, Treatment, & Discharge
        ii. Chemicals
        iii. Other Variable O&M
    c. Current Peak Season Capacity
    d. Amount of new capacity that will be added (user may also choose to use model default)
    e. Avoidable System Expansion Cost ($/MGD)
    f. Environmental Benefit of Reduced Water Demands ($/AF or $/MG)

DEFINE ACTIVITIES WORKSHEET

On this worksheet the user is prompted to enter the various water conservation programs to be analyzed.

1. Activity name
2. Affected Customer Class
3. Unit Water Savings Tab
    a. Unit Water Savings (Gal/Year)
    b. Annual Rate of Savings Decay (%/Year)
    c. Peak period savings (% of Annual)
    d. Useful Life (Years)
    e. Participant Freeriders (% of Participants)
4. Utility Costs Tab
    a. Year in Which Participant Costs are Denominated
    b. Fixed Setup Costs ($)
    c. Costs per Participant ($/Participant)
    d. Number of Years of Follow-on Utility Costs
    e. Annual Follow-on Fixed Costs ($/Year)
    f. Annual Follow-on Variable Costs ($/Participant/Year)
5. Participant Costs Tab
    a. Year in Which Participant Costs are Denominated
    b. Initial Cost per Participant ($)

    c. Number of Years of Participant Follow-on Costs (Years)
    d. Annual Follow-on Participant Costs ($/Participant/Year)
6. Participant Non Water Benefits Tab
    a. Unit Sewer Discharge Reduction (Gal/Year)
    b. Unit Gas Savings (Therm/Gal)
    c. Unit Electricity Savings (kWh/Gal)
7. Plumbing Code Tab
    a. Year in Which Code Took (or will take) Effect
    b. Code Unit Water Savings (Gal/Year)
    c. Annual Rate of Code-Driven Replacement (%/Year)

ENTER ANNUAL ACTIVITY WORKSHEET

In this worksheet the user enters the activity level for each of the conservation programs.

GHG MODULE INPUTS WORKSHEET

1. eGRID Region in which you are located
2. Average Generation Emission Factors – User entered or eGRID default factors
    a. CO_2
    b. CH_4
    c. SO_2
    d. NO_x
    e. N_2O
    f. Hg
3. Average rate ($/KWh) your utility pays for electricity
4. Energy Intensity of Water Supply Withdrawal, Treatment, and Distribution – User entered or generated with built-in AWE Water and Wastewater Energy Intensity Calculator
5. Energy Intensity of Wastewater Pumping and Treatment Distribution – User entered or generated with built-in AWE Water and Wastewater Energy Intensity Calculator

Appendix A.3

AWE Tracking Tool - Version 2.0
Changes Made to the Conservation Activity Library Parameters

AWE Tracking Tool - Version 2.0
Changes Made to the Conservation Activity Library Parameters

The table that follows documents the changes made to the parameters of conservation activities included in the Tracking Tool library as part of Version 2 of the Tracking Tool. In addition to these activity-specific changes, the following global changes were also made to the library:

1. The fixed setup cost of $10,000 was removed from each activity's cost specification. The model now prompts the user when importing a library activity that they must enter an appropriate set-up cost for their local circumstances.
2. The library documentation included with the User Guide has been revised and updated. Included with each activity is a text box laying out the basis for the library default parameter values.

Table of Changes to Activity-Specific Parameters

Library Activity	Changes to Parameters
1. Residential Surveys, Single Family	• Participant Savings, Gas (Therms/Gal) corrected to account for split between indoor and outdoor water savings
2. Residential Surveys, Multi Family	• Savings, Per Unit (gpy) changed from 10,950 gpy to 4,015 gpy to reflect average water savings for an indoor survey resulting in one showerhead, toilet displacement device, and faucet aerator, per CUWCC (2005). Note this corrects a typo in the Version 1.2 library which set unit savings at 10,950 rather than 4,015. • Participant Savings, Sewer (gpy) corrected to reflect average water savings for an indoor survey resulting in one showerhead, toilet displacement device, and faucet aerator, per CUWCC (2005)
3. Residential ULF Toilet Rebates, Single Family	• None
4. Residential ULF Toilet Rebates, Multi Family	• None
5. Residential HE Toilet Rebates, Single Family	• Utility Costs, Initial Variable ($/Unit) changed from $180 to $200 (rebate of $150 and admin cost of $50/rebate) • Participant Costs, Initial ($) changed from $120 to $100 (toilet purchase cost of $200 plus install cost of $50 less rebate of $150) Note: rebate and admin costs normalized to be consistent with ULF Toilet Rebate costs. The HE rebate is assumed to be $50 more than the ULF rebate to account for higher HE toilet cost and incentivize HE toilets. Admin costs are assumed to be the same for ULF and HE rebates.
6. Residential HE Toilet Rebates, Multi Family	• Utility Costs, Initial Variable ($/Unit) changed from $180 to $200 (rebate of $150 and admin cost of $50/rebate)

