SPECIAL PUBLICATION SJ2011-SP2

WATER CONSERVATION POTENTIAL FOR THE DISTRICT WATER SUPPLY PLAN 2010

Water Conservation Potential for the District Water Supply Plan 2010

St. Johns River Water Management District

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2010

Contents

List of Figures

List of Tables

Executive Summary

The St. Johns River Water Management District (District) contracted with Jones Edmunds to evaluate current and future potential for reducing potable water demands from retail customers within five utility service areas by implementing demand-side management practices. The participating utilities included Gainesville Regional Utilities, Leesburg, Palm Bay, Palm Coast, and St. Johns County. A previously completed pilot study used standard industry benchmarks to estimate water use and water conservation potential. This study expands on the pilot study by using account-level billing information from each of the participating utilities. Water savings potential and costs were estimated for residential and commercial demand-management programs over the 2010 to 2030 planning horizon through the process of joining account water use with property appraisal and population data. The primary tasks comprising this project were collecting data, refining methods, analyzing water use, estimating conservation potential, and incorporating feasibility.

Collecting Data

The District obtained the most recent parcel geodatabases and accompanying business tables directly from county property appraiser offices for the five counties containing the pilot utilities. The five utilities participating in the study provided account billing records with spatial references to parcels. The District received data in various formats covering various date ranges. The date range used for this study was January 2008 through December 2009[1]. The District provided a population geodatabase used to estimate population and residential water use for the 2010 District Water Supply Plan.

Compiling and maintaining property geodatabases is variable and complex. Throughout this process, joining multiple large datasets with differing standards and sources presented numerous challenges. The primary issues overcome in the effort were: different data schemas, systematic differences in irregular monthly readings, metered units, and spatial relationship to parcels, incomplete datasets, and geometry differences. As expected with these types of data repositories, not every attribute is available for every parcel and some information is likely to be outdated or erroneous. The majority of the records (from 85% to 94%) matched between the datasets; however, at the end of the data preparation process, there were billing accounts without matching parcel IDs and/or population projection information.

[1] For Palm Coast, January 2008 was dropped because there were excessive accounts with zero consumption. SJCUD data does not include November or December 2009, and Palm Bay does not include October, November, or December 2009.

Refining Methods

The governing concept for this study was to join geospatial property attributes (typically in square feet) with a normalized water use (gallons per day per square feet) or benchmark to estimate conservation potential for various conservation practices applicable to the water use category and build-out condition.

Jones Edmunds separated residential demands into six water-use categories and four build-out conditions. Jones Edmunds applied the same approach used in Dr. John B. Whitcomb's *Florida Water Rates Evaluation of Single-Family Homes* (2005) to the five utilities within this study. The 25th, 50th, 75th, and 90th percentiles of the just values were calculated for parcels that had residential accounts in the billing data. A sixth residential profile was used to represent high-density residential settings such as apartments and higher-density land use. Commercial categories were created based on aggregated Florida Department of Revenue Codes

Construction year is an important component of estimating conservation potential. The four build-out conditions used in this effort were assigned to capture the differences between houses and facilities constructed under different plumbing code standards. The following date ranges of the build-out conditions were used:

- Pre-1984 (Pre-plumbing standard)
- 1984 through 1993 (National Plumbing Code)
- 1994 to Present (Federal Energy Act)
- Future (assumed current plumbing standard)

Proportioning water use into the type of use is a critical element of estimating conservation potential. The first step in this process is to separate water use between indoor and outdoor use. Because of the inadequate number of dual-metered accounts, the minimum month method was applied to each account to separate indoor and outdoor water use.

Because of the importance of outdoor irrigation in estimating conservation potential, Jones Edmunds estimated the number of customers that were using automatic in-ground irrigation systems from the potable supply.

Jones Edmunds developed a library of conservation practices for estimating conservation potential. As part of this work, Simmons Environmental Consulting reviewed the Conserve Florida Guide and Alliance for Water Efficiency (AWE) tools extensively. The methods used to calculate conservation potential and feasibility across the pilot utilities were developed using information gathered from literature and other conservation studies. Principles of the Conserve Florida Guide and AWE tools coincide with the methodologies applied in this study. Passive replacement, efficiency, and saturation rates were applied to estimate conservation potential for each conservation practice.

Analyzing Water Use

Once the highest water-using residential and commercial categories were defined for each utility, Jones Edmunds calculated water-use metrics and summarized them as benchmarks. The term *benchmark* represents the statistical summary—typically the mean—of the water metrics for each utility and use category. Since the goal of the study was to estimate conservation potential, the methods used to calculate the benchmarks excluded accounts with zero or low use and included metered accounts with seasonal and continuous consumption. Once screened, the following water-use metrics were calculated for each remaining account and derived as benchmarks:

- Gallons of indoor water use per capita per day (residential only)
- Gallons of indoor water use per building area
- Gallons of indoor water use per heated area
- Gallons of outdoor water use per parcel area
- Gallons of outdoor water use per irrigable area (residential only)
- Gallons of water use per account per day

It is important to distinguish water-use metrics and benchmarks that are used in estimating reliable conservation savings from a water-use benchmark that is used in estimating the amount of gross water need by a utility to meet its level of service to its customers. While the conservation metrics include seasonal non-consumption so that savings are not overestimated, the utility cannot readily discount these meters or the zero-consumption meters in planning for future water supply because of the utility's obligation to provide a common level of service to all metered accounts in accordance with local, state, and federal drinking-water standards. The water-use metrics represent retail or water that is recorded at the customer's meter. They do not represent delivery system or treatment losses.

Water use varies considerably from one utility to the next. A comparison of the indoor and outdoor components shows that the primary difference is outdoor water use. Jones Edmunds attributes this difference to the penetration of private irrigation wells within each utility's service area and other alternative water sources.

General conclusions drawn from the benchmarks for the residential categories include the following:

- Newer homes with more building square footage are using more water in total but less water on a per-square-foot basis.
- Total outdoor water use has trended upwards and has become more variable in each category
- Higher-value homes are using more water both indoors and outdoors.

The top water-using commercial categories vary by utility. For the five utilities combined the top categories are as follows:

- Office Buildings
- Retail
- Restaurants
- Hotels
- Schools
- Manufacturing
- Live-in Care

Commercial water use is more variable than residential uses. It is not possible to distinguish any end-use specific patterns from the account data.

Estimating Conservation Potential

The first step of the process establishes the amount of water savings potential for each conservation practice in each use category, build-out condition, and use type. The next step evaluates how much of water savings potential is achieved through passive and program savings for each conservation practice under a given implementation period and saturation. Then the most cost-effective conservation practices that are below the specified cost threshold are selected. The conservation practices or Best Management Practices applied in this study fall into three families: Global, Indoor, and Outdoor. The study's goal was to apply conservation practices aggressively where water end uses could be reasonably defined.

Most of the conservation practices applied in the study are focused on plumbing retrofits on existing homes and commercial facilities. Two of the practices are directed at future use: adopting high-efficiency indoor standards and modifying land development requirements. The study assumes that the same standard on new construction will be required if a utility chooses retrofits to bring customers to more efficient uses.

Feasibility Analysis

The initial step in estimating costs associated with water savings is to estimate the number of fixtures, units, or accounts to be replaced depending on the conservation practice being implemented. During Phase I, Jones Edmunds developed methodologies for estimating fixture counts for residential and commercial parcels. The District provided shapefiles containing data that were used to better refine the fixture counts within hospitals and hotels. The methods developed in the initial phase of the Pilot Study were used for residential and the remaining commercial categories.

To determine the most cost-effective alternatives, practices with equivalent unit costs below the cost threshold ($4.00/kgal) were selected. For mutually exclusive practices, the program with the lower equivalent unit cost that fell under the cost threshold was selected. Operation and maintenance (O&M) of conservation programs is an important consideration if conservation will be relied upon to achieve sustainable savings and maintain the saturation rate. This study assumes that significant effort will be needed by each utility to maintain water conservation savings. The O&M aspects of implementing utility-wide conservation programs are captured in the global conservation practices.

Jones Edmunds analyzed four implementation scenarios (1-, 5-, 10-, and 20-year) as part of the Pilot Study. The implementation period affects the split between passive savings and program savings and the program implementation costs. The longer the implementation period, the more passive savings accumulate, thereby reducing program savings and program implementations, which in turn reduce the cost of conservation. Therefore, the longer the implementation period, the lower the costs of achieving savings related to conservation and more efficient water use. The 20-year implementation scenario is the most cost effective.

Results

The average equivalent unit cost of programs focused on existing customers is $1.90/kgal.

Table E.1 summarizes the results for the 20-year implementation period for programs focused on existing customers.

Table E.1 Cost-Effective Conservation Savings from Existing Customers

Utility	Program Savings (gpd)	Program Capital Costs[1]	Annual O&M Costs[1]	Percent Savings of Existing Retail Use
Gainesville Regional Utilities	1,313,000	$5,066,000	$516,000	9%
Leesburg	651,000	$1,606,000	$172,000	10%
Palm Bay	277,000	$1,457,000	$346,000	5%
Palm Coast	349,000	$2,158,000	$287,000	6%
St. Johns County	408,000	$1,754,000	$308,000	6%

1. Includes a 20% contingency

The most cost-effective water savings associated with future water use can be achieved by adopting high-efficiency ordinances and modifying land development codes. These practices make up between 21% and 56% of the total water-savings potential in 2030 across the five utilities

Generally, the most cost-effective practices for residential conservation include soil moisture sensors, high-efficiency showerheads, and faucet aerators. Non-turf efficiency programs, and toilet retrofits are the next level of cost-effective alternatives, while programs like landscape replacement, clothes washers, dishwashers, and submetering are the most expensive. The costs for commercial are much less than those for residential. This is likely the result of inaccurate estimates of end uses and fixtures within the commercial categories, limited sample size for certain sectors, difficulty in quantifying end uses within each sector.

The total retail water-savings potential that can be achieved cost effectively equals 10.3 MGD by 2030. Jones Edmunds estimates that the total present-value cost to achieve this potential is $12,041,000 with an annual O&M cost of $1,630,000. This represents a significant number of retail water demands that can be offset through conservation practices.

Conclusions and Recommendations

This study shows that several complex spatial databases can be joined together to create new relationships that can be leveraged to increase our understanding of water consumption and estimate conservation potential. As with any pilot project, many new processes and methods were introduced to achieve the study objectives. The experiences and findings of this work show there are opportunities to improve and enhance the methods and processes for future efforts.

1.0 Introduction

Water purveyors throughout the St. Johns River Water Management District (District) are entering a new era of water resources, where traditional groundwater supplies are becoming: less available or degraded, operation and maintenance costs continue to rise, regulations are requiring cleaner water, revenues are decreasing, and the cost of developing alternative water supplies will create significant pressure to raise rates. The District is evaluating the impact that water conservation has on long-term potable water demands.

Water conservation will be a major component of all water supply solutions. The District will play a critical role in planning, promoting, and implementing conservation at the utility level. While conservation cannot be applied in a one-size-fits-all approach, it can be successfully implemented in all water supply systems. Within this context, it will be necessary to develop an efficient approach at a sufficiently large scale for the District to evaluate conservation in the development of cost-share programs, water supply planning, consumptive use permitting, and future development. This effort will set the foundation for a new approach to evaluate conservation on a District-wide level.

To help with this effort, the District contracted with Jones Edmunds to evaluate the current and future potential for reducing potable water demands from retail customers within five utility service area boundaries (SAB) by implementing demand-side management practices. The participating utilities include: Gainesville Regional Utilities (GRU), Leesburg, Palm Bay, Palm Coast, and St. Johns County Utility Department (SJCUD). This study expands on the Conservation Pilot Study Jones Edmunds performed for the District and evaluates conservation practices, water savings, and costs associated with a comprehensive demand-management program.

1.1 Background

The District aims to evaluate water conservation and the potential for improved water use efficiency within public water systems. Jones Edmunds developed a methodology for this evaluation in the pilot study titled, *Conceptual Water Conservation Plans for a Utility/Facility in the Northern Planning Area, Southern Planning Area, and Lake County Using County Appraisal Information and Department of Revenue Codes* (Pilot Study). The methodology uses a geographic information system (GIS) to join spatial property appraisal attributes (units) with normalized water use (gallons/unit). In the initial study, normalized water use is based on recognized industry sources. The results of the study concluded:

- It is not possible to accurately estimate water conservation potential for a specific utility using industry water-use metrics.
- Spatial databases that include information such as parcel area, building area, year of construction, and number of bathrooms can be used to sector water use and gain a better understanding of conservation potential.

To overcome this limitation, five of the six pilot utilities provided account-level billing data to better define water use and conservation potential. This report summarizes the methods and results from the next phase of the effort to incorporate account-level data into estimating water conservation potential for public suppliers within the District.

1.2 Objectives

The objective of this effort is to calculate potential water savings and the cost associated with implementing conservation programs over the 2030 planning horizon by joining spatial property information to water-use metrics developed from account-level records for five participating utilities. The primary tasks completed as part of this project are:

- Collecting Data
- Refining Methods
- Analyzing Existing Water Use
- Estimating Conservation Potential
- Incorporating Feasibility Analysis

2.0 Data Collection and Preparation

Advances in GIS and relational data formats in customer information systems (CIS) made this type of study possible. The joining of spatial information (geodatabases) continues to advance our ability to understand potable water demands and estimate conservation potential. This section provides a summary for data sources and data structures used in this study. As discussed below, there is additional work that can be done to make joining the independent geodatabases used in this study more streamlined and powerful.

2.1 Property Appraisal Geodatabase

The District compiles select property appraisal data for each county in the District. Some of the attributes within the appraisal geodatabase include but are not limited to the following:

- Year built

- Parcel area
- Revenue/land-use codes
- Assessed value
- Just values
- Taxing codes
- Building area
- Heated and cooled area
- Addresses
- Number of stories
- Units

The types of data collected by the property appraiser offices vary among counties. For example, Alachua County collects information on number of bathrooms for each parcel, and Lake County only stores building area, not heated/cooled area.

For this phase of the project, the District obtained the most recent parcel geodatabases and accompanying business tables directly from county property appraiser offices for the five counties containing the pilot utilities. Each property appraiser was asked to better explain their information if metadata was not a sufficient source of explanation.

From the initial Pilot Study, it is evident that each county collects and stores information differently and has unique terminology for similar attributes. Land-use codes are a good example of the challenges associated with combining similar data stored by different identities. Each county stores their land-use codes differently. For example, land-use codes in Brevard County have one to four digits while land-use codes in Alachua and Flagler Counties have four digits and six digits, respectively. All together there were over 500 unique land-use codes that were normalized to approximately 100 Department of Revenue (DOR) codes and then aggregated to 28 land-use categories. The category aggregation applied in this study is provided in Appendix A.

Compiling and maintaining property geodatabases is variable and complex. As expected with these types of data repositories, not every attribute is available for every parcel and some information is likely to be outdated or erroneous. As part of the project, several general checks were made to understand the data and evaluate the information contained in the geodatabases. These checks included reviewing aerial imagery and making visual inspections to compare the site conditions to conditions reported in the property appraisal data. In most cases, the appraisal data appear to be up to date and contain valid attribution. However, there are instances where some of the data do not appear to reflect the actual site conditions. For example, several counties' data include number of bathrooms for each parcel; however, upon investigating the parcels, it is apparent that the bathroom counts in several counties are inaccurate, particularly for commercial parcels. This is also true for commercial building square footage. Aerial photography evaluations for randomly selected commercial parcels indicate that several parcels contain multi-story buildings that are not consistent with the building or heated/cooled square footage associated with the parcel in the appraisal databases. These types of irregularities proved challenging throughout the study.

2.2 Land-Use Codes

The normalized DOR land-use codes were cross-walked to the North American Industrial Classification System (NAICS) based on similar land-use descriptions (Appendix A). NAICS codes offer five levels of detail including the economic sector (first two digits), subsector (third digit), industry group (fourth digit), NAICS industry (fifth digit), and national industry (sixth digit). The cross-walk to NAICS codes from DOR codes can only be to the level of detail the DOR code descriptions provide. For example, DOR 2000 indicates that the land is being used for some type of transportation business such as airports, bus and marine terminals, piers, marinas, and other similar uses .NAICS sectors transportation and warehousing into economic sector 48 – 49 and then breaks the use into subsectors such as air transportation (481), rail transportation (482), truck transportation (484), or warehousing and storage (493). The particular type of facility cannot be determined from the DOR description; therefore DOR code 2000 is cross-walked to NAICS economic sector 48 – 49 and is not assigned to a subsector. DOR codes are assigned to NAICS subsectors and industry groups when possible. A value of UNKNOWN is given to the NAICS economic sector when appropriate cross-walks cannot be determined, including DOR codes that indicate vacant land, undefined land, right-of-ways, or rivers, lakes, and submerged lands. .

2.3 Fixture Count

During Phase I, Jones Edmunds developed methodologies for estimating fixture counts for residential and commercial parcels. The District provided shapefiles containing the number of beds in hospitals and the number of rental units in hotels. These data were used to better refine the fixture counts within hospitals and hotels. The majority of the bathroom counts within the property appraiser data for commercial parcels were unreasonable. The methods developed in the initial phase of the Pilot Study were used for residential and the remaining commercial categories.

2.4 Utility Billing Records

The five utilities participating in the study have the ability to provide account billing records with spatial references to parcels. The District received data in various formats covering date ranges from October 2007 to February 2010 as shown in the table below. The date range used for this study was January 2008 to December 2009. For Palm Coast, January 2008 was dropped because there were excessive accounts with zero consumption. SJCUD data does not include November or December 2009, and Palm Bay does not include October, November, or December 2009. Table 2.1 summarizes the account data provided from the five utilities. The utility consumption data were assumed to be binned into the correct month prior to delivery to the District.

Table 2.1 Summary of Account Data Provided by the Participating Utilities

Utility	Billing Type of Data Received	Time Period of Data Received
Gainesville Regional Utilities	Geodatabase, 65,792 records	March 2007 – Jan. 2010
City of Leesburg	Monthly spreadsheets, 25,044 records over 24 months	Jan. 2008 – Feb. 2010
City of Leesburg – Irrigation Data	Geodatabase table, 1154 records	Jan. 2008 – Jan. 2010
City of Palm Bay	Point shapefile, 32,745 records	Oct. 2007 – Sep. 2009
City of Palm Coast	One spreadsheet, 42,384 records	Jan. 2008 – Dec. 2009
St. Johns County Utilities	Point shapefile, 65,772 records	Jan. 2007 – Sep. 2009

The utilities compile and store account data in different file formats (shapefiles, spreadsheets, and geodatabases). They also store the information using different organizational structures or schemas. Compiling the five datasets into a common geodatabase schema that can be joined with other geodatabases was a challenging process. Each utility dataset required significant correspondence with the utility to import the water use into the common geodatabases. In some cases, multiple attempts were needed to import the utility data into the common geodatabase. Ultimately, 5,561,208 records were introduced intothe Spatial Database Engine (SDE) for further processing.

2.5 Population Projection Data

The District provided a population geodatabase that Jones Edmunds used to estimate population and residential water use for the 2010 District Water Supply Plan (DWSP). The original geodatabase that Jones Edmunds received from the District contains population numbers per parcel every 5 years from 2005 to 2035 along with population at build-out and dwelling units at build-out. The database was appended during pilot project to include attributes on build-out dwelling unit densities. Dwelling unit densities are used to assign future residential water use at the parcel level. It is important to note that the population geodatabase is based on 2005 parcel geometry. The parcel geometry is continually updated by each county; therefore, the 2005 parcel geometry is different from the parcel geometry used in the property appraisal geodatabases.

2.6 Service Area Boundaries and Reuse

The District provided shapefiles of existing and future service area boundaries in addition to reclaimed service areas for each utility. Additional information is provided in Florida Department of Environmental Protection's (FDEP) 2008 Reuse Inventory Report (FDEP, 2010).

2.7 Private Wells

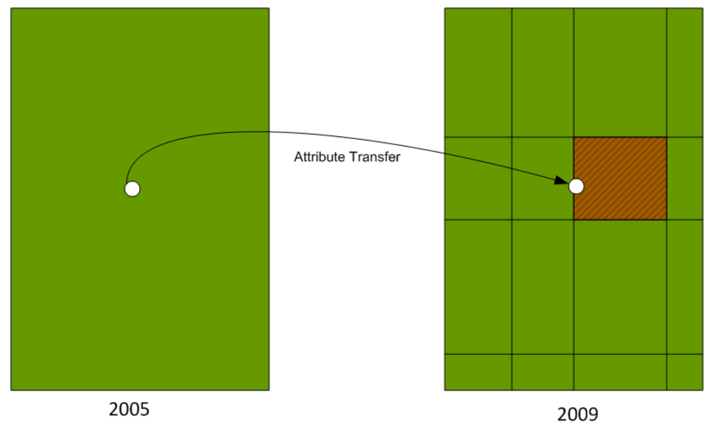
During the pilot project, the District provided several files of well completion data. In addition, Jones Edmunds gathered information from each county's Department of Health. The District data can generally be located to the nearest section, township, and range. The DOH well inventories are generally similar to the District, however the lack of metadata with each dataset makes it hard to distinguish well types and their purposes – monitoring, dewatering, domestic use, irrigation, etc. The utility SABs were used to identify the number of wells in each utility service area.

2.8 Spatial Data and Topology Issues

Throughout this process, joining multiple large datasets with differing standards and sources presented numerous challenges. The primary issues overcome in the effort were:

- Different Data Schemas – Some utilities store billing data with the customer number as records (columns) and the monthly reads as fields (rows) while others flip this structure and store monthly usage values in rows and the customer information in columns. Additionally, each utility has unique identifiers for account types and customer identifiers.
- Systematic Differences in Irregular Monthly Readings – Each utility has a different process for handling irregular meter readings such as missed reads, data entry errors, and stopped meters.