Library Activity	Changes to Parameters
	• Participant Costs, Initial ($) changed from $120 to $100 (toilet purchase cost of $200 plus install cost of $50 less rebate of $150) Note: rebate and admin costs normalized to be consistent with ULF Toilet Rebate costs. The HE rebate is assumed to be $50 more than the ULF rebate to account for higher HE toilet cost and incentivize HE toilets. Admin costs are assumed to be the same for ULF and HE rebates.
7. Residential HE Toilet Direct Installation, Multi Family	• Utility Costs, Initial Variable ($/Unit) changed from $300 to $265 (toilet purchase cost of $175 – which assumes a $25/toilet bulk purchase discount – plus install cost of $40 – which assumes a $10/toilet bulk install discount – plus program admin cost of $50/toilet
8. Residential LF Showerhead Distribution, Single Family	• None
9. Residential LF Showerhead Distribution, Multi Family	• None
10. Residential HE Washer Rebates, Single Family	• Savings, Useful Life (yrs) changed from 12 to 11 years to match EPA Energy Star Life Cycle Cost Calculator assumptions for residential washers. • Utility Costs, Initial Variable ($/Unit) changed from $300 to $200 ($150 rebate plus admin cost of $50/rebate) • Participant Costs, Initial ($/washer) changed from $0 to $150 (price premium of $300 for HE washer, per EPA and DOE (2004), less rebate of $150) Note: Utility rebate costs normalized to be consistent with how rebate costs are estimated for other fixtures (e.g. toilets)
11. Residential HE Washer Rebates, Multi Family	• Participant Costs, Initial ($/washer) changed from $0 to $420 (price premium for high capacity common area washers less typical rebate, as reported by Fox (2003) and Battelle PNL (2000))
12. Residential Irrigation Controller Rebates, Single Family	• Utility Costs, Initial Variable ($/Unit) changed from $400 to $300 ($250 rebate plus admin cost of $50/rebate) • Participant Costs, Initial ($) changed from $100 to $250 (average controller cost of $350, per Aquacraft (2009), plus average install cost of $150, per Jordan, Lang, and Gonzales (2004), less rebate of $250)
13. Residential Irrigation Controller Financing, Single Family	• Utility Costs, Initial Variable ($/Unit) changed from $200 to $135 (assumes utility pays controller supplier $100 to buy-down customer financing rate from 10% to 7% on capital costs of $800 – new controller plus 20 high-efficiency spray nozzles – plus program marketing and admin costs of $35/controller
14. Residential Turf Replacement Rebates, Single Family	• Participant Costs, Initial ($) changed from $500 to $1,188 (assumes replacement cost of $1.00/sqft less utility rebate of $0.45/sqft, per Las Vegas turf replacement program data) Note: This corrects a typo in the Version 1.2 library which set the participant cost at $500 rather than $1,188
15. Residential Water Efficient Irrigation Nozzles, Single Family	• Utility Costs, Initial Variable ($/Unit) changed from $8.50 to $10 per nozzle (assumes a direct installation program with purchase cost of $3.50/nozzle plus install cost of $5.00/nozzle plus admin cost of $1.50/nozzle. Note that Version 1.2 library did not include program admin cost.
16. Residential Meter Installation, Single Family	• Savings, Per Unit (gpy) changed from 16,233 gpy to 37,840 gpy (assumes an average reduction of 25.9%, per Maddaus (2001) and average per account residential water use of 400 gpd, per REUWS. The basis for the Version 1.2 library meter savings rate of about 11% is unknown and is not consistent with the reviewed literature.