- Metered Units – Some utilities have meters that read in different units.
- Spatial Relationship to Parcels – In some cases, a meter's spatial representation does not match the parcel or land use that is being served by the meter. Master metered parcels are the most problematic. Some utilities store the parcel number in a tabular format with a parcel ID to match to the parcel data layer while other utilities store the data spatially as a point layer with a GIS. Problems with both types of data were encountered when relating the billing information to the parcels. In the case of tabular data stored with a parcel ID, outdated or incorrect parcel IDs were found that led to billing accounts without a corresponding matching parcel. In the case of spatial points, issues surfaced where the points would fall outside the residential parcels. In one case, multi-family billing points were placed at the end of the service lateral, which places the point in a common area parcel instead of the correct residential parcel. This also led to billing accounts without a corresponding matching parcel.
- Incomplete Datasets – Based on experiences with handling the datasets and discussions with utility staff, it is possible that the exports from the CIS are incomplete. In several cases, additional data were provided from the utilities as the study proceeded. The information in the property appraisal databases has missing and invalid data.
- Geometry Differences – The datasets used in the study have different spatial geometries that need to be understood and resolved before joining attributes between geodatabases. Since the population data are based on 2005 parcels and the billing information relates to current parcels, joining the datasets results in accounts falling in parcels without any population information. This could be caused by spatial updates to the parcel information over time yielding offsets from the 2005 to the 2009 parcels or by parcels being changed and/or subdivided over time. For example, in the graphic shown below, the parcel on the left was one large parcel in 2005. The same area is shown on the right with the 2009 parcels: the original parcel has now been subdivided into 16 smaller parcels. The attributes from the 2005-based population projections only carry over to one of the new 16 subdivided parcels, leaving 15 parcel IDs without any matching population information.



At the end of the data preparation process there are billing accounts without matching parcel IDs and/or population projection information. Table 2.2 describes the results of these joins. The majority of the records (from 85% to 94%) match between the datasets.

Table 2.2 Joined Geodatabases Matching Summary

Utility	Total Number of Accounts Received	Number of Accounts Not Matched to a Parcel	Number of Accounts Without matching Population Projections	No Service Type	Number of Accounts Under Analysis	Overall % Matched
GRU	65,772	4,771	4,928	--	56,073	85%
Leesburg	25,044	309	3,076	--	21,659	86%
Palm Bay	32,745	287	1,089	1,813	29,556	90%
Palm Coast	42,384	98	2,282	--	40,004	94%
SJCUD	26,357	97	1,724		24,536	93%

2.9 Summary

Data collection and preparation is a lengthy process that is critical for the success of this study and similar future efforts. Jones Edmunds performed multiple iterations of data clean-up and preparation to yield a dataset that could be used as the foundation for estimating water savings potential. The data for the five participating utilities, including their corresponding parcel information was just over 7 gigabytes (GB) in size. This only included 2 years of billing information and yields an average size of 1.4 GB of data per participating utility. If longer time periods are studied these size requirements will only increase.

Successfully implementing and improving the processes outlined in this effort will require significant investment and collaboration among the District, county property appraisers, and utilities. The primary goal of this collaboration will be creating source datasets that maintain the same base parcel data layers. This will require the District to update the population projection data more frequently. The utilities will need to keep their billing data updated with current parcel IDs or ensure that the billing points fall within served parcels. The District and utilities will need to work with county property appraisers to coordinate parcel updates and work toward standardizing the attribution and collection process.

3.0 Methodology

Method refinement of the initial phase of the Pilot Study occurred within almost every task to incorporate the utility account-level data. The governing concept for this study was to join geospatial property attributes (typically in square feet) with a normalized water use (gallons per day per square feet) or benchmark to estimate conservation potential for various conservation practices applicable to the category, build-out condition, and the type of use, as shown in Equation 3.1.

Equation 3.1

$$[CP = U * WU * BMP_i]_{C,B,T}$$

$$CP = Conservation\ Potential\ (typcially\ in\ gallons\ per\ day)$$

$$U = Spatial\ Attribute\ (typically\ in\ units\ of\ area)$$

$$WU = Water\ Use\ Benchmark\ (gpd\ /unit\ of\ area)$$

$$BMP = Percent\ Water\ Saving\ from\ Conservation\ Measure\ i$$

$$C = Category\ of\ Use\ (Resential, Commercial, etc)$$

$$B = Build - out\ condition\ (Applicable\ plumbing\ standard\ years)$$

$$T = Type\ of\ Water\ Use\ (typically\ indoor\ or\ outdoor)$$

This section describes the methods applied to characterize water use and outlines the process used to estimate conservation savings and costs for the family of conservation practices considered in the study.

3.1 Sectoring Water Use

Most utilities aggregate customers into classes based on type of use and/or meter size. These classes are unique to each utility and have evolved around CIS advancements and a utility's billing and rate-making needs. These classes often cover a broad group of customers. For example, it is fairly common to classify all single-family residential customers with a 5/8-inch meter as *Residential*. There are obvious conveniences to this approach for billing and utility management. Unfortunately, this aggregation masks the differences in end-use water consumption behavior that occur within the classes.

Both American Water Works Association Research Foundation (AWWARF) end-use studies (Mayer et al., 1999, and Dziegielewski et al., 2000) show distinctions between various residential and commercial uses. This is intuitive for commercial use, where it is easy to understand that differences in water use relate to differences in business types. Office building customers will use water differently than commercial laundry customers. Within the residential customer class, Whitcomb (2005) and others (Haley and Dukes, 2007, and Mayer et al., 1999) have shown that indoor and outdoor water use can vary widely among different residential customers. Factors such as rates, weather, soils, vegetation, fixture and irrigation system types, irrigable area, and private wells influence water consumption.

While aggregated classes are often sufficient to analyze total water consumption, they are more limited for the purposes of estimating water conservation potential because of the need to match specific conservation practices to specific end uses. For this study, water use for each utility is sectored based on various residential categories and different types of commercial land use to better define end uses. While the billing and appraisal data allow water use to be sectored into unique categories to gain more resolution on water use, the data are not able to quantify the distribution of end uses within the categories. In the case of office buildings, it is possible to find the office building accounts and quantify total use, but quantifying how much water goes to each end use, such as toilet flushing, outdoor irrigation, and food service, is not possible. Portioning water use in each category is accomplished by applying the results of national end-use studies and accepted literature sources.

3.1.1 Residential Categories

Jones Edmunds separated residential demands into six distinct water-use categories and four distinct build-out conditions. Dr. John B Whitcomb's *Florida Water Rates Evaluation of Single-Family Homes* (2005) study suggests that water-use behavior can relate to property values. His four profiles were based on defining the 25th, 50th, 75th, and 90th percentiles of the property values of all the properties under his study. This same approach can be applied to the five utilities within this study. The 25th, 50th, 75th, and 90th percentiles of the just values were calculated for parcels that had residential (RES) accounts in the billing data. Homes with a just value greater than $1,000,000 were excluded from the percentile calculation. A sixth residential profile was developed to represent high-density residential settings such as apartments and higher-density land use. The high density parcels are selected based on DOR attributes which does not always match the utilities customer class designation for multi-family accounts. Table 3.1 shows the property values and their corresponding residential categories for each utility.

Table 3.1 Just Value Costs Associated with Percentiles Used to Categorize Residential Water Use

Residential Category	Just Value Percentile	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS1	≤ 25th	$80,500	$80,000	$74,000	$107,000	$135,000
RS2	> 25th ≤ 50th	$119,000	$127,000	$102,000	$129,000	$177,208
RS3	> 50th ≤ 75th	$168,000	$164,000	$136,000	$162,000	$250,000
RS4	> 75th ≤ 90th	$238,000	$200,000	$171,000	$207,000	$371,000
RS5	> 90th	> $238,000	> $200,000	> $171,000	> $207,000	> $371,000

To verify that the property value method provides unique categories of water use, Jones Edmunds inspected time series plots and statistical tests. Kruskal-Wallis tests were applied for each utility to confirm that at least one category was statistically different from at least one other category. Additionally, Tukey simulations were performed for pair-wise analysis between categories. The results of these non-parametric analyses indicate that the categories are statistically different across the five pilot utilities. However, there are cases where two categories within a utility approach each other statistically. Therefore, in some of the utilities, it could be justified that only four categories are needed to distinguish water use by property value. Figure 3.1 shows an example of the residential water-use categories for one utility in the study. As shown, the RS3 and RS4 categories have similarities that could be combined.

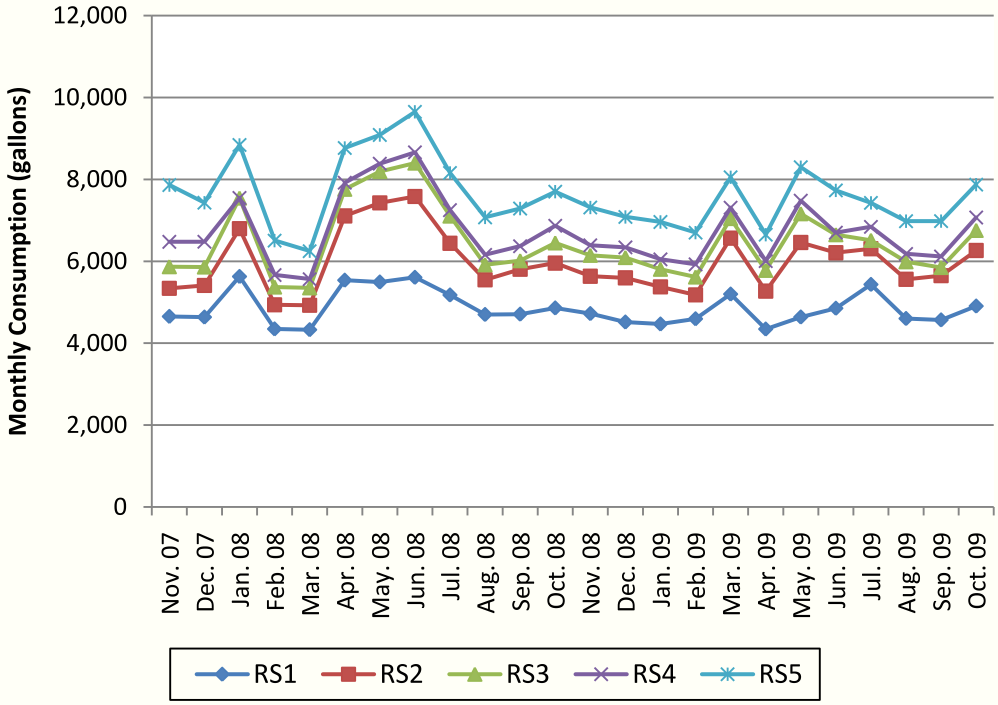


Figure 3.1 Residential Category Water Use versus Time for One Utility in Pilot Study

The results of the visual and statistical tests provide insight to the challenges of distinguishing unique water-use behaviors within the residential customer class. While the property value method provides a reasonable way to distinguish unique water use for this study, it is not the only method. Each utility is likely to have different and more dominant influencing factors that would be as applicable for distinguishing water use among residential customers. The property value was chosen because of its success in other studies and its presence in the property appraisal databases. Dziegielewski and Keifer (2010) provide additional discussion on the challenges of making utility-to-utility comparisons.

3.1.2 Commercial Categories

To estimate water conservation potential from non-residential customers, Jones Edmunds sorted the non-residential accounts by the aggregated DOR land-use codes developed in the initial Pilot Study. Table 3.2 details the top water–using, non-residential categories for the aggregated DOR land-use types.

Table 3.2 Top Commercial Water Using Categories for Each Utility					
	GRU	Leesburg	Palm Bay	Palm Coast	St. Johns
OFFICE BUILDINGS	X	X	X	X	X
RETAIL	X	X	X	X	X
RESTAURANTS	X	X	X	X	X
HOTELS	X		X	X	X
SCHOOLS	X		X	X	X
MANUFACTURING	X	X	X	X	
LIVE-IN CARE		X	X	X	X
AUTO & REPAIR	X	X	X	X	X
INDOOR RECREATION	X	X	X	X	
WAREHOUSES/STORAGE	X	X	X		
MISCELLANEOUS		X			X
VACANT OR UNDEFINED	X				
HOSPITALS		X			
UNKNOWN					X
OUTDOOR RECREATION				X	X

3.1.3 Build-Out Conditions

Construction year is an important component of estimating conservation potential. The build-out condition is assigned to capture the relation between houses and facilities constructed under different plumbing code standards. Jones Edmunds used four build-out conditions in this study. The first three build-out conditions were established for existing customers based on dates related to changes in plumbing codes. State and national legislative initiatives and voluntary industry standards have resulted in more efficient indoor water use since the mid-1980s. This increased efficiency stems primarily from improvements in the efficiency of plumbing fixtures and appliances (Vickers, 2001). The 1980 National Standard Plumbing Code was adopted by the Association of Plumbing-Heating-Cooling Contractors in October 1982. The Federal Energy Policy Act of 1992 established uniform water efficiency standards for nearly all toilets, urinals, showerheads, and faucets manufactured after January 1994 (Vickers, 1993).

The existing build-out conditions used in this study were adopted from the estimated water use and savings tables provided in the *Handbook of Water Use and Conservation*. It should be noted that the influence of new standards is not absolute and the build-out time periods are used to approximate differences in end use. The following are the dates of the existing build-out conditions:

- Pre-1984 (Build-out condition = 1)
- 1984 through 1993 (Build-out condition = 2)
- 1994 to Present (Build-out condition = 3)

The remaining build-out condition (Build-out condition = 4) applies to future customers.

3.1.4 Types of Water Use

3.1.4.1 Residential Indoor

Proportioning water use into the type of use is a critical element of estimating conservation potential. The first step in this process is to separate water use between indoor and outdoor use. The challenge of this proportioning is that there is typically not a separate meter to measure indoor and outdoor use. Some of the pilot utilities have separate irrigation or reclaimed meters, but there are not sufficient populations of these meters to build a relationship between indoor and outdoor use within each residential category.

Several methods have been used to separate the account data into indoor and outdoor water use (Palenchar et al., 2009, Dziegielewski and Keifer, 2010, and Billings and Jones, 2007). The method Jones Edmunds applied in this study is commonly referred to the minimum month method. This is where the minimum monthly consumption represents the non-seasonal indoor use and is subtracted from each month to calculate the seasonal outdoor water use. There are known limitations to this method, which tends to over-predict indoor use in warm weather climates, but in the absence of additional accounts with separate meters it is the preferred method for this study. Figure 3.2 shows the minimum month concept applied to this study.

Jones Edmunds applied the minimum month method to each account so that additional relationships between customer behavior and property information could be created. This method is problematic for households that are transient and have several months of zero consumption. For these accounts, the average water use over the period was used as an estimate of indoor water use.

After indoor water is separated, it must be further categorized into its ultimate end use. It was assumed the indoor water use follows the proportions reported in the AWWARF Residential End Use Study (Mayer, 1999) as shown in Figure 3.3.

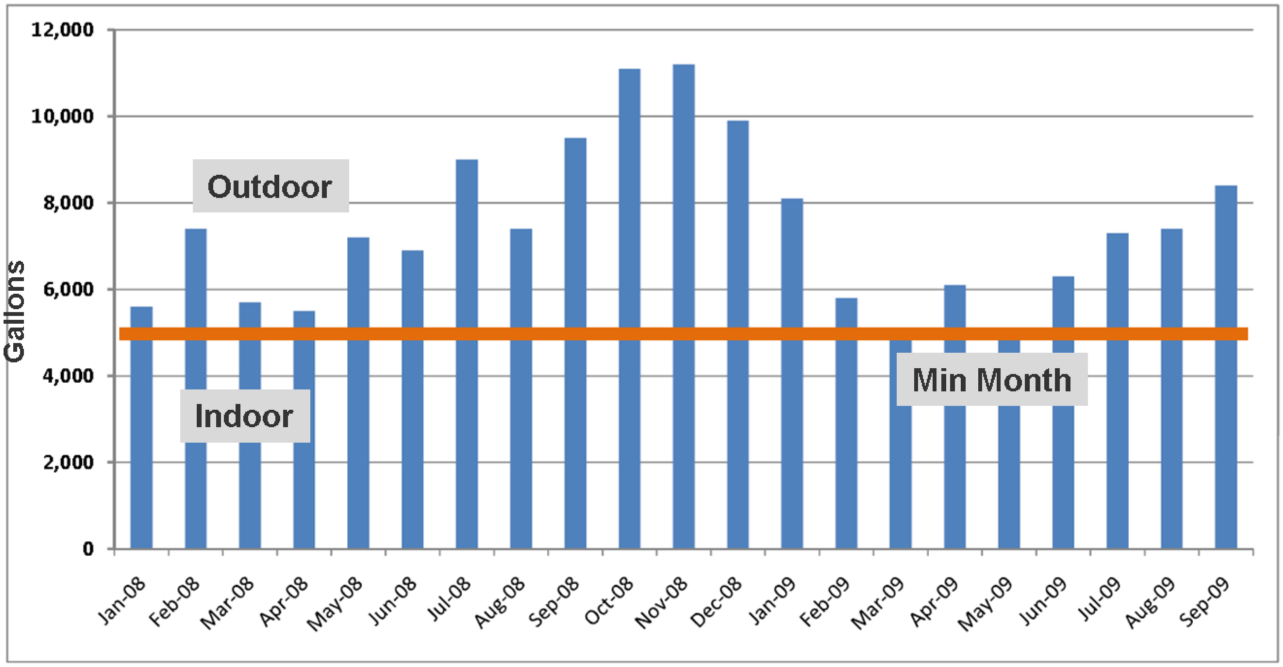


Figure 3.2 Minimum Month Method of Proportioning Indoor and Outdoor Water Use

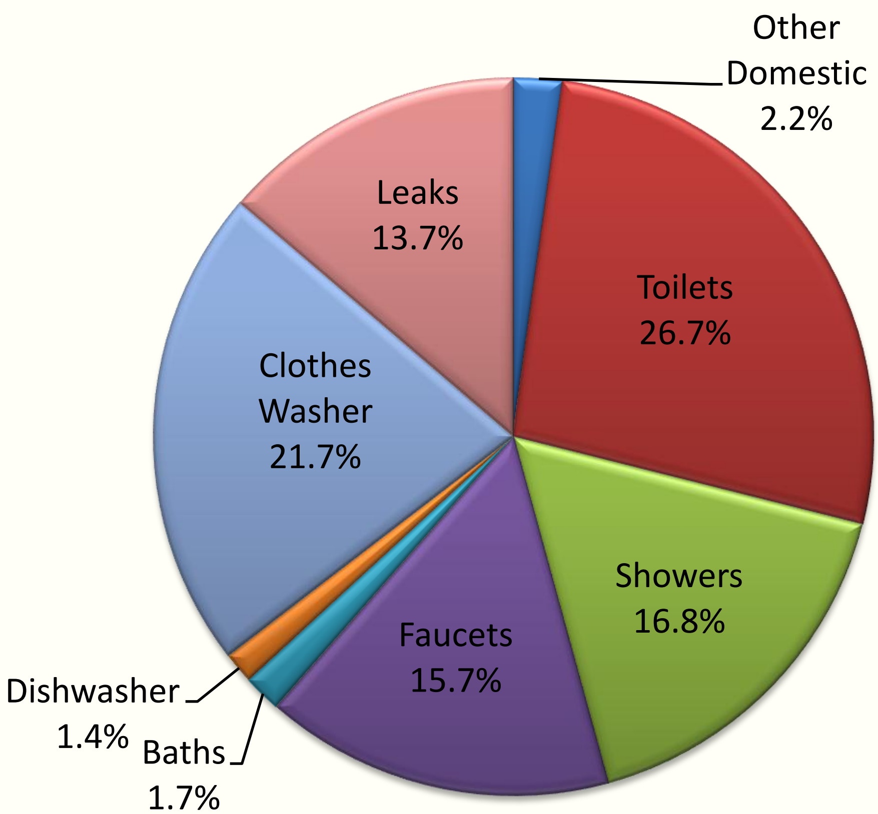


Figure 3.3 Relative Residential Water End Use Indoors (adopted from Mayer, 1999)

3.1.4.2 Residential Outdoor Use and Irrigation Systems

The outdoor use is the total monthly water use minus the minimum month volume. Because of the importance of outdoor irrigation to estimating conservation potential, Jones Edmunds analyzed several methods to establish how many customers were using water outdoors from the potable supply and how many customers were using automatic in-ground irrigation systems. Jones Edmunds developed several methods using a subset of the SJCUD data and then tested those methods against accounts in GRU and Palm Coast that had irrigation meters. For the GRU and Palm Coast accounts, it was assumed that accounts with irrigation meters had in-ground irrigation systems.

Method 1

This method assumes that any account with monthly water consumption greater than 9,500 gallons has an irrigation system. To be included, the accounts had to have at least 500 square feet of irrigable area. This method identified 3,520 accounts having an irrigation system from the 11,260 accounts under study (31% of the total accounts).

Method 2

This method is based on recent studies conducted by the University of Florida (Haley, 2005 and Palenchar et al., 2009) that estimate irrigation depths for customers who irrigate using automatic irrigation systems. From these studies, Jones Edmunds established a threshold of 3.0 inches/month to identify customers who likely had irrigation systems. Accounts with irrigation depths in the maximum usage month greater than the 3.0 inches/month threshold were considered to have irrigation systems. This method identified 3,563 accounts that had irrigation systems from the 11,260 accounts under study (32% of total accounts).

Method 3

The third method is based on the standard deviation of the consumption data. This method assumes that accounts with higher variability in consumption will likely have an irrigation system. By calculating the standard deviation of the 24-month period, Jones Edmunds compared each account standard deviation to a threshold. The threshold was chosen by determining the average standard deviation of all the accounts, which is roughly 2,500 gallons. It was assumed that any account with a standard deviation higher than 2,500 would likely have an irrigation system. This method estimated that 3,561 accounts had irrigation systems (32% of total accounts).