Library Activity	Changes to Parameters
	• Participant Savings, Sewer (gpy) changed from 6,493 gpy to 15,136 gpy (assumes 40% of water savings come from indoor uses that would otherwise have discharged to the sewer – e.g. leaking toilets)
17. CII ½ GPF Urinal Rebates	• None

18. CII ULF Toilet Rebates	• This measure has been separated into two different measures
	  ○ Rebates for Tank-Type Toilets
	  ○ Rebates for Valve-Type Toilets
	• Tank-Type Toilets
	  ○ Utility and participant cost parameters are the same as for **Residential ULF Toilet Rebates, Multi Family**
	• Valve-Type Toilets
	  ○ Utility rebate costs are increased to $225/toilet to reflect higher cost of valve-type toilet replacement (rebate of $175 plus admin cost of $50/rebate)
	  ○ Participant costs are increased to $125/toilet (toilet purchase cost of $225 plus install cost of $75 less rebate of $175)

19. CII HE Toilet Rebates	• This measure has been separated into two different measures
	  ○ Rebates for Tank-Type Toilets
	  ○ Rebates for Valve-Type Toilets
	• Tank-Type Toilets
	  ○ Utility and participant cost parameters are the same as for **Residential HE Toilet Rebates, Multi Family**
	• Valve-Type Toilets
	  ○ Utility rebate costs are increased to $275/toilet to reflect higher cost of valve-type toilet replacement (rebate of $225 plus admin cost of $50/rebate)
	  ○ Participant costs are increased to $125/toilet (toilet purchase cost of $275 plus install cost of $75 less rebate of $225)

20. CII Laundromat Washer Rebates	• Utility and participant costs are assumed to be the same as for **Residential HE Washer Rebates, Multi Family**. The utility cost decreases from $460 to $370 and the participant cost increases from $0 to $420 per rebate.
21. CII Dishwasher Rebates	• Utility Costs, Initial Variable ($/unit) increase from $340 to $1,000 (equal to approximately ½ the cost differential between conventional and Energy Star rated commercial dishwashers, per EPA's Life Cycle Cost Calculator for Commercial Dishwashers) • Participant Costs, Initial ($) decreases from $1,340 to $1,000 (equal to cost differential of $2,000 between conventional and Energy Star rated commercial dishwashers and utility rebate
22. CII Kitchen Spray Rinse Valve Replacements	• Utility Costs, Initial Variable ($/Unit) decreased from $200 to $150, per CUWCC (2004a)
23. CII Kitchen Food Steamer Rebates	• Savings, Useful Life (yrs) reduced from 15 years to 10 years to match MWDSC (2008) program assumptions • Participant Costs, Initial ($) increased from $0 to $640 (avg cost differential between conventional and high-efficiency steamer of $1,125, per PEC (1999), less rebate of $485
24. CII Cooling Tower Retrofit Rebates	• Savings, Per Unit (gpy) reduced from 371,470 to 209,880, per MWDSC (2008). Estimated savings based on conductivity controller retrofit. • Savings, Useful Life (yrs) reduced from 10 to 5, per MWDSC (2008). Useful life adjusted to match MWD conductivity retrofit rebate program assumptions.

Library Activity	Changes to Parameters
	• Utility Costs, Initial Variable ($/unit) reduced from $1,900 to $625 to match MWD conductivity retrofit rebate costs • Participant Costs, Initial ($) reduced from $24,100 to $2,225. Previous estimate reflected cost for major retrofit of entire cooling system, per Koeller & Company. Revised estimate reflects mid-point cost for conductivity and /pH controller retrofits less utility rebate.
25. Large Landscape Surveys	• Utility Costs, Initial Variable ($/unit) reduced from $620 to $571. Cost assumes an average site size of 2 acres and is from CCWD (1994), adjusted to 2008 dollars. Previous estimate applied a unit cost per acre, ignoring scale economies, and did not adjust dollars to 2008. Note: landscape program costs have been updated to employ consistent assumptions across the different landscape programs.
26. Large Landscape Water Budgets	• Utility Costs, Initial Variable ($/unit) reduced from $3,001 to $2,952. Utility cost assumed to include initial landscape site survey ($571), development of site-specific water use budget ($881), and customer incentives for irrigation system improvements ($1,500). Cost is based on 2 acre average site size. Note: landscape program costs have been updated to employ consistent assumptions across the different landscape programs.
27. Large Landscape Irrigation Controller Rebates	• Utility Costs, Initial Fixed ($) reduced from $2,120 to $2,071. Utility cost assumed to include initial landscape site survey ($571) and customer incentives for irrigation system improvements ($1,500). Cost is based on 2 acre average site size. Note: landscape program costs have been updated to employ consistent assumptions across the different landscape programs.
28. Large Landscape Turf Replacement Rebates	• None