Method 4

The last method assumes that accounts with a higher ratio of maximum-month-to-minimum-month consumption will likely have an irrigation system. Jones Edmunds calculated the threshold by calculating the average of the maximum month divided by the minimum month for the entire dataset. The average maximum to minimum ratio equals 4.2. It was assumed that accounts with a ratio higher than 4.2 would likely have irrigation systems. This method estimated that 3,960 accounts had an irrigation system (35% of total accounts).

While the methods generated similar percentages, the methods did not always select the same accounts. Given the general similarity of the results between the methods, Jones Edmunds chose the most straightforward method, Method 1, for additional testing. Using the GRU and Palm Coast irrigation meters, the indoor and outdoor meters were combined to replicate an account with a single meter. Of these accounts, Method 1 was able to identify 90% of the GRU irrigation accounts and 65% of the Palm Coast irrigation accounts. After reviewing the Palm Coast accounts, over 25% of the accounts use less than 2 inches of water during the peak irrigation season. Therefore, this method is likely biased low for predicting the total number of automatic irrigation systems being used. However, in the context of estimating water savings potential from irrigation systems, this is a conservative approach.

Based on these tests, it is important to note that methods to estimate the number of irrigation systems are estimates for those homes *using* water from the potable supply for irrigation. It does not represent the total number of homes in the utility service areas with irrigation systems. In many service areas there are likely homeowners that have an irrigation system but do not use it or that have an irrigation system connected to an alternative water source. It is understood that not all outdoor use is irrigation, but generally irrigation is the highest use.

3.1.4.3 Reclaimed Water

The potable utility demands offset by reclaimed water use are estimated using the parcels identified in the reclaimed water service areas obtained from the District. For parcels with reclaimed water use, outdoor potable demand was set to zero.

3.1.4.4 Commercial

After separating account-level data into the top commercial categories, Jones Edmunds performed analyses to evaluate patterns that would be used to separate indoor uses from other high-volume uses such as outdoor irrigation and cooling tower make-up. Figure 3.4 shows monthly water use for the major water-use categories across the five utilities. As shown in the figure, office buildings dominate the water use, but there are no discernable patterns to further sector water-use types within the monthly account-level data.

As noted by Vickers (2001), commercial end uses are complex compared to residential water. The differences between individual facilities and overall commercial water use prove challenging when estimating water savings from blanket assumptions pertaining to water-use patterns and conservation practices. Each commercial category has unique proportions of water used in kitchens, restrooms, landscaping, cooling and heating, and other uses that are not distinguishable from the account-level data.

Jones Edmunds performed additional screening to try to isolate commercial customers with multiple accounts to find separate meters on high-volume uses like cooling towers, where it is advantageous for the customer to avoid the inferred wastewater charges based on the potable water demands. While there were commercial accounts with multiple accounts, the use classification was often ambiguous and highly variable. For example, several office buildings and hotels had multiple accounts, but it was not clear if the water use on the secondary meters was for irrigation, cooling water, or other uses.

The team further investigated office buildings, given their dominance over the other water-use categories. Analyzing the peak month of December 2008 shown in Figure 3.4 provides two examples of the complexities and irregularities of the data discussed in Section 2. A single account within the dataset accounts for 24 million gallons of use in December 2008. According to the account data, the typical use for this facility is 6 million gallons per month. While this is an easily identifiable anomaly, it is not easy to recognize and discount these types of anomalies from the analyses in a standardized fashion for all five pilot utilities in all the DOR categories. Further, this parcel is listed in the DOR category for office buildings but field confirmation of the address reveals that the parcel's land is primarily used for health care and hospital-related purposes. This indicates that "office buildings" could be a catch-all category for county appraisers as they classify commercial parcels.

To help further separate end uses in the commercial categories, the team consulted references from EBMUD and AWWAF. In 2008, East Bay Municipal Utility District published a *Watersmart Guidebook* that includes typical water use for 19 business types that were adopted in this study for applicable categories (Table 3.3). The AWWARF Commercial End Use Study provides some insights on commercial use, but it does not proportion end uses in a similar fashion as the residential end-use study. Statistics from the *Residential End Uses of Water* (Mayer et al., 1999) were used to further partition water use in each commercial category to which conservation practices could be applied.

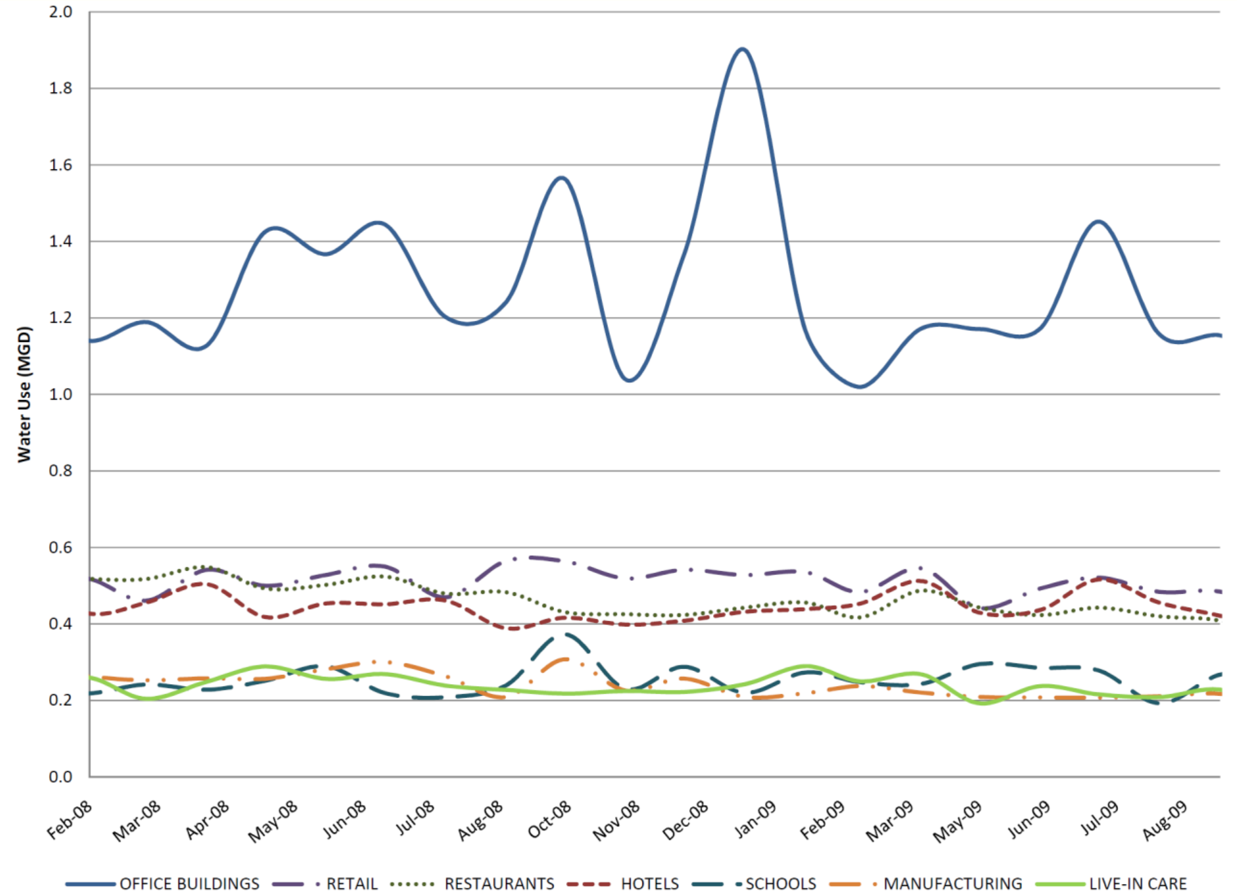


Figure 3.4 Time Series Plot of Monthly Commercial Water Use Across All Five Pilot Utilities

Table 3.3 Percent Total of Typical End Uses in Commercial Facilities[1]

Category	Kitchen & Other	Domestic & Restrooms	Cooling & Heating	Landscape	Other	Laundry
Hospitals	7	31	23	10	22	6
Hotels & Motels	16	35	11	23	-	15
Office Buildings	11	34	28	27	-	-
Restaurants & Fast-Food Outlets	47	33	2	5	13	-
Commercial and Retail Centers	15	26	21	38	-	-
Schools	13	44	12	31	-	-
Live-in Care[2]	16	35	11	23	-	15
Warehouses/Storage[2]	11	34	28	27	-	-
Indoor Recreation[2]	11	34	28	27	-	-

1. Adopted from *Watersmart Guidebook – A Water Efficiency Plan Review Guide for New Businesses* (EBMUD, 2008).
2. Assumed live-in care has similar water use as hotels and motels. Assumed warehouse/storage and indoor recreation has similar water use as office buildings.

3.2 Water-Use Metrics and Benchmark Development

Account-level water consumption data are complex and unique to each utility. Joining the account water-consumption data with property appraiser geospatial data results in inconsistencies and anomalies that need to be recognized, evaluated, and cleaned in order to generate meaningful water-consumption benchmarks and statistics.

For the purpose of this study, the term *benchmark* represents the statistical summary—typically the mean—of the water metrics for each utility and use category. For example, the metric *gallons per square foot* is calculated for each account. The benchmark is derived by statistically summarizing metrics for all accounts in each utility, category, build-out condition, and use type.

To create the benchmarks, Jones Edmunds first joined the billing data to the latest parcel datasets, with 85% to 94% of the parcels matching for each utility. Jones Edmunds then cleaned and screened the data to develop a good baseline dataset for use in benchmark development. Initial screens (Table 3.4) were performed to validate the processes of handling a large dataset and to make comparisons with recognized water end-use studies such as Mayer, et al. (1999).

Table 3.4 Initial Screens

Screen	Purpose
Minimum month	Develop a clean data set to compare against industry benchmarks for occupied homes and develop an understanding for indoor/outdoor use characteristics
Accounts with population less than one for residential parcels	Removes accounts with population less than one person
Accounts without property attributes	Accounts must have year built and applicable areal attributes to make calculations

After the initial process validation, Jones Edmunds carefully considered which accounts to use in generating the benchmarks, which would be applied to calculating water conservation potential. The primary issue was whether to include all metered accounts with accompanying population and property attribution or only a subset of metered accounts that represented occupied land use. In reviewing the billing records for all five utilities, there were generally three consumption-pattern groupings: accounts that had zero or low consumption over the entire period, accounts that exhibited transient behaviors (cyclical water use with alternating periods of zero or low use), and accounts that registered consumption each month. It is not uncommon in GRU's service area for accounts to discontinue or reduce water use coincident with semester changes at the University of Florida, and in many accounts in Palm Bay and Palm Coast, there are long durations of no use or sporadic use over durations lasting more than one month. Since the goal of the study is to estimate conservation potential, the methods used to calculate the benchmarks excluded accounts with zero or low use and included metered accounts with seasonal and continuous consumption. The reasoning is that there must be water used before it can have water savings potential. Several screens were tested to isolate the accounts with low consumption from seasonal users. No screen was ideal for all five utilities. After several iterations, the final residential screen excludes accounts with a total consumption of less than 15,000 gallons over the entire period, and the commercial screen excludes only accounts that have zero consumption over the entire period.