Appendix B

Draft Residential Water Use and Conservation Survey

Solano County Water Agency
Residential Water Use and Conservation Survey

Customer Information

1. What city do you live in?
   - ☐ Benicia
   - ☐ Dixon
   - ☐ Fairfield
   - ☐ Rio Vista
   - ☐ Suisun City
   - ☐ Vacaville
   - ☐ Vallejo
   - ☐ Unincorporated Solano County
2. How would you categorize your housing unit:
   - ☐ Single-family house
   - ☐ Duplex
   - ☐ Multi-family residence (e.g., apartment complex)
   - ☐ Other: _____
3. How many people live in your house? _____
4. How many bathrooms do you have in your house? _____
5. When was your house built?
   - ☐ 2000 – 2016
   - ☐ 1980 – 1999
   - ☐ 1960 – 1979
   - ☐ Prior to 1960
   - ☐ Unknown
6. Do you have a lawn?
   - ☐ Yes
   - ☐ No
7. Do you irrigate your yard (i.e., do you have a sprinkler or other system)?
   - ☐ Yes
   - ☐ No
8. Do you have a smart irrigation controller?
   - ☐ Yes
   - ☐ No
   - ☐ I don't know what that is
9. Do you have your own well?
   - ☐ Yes
   - ☐ No
10. Who is your water supplier? _____
11. Have you heard of the Solano County Water Agency (SCWA)?
    - ☐ Yes
    - ☐ No
12. What is the Solano County Water Agency (SCWA) responsible for? _____
13. What is your average water bill?
    - ☐ $0 -- $20
    - ☐ $20 -- $40
    - ☐ $40 -- $60
    - ☐ $60 -- $80
    - ☐ $80 -- $100
    - ☐ Greater than $100

Water Use and Conservation

14. How would you rate your water consumption relative to houses of a similar size?
    - ☐ My house uses <u>more</u> water than those of a similar size
    - ☐ My house uses <u>about the same</u> amount of water as those of a similar size
    - ☐ My house uses <u>less</u> water than those of a similar size

15. In the past ten years, which of the following (if any) fixtures or appliances have you replaced? Check all that apply.
    - ☐ Toilets
    - ☐ Bathroom faucets
    - ☐ Showerheads
    - ☐ Clothes washer
    - ☐ Kitchen faucets
    - ☐ Dishwasher
    - ☐ Sprinklers/ drip irrigation

16. Which of the following actions (if any) have you taken in the past to decrease your water consumption? Check all that apply.
    - ☐ Used washing machine only with full loads
    - ☐ Reduced your time spent showering
    - ☐ Adjusted the watering schedule for your lawn and yard
    - ☐ Replaced grass or other plants with less water-intensive landscaping
    - ☐ Repaired plumbing leaks
    - ☐ Other _____

17. Have you participated in any of the following conservation programs? Check all that apply.
    - ☐ High-Efficiency Toilet Rebate
    - ☐ High-Efficiency Washer Rebate
    - ☐ Turf Replacement Rebate
    - ☐ Water Use Surveys
    - ☐ Smart Irrigation Controllers

18. If you are interested in participating in or receiving information about any of the above programs, please provide your email address: _____

19. How knowledgeable do you consider yourself to be about your water use and how you could save water?
    - ☐ Very knowledgeable
    - ☐ Somewhat knowledgeable
    - ☐ Not knowledgeable

20. How interested are you in reducing your water use?
    - ☐ Very interested
    - ☐ Somewhat interested
    - ☐ Not interested

21. What is your primary reason for using less water?
    - ☐ Save money
    - ☐ Avoid waste
    - ☐ Protect the environment
    - ☐ Help the community
    - ☐ Respond to drought conditions

22. Where do you think your household could save the most water?
    - ☐ Indoors
    - ☐ Outdoors

23. What do you think is the most effective way to save water in your household?
    - ☐ Change your water use habits
    - ☐ Replace appliances and fixtures
    - ☐ I don't know

24. How concerned are you about having an adequate water supply in the future?
    - ☐ Extremely concerned
    - ☐ Somewhat concerned
    - ☐ Not concerned

25. For what applications would you support recycled water use in your community? Check all that apply.
    - ☐ Irrigation for city land and public parks
    - ☐ Irrigation for residential properties
    - ☐ Irrigation for school yards
    - ☐ Commercial and industrial purposes
    - ☐ Tap water

26. If there is any information that you would like to receive, or comments you would like to make, regarding water supply, use, or conservation in your community, please provide them below:

_____

_____

_____

_____