Table 3.5 provides the screens applied to isolate accounts to calculate water-use metrics and derive benchmarks.

Table 3.5 Water Use Metrics and Benchmarks Screen

Screen	Purpose
Accounts with population less than one for residential parcels	Removes parcels assigned anomalous population from Districts Population Projection Model data.
Accounts without property attributes	Accounts must have meaningful DOR information, year built and applicable areal attributes to make calculations
Separate accounts with anomalously low consumption	There are accounts that are assigned a population from the Districts Population Projection Model data, but look to be vacated over the entire period of the analysis.
Screen for minimum irrigable area	Subtracting house area from parcel area must be greater than 500 square feet to avoid small or negative numbers.

Once screened, the following water-use metrics were calculated for each remaining account and derived into benchmarks:

- Gallons of indoor water use per capita per day (residential only)
- Gallons of indoor water use per building area
- Gallons of indoor water use per heated area
- Gallons of outdoor water use per parcel area
- Gallons of outdoor water use per irrigable area (residential only)
- Gallons of water use per account per day

Jones Edmunds calculated irrigable area based on the following formula (Equation 3.2):

Equation 3.2

$$IA = (Parcel\ Area - Building\ Area) * IrrF$$

$$IrrF = Irrigation\ Area\ Factor = 0.7$$

Jones Edmunds derived the irrigation area factor of 0.7 in the initial Pilot Study, and it corresponds well with recent investigations by the Southwest Florida Water Management District (2010) (SWFWMD).

It is important to distinguish water-use metrics and benchmarks that are used in estimating reliable conservation savings from a water-use benchmark that is used in estimating the amount of gross water need by a utility to meet its level of service to its customers. While the water use metrics include seasonal non-consumption so that savings are not overestimated, the utility cannot readily discount these meters or the zero-consumption meters in planning for future water supply due to the utility's obligation to provide a common level of service to all metered accounts in accordance with local, state, and federal drinking-water standards.

The water-use metrics represent retail or water that is recorded at the customer's meter. They do not represent delivery system or treatment losses. If a comparison is made between the water-use benchmark developed for this study and other water-use benchmarks used in water supply planning, it is important to recall that the metrics for this study are based on only two years of account data that represent a unique economic time period.

3.3 Future Water Use Data Development

To develop the input tables for future water use calculations, Jones Edmunds joined the current parcel centroids spatially within the participating utility SABs to the District population data to create a JoinID. The JoinID was then used to relate the necessary current property appraiser data, such as square footage, to the Districts Population Projection Model population. This yielded a dataset with 2005 parcel polygons with population growth attributes and current parcel attributes. Jones Edmunds used this dataset for the water-use projections and estimating future conservation potential.

3.4 Assigning Future Water Use Characteristics

3.4.1 Residential

Jones Edmunds derived future residential water use from the joined account geodatabases and the population geodatabase. Parcels that do not have existing accounts that are within the future SABs and have increased in population over the planning period are considered to be future residential parcels to be served by the utility. To estimate future conservation potential in each category, Jones Edmunds developed a relationship between each residential category's most recent build-out condition and the average number of dwelling units per acre using the population geodatabase. This relationship links the future densities applied in the population model to an existing water use representative of those densities in the account-level data. This method assumes that a utility's future growth will have the same water-use characteristics as the accounts in the most recent build-out condition. The method also recognizes the categories of different residential users by relating the water-use categories to dwelling-unit densities. For example, GRU's existing service area has a significant amount of higher-density dwellings, which in general have lower normalized water use. However, future population densities show that future residential growth will be in lower-density homes, which typically use more water per person than the high-density dwellings. Therefore, normalized water use at GRU will likely be higher in the future.

Appendix B provides a detailed workflow for assigning water use to future parcels.

3.4.2 Commercial

There is not an existing spatial commercial growth model across the District. To assign future water use to commercial categories, the following steps were taken for the five pilot utilities:

- Calculated theoretical growth rates (parcel area per year) from 1980 to present day for each commercial category using the property appraisal year-built data.
- Calculated theoretical 2030 parcel areas for future commercial growth for each category.
- Determined percent relative growth rates for each category.
- Selected all vacant commercial, industrial, and institutional (CII) lands within the future SABs that had a population of zero as candidates for commercial growth.

- Capped commercial growth at the theoretical 2030 area if the vacant CII area was greater than the theoretical 2030 area.
- Capped the commercial growth at the vacant CII area if the vacant CII area was less than the theoretical 2030 area.
- Calculated residential growth rates at 5-year increments (2015, 2020, 2025, and 2030) using the population data, assuming commercial growth reflected residential growth patterns.
- Used residential growth rates and percent relative growth rates to grow the available commercial area by commercial category in 5-year increments.
- Applied the most recent build-out condition metric for each commercial category to the parcel area to estimate future commercial water use.

Appendix C provides the detailed workflow for the commercial categories, and Appendix D provides the growth rates in each commercial and residential category for each utility in the SAB.

3.5 Water Savings Potential

Calculating the water savings potential associated with applicable conservation practices is the primary focus of this study. There are several tools used to calculate conservation potential and costs. As part of this work, Simmons Environmental Consulting (SEC) reviewed the Conserve Florida Guide and Alliance for Water Efficiency (AWE) tools extensively. SEC's review is provided in Appendix E. The purpose of this review was to evaluate the features and the possibility of using these tools for the purposes of this project. Based on SEC's recommendations and our consultation with District staff, Jones Edmunds developed a spreadsheet using information gathered from literature and other conservation studies to calculate conservation potential across the pilot utilities. The spreadsheet methodology coincides with the principles of the Conserve Florida Guide and AWE tools.

Several factors that must be considered in the process of estimating water conservation potential on a utility- and District-wide basis are described below.

Eligible Units (EU): The number of units (fixtures, square feet, etc.) after considering passive replacement and efficiency that have the potential to be replaced, changed, or modified by a conservation practice.

Efficiency (Eff): The reality that some customers will revert back to previous behaviors or discontinue using conservation practices. Efficiency is expressed as a percentage of customers in each build-out condition.

Equivalent Unit Cost (EUC): The unit cost of a conservation alternative, derived from annualizing the present value of the conservation program over the planning horizon and dividing by the annual program savings at the end of the planning horizon.

Cost Threshold: The cost above which conservation practices are considered not cost effective, expressed in terms of dollars per thousand gallons.

Implementation Period (IP): The amount of time allowed to implement a conservation program.

Mutually Exclusive: The term for when two or more conservation practices focus on saving that same water use (i.e., high-efficiency toilets and ultra-low flow toilets).

Passive Replacement (PR): The number of customers, applied as a percentage per year, who have already implemented or will likely implement the conservation practice being considered without any incentives from the utility or the District.

Passive Implementations (PI): The number of implementations that are implemented in the future without incentives.

Passive Savings (PS): The amount of water savings, expressed in gallons per day, that occurs due to passive replacement or implementation of water conservation practices without any incentives from the utility or the District over the planning horizon.

Program Costs (PC): The present value of implementing a conservation program.

Program Implementation Rate (PIR): The rate, expressed in units per year, at which conservation practices are implemented.

Program Savings (PS): The amount of water savings, expressed in gallons per day, that occurs due to a utility-funded program over the planning horizon.

Saturation (S): The limit of a conservation program's market penetration, expressed as a percentage.

Saturation Implementations (SI): The number of implementations needed to reach saturation.

Percent Water Savings (%Savings): The percent of water savings that can be achieved by applying the BMP (derived from literature and manufacture data).

Unit Costs (UC): The cost to implement each conservation practice.

These factors are combined with estimated water use to calculate water savings over the planning horizon for each pilot utility in the following two-step process.

The first step establishes the amount of water savings potential for each conservation practice in each use category, build-out condition, and use type. The water savings potential is calculated as follows:

Equation 3.4

$$[WaterSavings = (1 - PR) * Eff * \%Savings * H_2 0]_{i,C,B,T}$$

$$i = Conservation\ Measure$$

$$C = Category\ of\ Use\ (Resential, Commercial, etc)$$

$$B = Build - out\ condition\ (Applicable\ plumbing\ standard\ years)$$

$$T = Type\ of\ Water\ Use\ (typically\ indoor\ or\ outdoor)$$

The next step evaluates how much of water savings potential is achieved through passive and program savings for each conservation practice under a given implementation period and saturation. Then the most cost-effective conservation practices that are below the specified cost threshold are selected. The equations governing the second step in the process are as follows:

For each conservation practice (*i*) and implementation period (*IP*), calculate passive implementation, saturation implementations, and program implementations.

$$NI = EU * NR * IP$$

$$SI = EU * S$$

If $NI < SI$, *then*

$$PIR = \frac{SI - NI}{IP}$$

$$PI = PIR * IP$$

$$Else, PI = 0$$

After the number of implementations is established, the amount of water saved is proportioned between passive and program water savings or each conservation practice.

The saturation rate is an important component of calculating the program savings and deserves additional clarification through an example. The intent of the process is to take the pool of all customers and target potential accounts for each conservation practice. This targeting is done by assigning accounts to a residential category and build-out condition and discounting by the passive replacement and efficiency factors. Once targeted, implementation is focused on the number of accounts in a targeted category up to a saturation point. In this study, the saturation rate is applied to the targeted group of customers and not the entire customer pool, as shown in the following example for a toilet retrofit program:

Total pool of single-family accounts = 26,000

Total homes in residential category 3, built between 1984 and 1994 = 600

Passive Replacement = 4%

Efficiency = 100%

Targeted Accounts = 600*(1-0.04)*1.0 = 576

Saturation = 90%

Program Accounts = 576*0.9 = 518

From the total pool of 26,000 accounts, there are 600 homes in the RS3 category and build-out condition 2. Of these homes, 24 likely have already installed or tried new toilets, which leaves 576 accounts that likely have conservation potential. Of the remaining homes, the program will not reach more than 518. The concept is that a utility considering conservation programs would do a similar analysis to target accounts that have a high potential and implement a focused program.

Another important observation was made as part of incorporating methods from established conservation tools. Initially, absolute savings rates were used to calculate water savings for each conservation practice rather than a percent water savings. By using this method, it quickly became apparent that the absolute savings rates will over-predict water savings unless they are carefully calibrated to the water utility's end uses. This is best illustrated by an example for one of the utilities. In Palm Bay, houses in a residential category RS1, with build-out conditions from 1984 to 1994, use approximately 86 gallons per account per day (gpad) indoors. Many of these homes are candidates for an ultra-low flow toilet and efficient showerhead retrofit. The savings rates for a toilet and showerhead retrofit are estimated at 32.3 and 4.7 gpad, respectively. For homes eligible for both replacements, this equates to a 37-gpad reduction in water or a 43% reduction in average daily water use to 49 gpad. For the 2,500 homes in this category, this equates to an estimated water savings of 92,500 gpd.

The method in this study applies a percent savings to each end use. So in the Palm Bay example, the water savings is calculated as follows:

From homes in the RS1, Build-out Condition 2:

Water Use = 86 gpad

Toilet Water Use = 26.7%

Water Savings for Water Used in the Toilet with Ultra-low Flow Retrofit = 60%

Shower Use = 16.8%

Water Savings for Water Used in Showers with High-Efficiency Retrofit = 45%

Toilet Water Savings = 86 * (26.7%*60%) = 14 gpad

Shower Water Savings = 86 * (16.8%*45%) = 6 gpad

Total Water Savings Potential = 20 gpad

The estimated savings for the 2,500 homes in this category equals 50,000 gpd, which is almost half of the savings that would have been over-predicted by applying absolute savings rates.

3.6 Conservation Practices

The conservation practices or Best Management Practices (BMPs) applied in this study fall into three families: Global, Indoor, and Outdoor.

Global

- Conservation Coordinator and Customer Education
- Aggressive Meter Monitoring Program

Indoor

- Low-Flow Volume Showerhead Replacement
- High-Efficiency Showerhead Replacement
- Low-Flow Faucet Aerator Replacement
- Ultra-Low Flush Toilet Replacement Program
- High-Efficiency Toilet Replacement Program
- High-Efficiency Clothes Washer Replacement

- High-Efficiency Dishwashers
- Urinal Replacement Program
- Waterless Urinal Replacement Program
- Commercial Kitchen Pre-Rinse Spray Valve Replacement
- Water Reuse/Recycling Laundry Machines
- Ordinances Adopting Higher Indoor Efficiency Standards
- Submetering Billing of Apartment Units – Indoor

Outdoor

- Efficient Irrigation Systems (Non-Turf)
- Install Soil Moisture Sensor Shut-Off Devices
- Install Single-Family Advanced Evapotranspiration Irrigation Controllers
- Landscape Replacement Program
- Modifications to Land Development Regulations (LDRs) Limiting Water Use

Appendix F provides a complete description of each conservation practice with values for passive replacement rates and unit costs. While there are several references that document water savings for each BMP, each utility will experience a unique water savings rate once it implements conservation. Factors assigned in this study were applied based on literature information and consultation with District staff. The study's goal was to apply conservation practices aggressively where water end uses could be reasonably defined.

As part of this process, Jones Edmunds matched each conservation practice with its end use in each category and build-out condition. For residential categories, there are six categories and three build-out conditions to which retrofit BMPs can be applied, which creates 18 combinations for each conservation practice. For each combination, water savings and associated costs are calculated. For the top 10 commercial categories and the 6 residential categories, there are nearly 500 combinations of conservation practice and water-use categories considered for each utility.

As previously described above, defining commercial end use is challenging. There are indications that commercial facilities can achieve between 9% to 51% water savings at a facility (EPA, 1997). However, these savings are not easily transferable across a group of similar commercial use types because of the site-specific nature and variability of commercial use. There are commercial practices that exist beyond those applied in this study. In many cases the water savings from these commercial practices are sensitive to the exact water-using machine or process. Another confounding issue in estimating water savings from the utility potable supply is that many of these systems are not uniformly connected to the potable water supply. Cooling-tower waters, medical water use, and commercial irrigation are good examples of end uses that are highly unique to each customer's machinery and water source. While the account-level billing information provides advances in understanding water use across common commercial categories, there are limitations in predicting water conservation savings for commercial end uses without additional information.

Most of the conservation practices applied in the study are focused on retrofits in existing homes and facilities. Two of the practices are directed at future use: adopting high-efficiency indoor standards and modifying land development requirements (LDRs). The study assumes that the same standard on new construction will be required if a utility chooses retrofits to bring customers to more efficient uses. For example, if a utility implements a comprehensive soil moisture sensor program, then LDRs would be modified to require soil moisture sensors or equal for new construction.

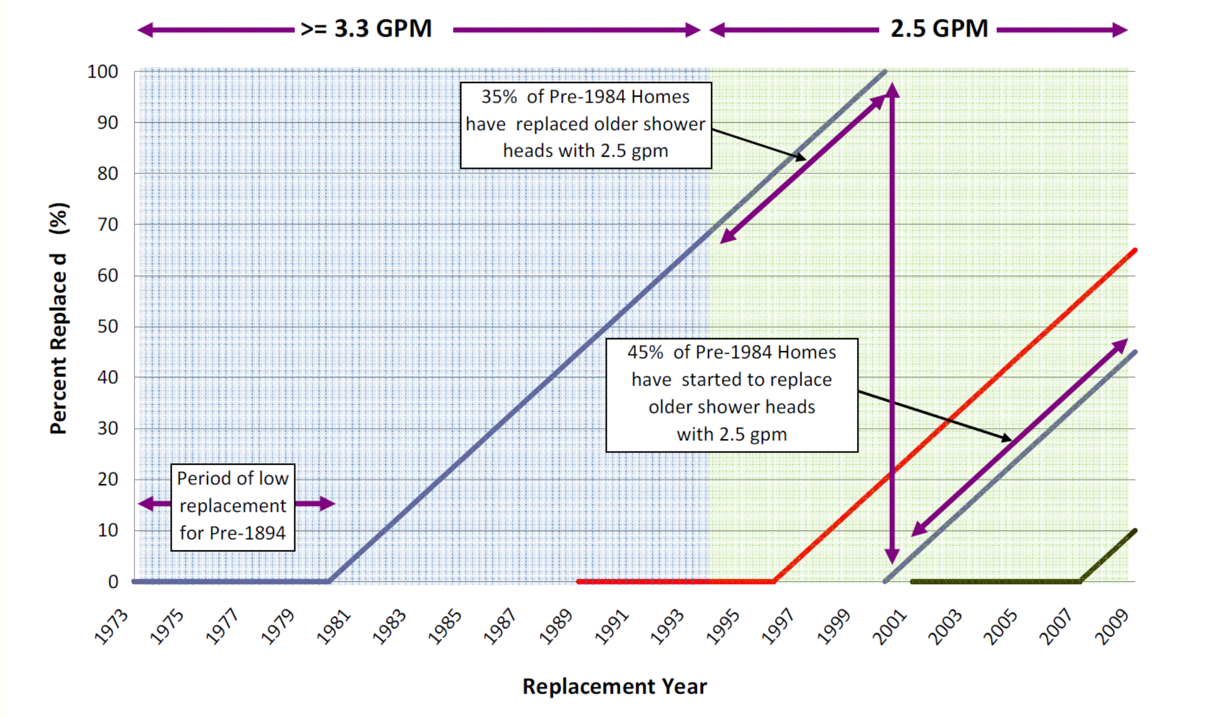
3.7 Fixtures and Passive Replacement

The initial step in estimating costs associated with water savings is to estimate the number of fixtures, units, or accounts to be replaced depending on the conservation practice being implemented. During Phase I, Jones Edmunds developed methodologies for estimating fixture counts for residential and commercial parcels. The District provided shapefiles containing the number of beds in hospitals and the number of rental units in hotels. These data were used to better refine the fixture counts within hospitals and hotels. The majority of the bathroom counts within the property appraiser data for commercial parcels were unreasonable. The methods developed in the initial phase of the Pilot Study were used for residential and the remaining commercial categories. The methods are provided in Appendix G.

Passive replacement is an important consideration in estimating conservation potential. Passive replacement usually occurs because of remodeling, fixture wear-out, or changes in plumbing codes. Little research has been conducted to determine the best method to estimate passive replacement. The method used within this library estimates the impact of passive replacement using the fixture device life, the average year built in each build-out condition, and documented annual replacement rates (when available).

The method for calculating passive replacement assumes that there is a time period (half the device life) when a device failure and remodeling change-out is very low. After this initial period, devices are replaced at an annual rate according to available saturation and replacement studies until passive replacement reaches 100%. Once a device reaches 100% replacement, it no longer has conservation potential until a newer, more efficient standard is available. If there is a more efficient device, the passive replacement calculation estimates the number of replacements to the newer model. Below is an example of how passive replacement is calculated for low-flow volume showerheads (2.5 gpm).

For showerheads, the device life published by the US Department of Housing and Urban Development is approximately 15 years, and the annual replacement rate documented by California Urban Water Conservation Council is estimated at 5%. The calculation assumes that passive replacement would not begin until the device reached half of its useful life, or 7.5 years for showerheads (the analysis rounds the half-life to 8 years to avoid fractions). The average home ages for the three different build-out conditions are 1973, 1989, and 2001 for the five utilities, which translates to annual replacements starting in 1980 (blue line), 1996 (red line), and 2008 (green line), respectively. As shown below, all the showerheads installed in the Pre-1984 build-out condition have been replaced at least once and some have been replaced a second time. Therefore, the number of homes that have not yet installed the 2.5 gpm showerheads that became standard in 1994 with the U.S. Energy Act of 1992 must be estimated. Based on the device lives and annual replacement rates, approximately 80% (35% + 45%) of the homes in the Pre-1984 category have a 2.5 gpm showerhead. For the 1984–1993 build-out condition, the passive replacement reaches approximately 65% by 2009. This indicates that 35% of homes within this build-out condition have their original showerhead (3.3 gpm). Since homes built during the 1994–Present build-out condition have 2.5 gpm or lower showerheads, the passive replacement of this build-out condition defaults to 100%.



3.8 Conservation Feasibility

With the number of implementations, unit costs, and the passive implementation rate, the program implementation rate, implementation costs, and equivalent unit costs can be calculated as follows:

Equation 3.5

$$PC_i = PI * UC_i$$

$$EUC_i = \left[\frac{\frac{PC * DR}{1 - (1 + DR)^{-n}}}{PS} \right]_i * K$$

Where

$$n = years\ in\ planning\ horizon$$

$$DR = Discount\ Rate$$

$$K = Units\ conversion\ to\ obtain\ \$/kgal$$
$$i = BMP$$

To determine the most cost-effective alternatives, practices with equivalent unit costs below the cost threshold were selected. For mutually exclusive practices, the program with the lower equivalent unit cost that is under the cost threshold was selected. For this study, the results were compiled to report water savings in 5-year periods.

The costs for conservation practices were established from the perspective that the utility will bear the burden of all program costs up to the first replacement or implementation. Rebates and cost sharing were not considered in this analysis. Once installed, these practices would continue to achieve savings by virtue that non-conserving fixtures or practices would no longer be available or allowed. Jones Edmunds also assumed that, if a utility embarked on a conservation program to achieve sustainable water savings, a conservation practice, once installed, would be required to be replaced through agreements with customers or through changes to local codes that enforce program implementation. This replacement cost was not included in the analysis.

Operation and maintenance (O&M) of conservation programs is an important consideration if conservation will be relied upon to achieve sustainable savings and maintain the saturation rate. It is well documented (Vickers, EBMUD) that education, customer audits, and tracking of conservation programs can lead to significant water savings. However, it is less certain how much of this savings is retained over time. There are additional concerns with water efficiency devices failing and the associated water savings being lost due to the lack of upkeep of the conservation practice on the customer side of the meter. The best example of this is the rainfall shut-off devices required on all irrigation systems in Florida since 1991. When operational, these devices prevent unnecessary irrigation, but there is little evidence that installing these devices has resulted in any sustainable water savings because of their high failure rates. This same risk exists for many conservation practices, specifically outdoor practices. This study assumes that significant effort will be needed by each utility to maintain water conservation savings. The O&M aspects of implementing utility-wide conservation programs is captured in the global conservation practices described below and in Appendix F. A conservation coordinator and an aggressive meter monitoring program are global practices that are considered necessary to operate a conservation program and maintain the savings over time. The costs associated with conservation O&M include a $65,000 annual cost to cover a conservation coordinator (or equivalent combined staff) and an annual meter monitoring cost that varies by utility based on size but ranges between $73,000 and $243,000 per year for the utilities in this study.

Jones Edmunds did not include deferred capital, lost revenue cost, and secondary benefits such as energy use reductions and treatment chemical cost reductions in this analysis. All of these are influencing factors that are unique to a utility's operational condition and financial structure. The costs in this study are presented as 2010 present-value dollars. The equivalent unit costs calculated in the study are represented in a format customary to evaluating traditional water supply alternatives. While this is sufficient to make relative comparisons between conservation alternatives, it is recognized that conservation practices may not be able to be financed and evaluated in the same manner as traditional water supplies. Comparisons between unit production costs for traditional supplies and conservation programs should be done with this understanding. SEC provides additional discussion on this topic in Appendix E.

4.0 Analyzing Water Use under Existing Conditions

Using the methods defined in Section 3, water-use metrics and benchmark statistics are calculated for each utility in the study. This section provides a summary of the calculation as it relates to the study. Appendices H through L provide more extensive information for each utility. For convenience, the appendices are grouped by utility.

Figure 4.1 shows a summary of the top water-using categories for all of the accounts in the Pilot Study. As expected, residential categories dominate potable water being delivered by the utilities. Approximately 81% of the water use is residential during the period of analysis.

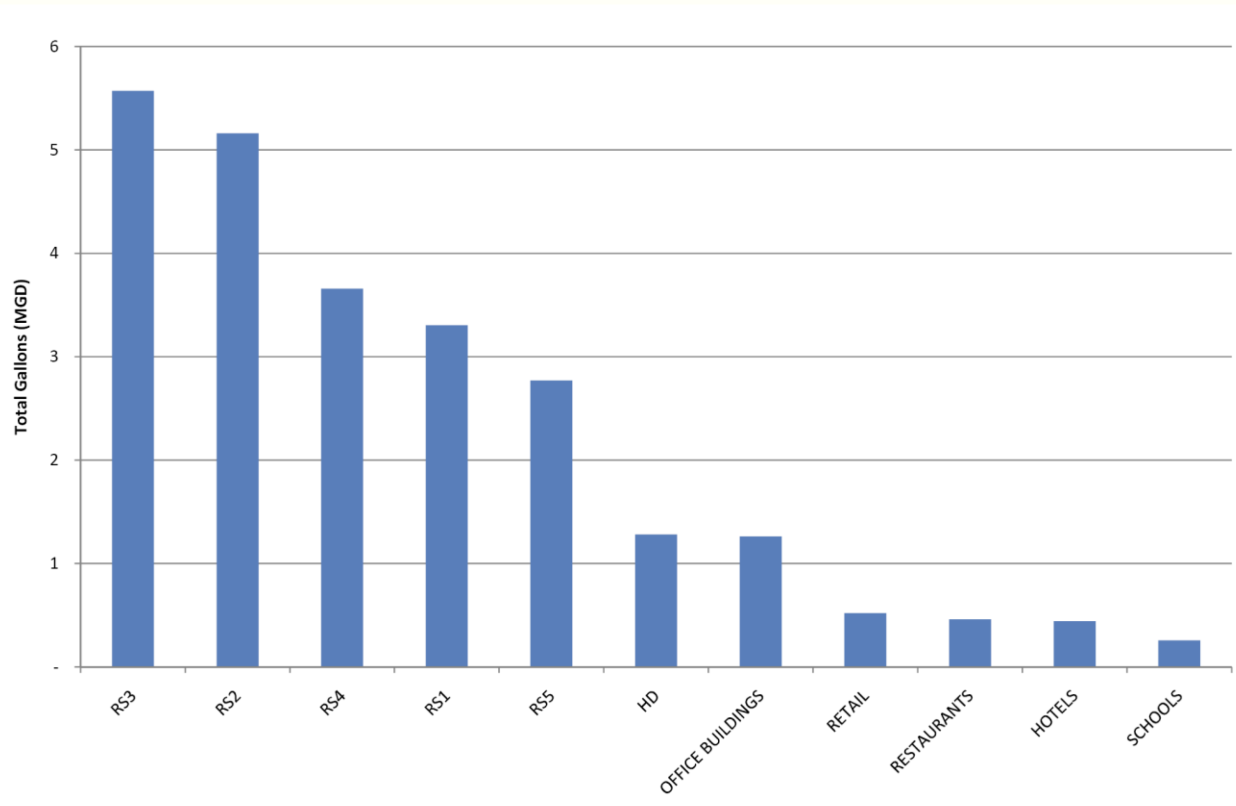


Figure 4.1 Top Water-Using Categories for All Five Pilot Utilities

4.1 Residential

4.1.1 Initial Screening Analysis

To validate the processes for separating indoor and outdoor water use and to provide a comparison to common industry standards, initial screens isolated accounts that had a minimum continuous use over the period of study with attributes for population and appraisal data. This analysis represents homes that are considered fully occupied over the period of study. Per capita water use is a typical metric that is reported in literature references. Tables 4.1(a, b, c) show the averages for each single-family residential category and build-out condition for each utility. It is not possible to break out multi-family accounts and determine occupancy because of the variability in how these types of accounts are metered across utilities.

Table 4.1a Average Per Capita Water Use by Utility for Fully Occupied Single-Family Homes (gpcd)

Res Class	Build-Out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS1	Pre 1984	94	151	101	78	108
	1984 - 1993	106	132	95	73	110
	1994 to Present	85	139	90	63	121
RS2	Pre 1984	108	214	102	87	102
	1984 - 1993	122	255	96	75	104
	1994 to Present	119	242	93	64	125
RS3	Pre 1984	107	340	108	72	100
	1984 - 1993	132	268	103	79	96
	1994 to Present	141	285	100	71	135
RS4	Pre 1984	138	417	116	81	111
	1984 - 1993	169	297	103	90	116
	1994 to Present	176	322	120	82	141
RS5	Pre 1984	162	369	111	86	165
	1984 - 1993	217	313	104	100	175
	1994 to Present	213	366	115	100	172
	Range	132	285	31	38	79
	Weighted Average	134	261	101	73	128

Table 4.1b Average Indoor Per Capita Water Use by Utility for Fully Occupied Single-Family Homes (gpcd)						
Res Class	Build-Out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS1	Pre 1984	54	70	70	71	69
	1984 - 1993	62	75	64	67	72
	1994 to Present	48	66	61	57	70
RS2	Pre 1984	57	93	68	78	67
	1984 - 1993	67	99	64	67	66
	1994 to Present	64	100	63	59	70
RS3	Pre 1984	54	128	69	68	62
	1984 - 1993	68	110	66	68	64
	1994 to Present	68	115	66	62	72
RS4	Pre 1984	64	135	68	72	65
	1984 - 1993	71	92	65	75	74
	1994 to Present	75	125	77	68	73
RS5	Pre 1984	68	123	68	77	89
	1984 - 1993	82	116	66	83	94
	1994 to Present	85	140	74	77	84
	Range	38	74	16	25	32
	Weighted Average	64	105	66	64	72

Table 4.1c Average Outdoor Per Capita Water Use by Utility for Fully Occupied Single-Family Homes (gpcd)						
Res Class	Build-Out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS1	Pre 1984	40	80	31	7	39
	1984 - 1993	44	57	31	6	38
	1994 to Present	37	74	28	5	51
RS2	Pre 1984	51	121	34	9	35
	1984 - 1993	55	156	33	8	38
	1994 to Present	55	141	30	6	55
RS3	Pre 1984	52	212	39	4	37
	1984 - 1993	64	158	37	11	32
	1994 to Present	73	170	34	9	64
RS4	Pre 1984	74	283	48	8	47
	1984 - 1993	98	205	38	15	42
	1994 to Present	101	197	43	14	68

Table 4.1c Average Outdoor Per Capita Water Use by Utility for Fully Occupied Single-Family Homes (gpcd)						
Res Class	Build-Out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS5	Pre 1984	94	246	42	8	76
	1984 - 1993	135	196	37	18	81
	1994 to Present	127	227	41	23	88
	Range	98	226	19	19	56
	Weighted Average	70	156	35	9	56

Per capita water use varies considerably from one utility to the next. A comparison of the indoor and outdoor components shows that the primary difference is outdoor water use. The difference can be attributed to the penetration of private irrigation wells within each utility service area. While there is less water being used from the utility per person in Palm Bay and Palm Coast, it is not possible to conclude that Palm Bay and Palm Coast customers are conserving more than customers in the other utilities given that Palm Coast and Palm Bay are known to have a high density of customers with irrigation wells.

Mayer et al. (1999) determined that average indoor water use is near 70 gallons per capita per day (gpcd) with a standard deviation of 40 gpcd. The results for all five utilities are comparable to the national end-use study. However, Leesburg tends to have much higher indoor water use than the other utilities.

Jones Edmunds analyzed Leesburg's data to understand why indoor use is noticeably higher than the other utilities. It was discovered that many of the accounts have identical monthly readings. After discussions with Leesburg staff, the reason for these similar readings is that the City has numerous meters that measure in units of hundreds of cubic feet (HCT). For billing purposes, the City makes a conversion to calculate water use in terms of gallons. The frequency plots in Appendix H show the influence of HCT meters. The nature of these meters and the unit conversions tend to mask seasonal differences and limits, which tend to increase the minimum month. Another challenge presented by the Leesburg data is the number of accounts exhibiting bi-monthly reading patterns. In several accounts, consumption is zero in one month and then double in the preceding or following months. This likely results from metering cycles that are binned into monthly consumption. Another factor likely contributing to the higher indoor water use for Leesburg is the inherent limitations of minimum month methods in warmer climates, which will tend to over-predict indoor water use due to irrigation in warmer winter months.

Another test of the indoor/outdoor separation compares the dual metered accounts where indoor consumption is measured separately from outdoor consumption. The dual meter comparison accounts for GRU, Leesburg, and Palm Coast are presented below.

4.1.2 Residential Benchmarks

Once validated, Jones Edmunds calculated the water-use metrics and benchmarks for each utility. The calculations are based on accounts that have necessary property appraisal data and include accounts that have both seasonal and continuous consumption. Accounts with zero or minimal water use over the record were dropped from the analysis.

Tables 4.2 through 4.6 show the property attribute summary statistics and benchmarks developed for each utility.

Since per capita is a commonly used metric, Table 4.7 shows the residential per capita water use for each utility. Table 4.8 provides a summary of average monthly and maximum water use per residential category.

Table 4.2 GRU Residential Benchmarks											
Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Avg Parcel Size (sqft)	Avg Bldg Area (sqft)	Avg Heated Area (sqft)	Avg Indoor Water Use Per Building Area (gpd/sqft)	Avg Indoor Water Use Per Heated Area (gpd/sqft)	Avg Outdoor Water Use Per Parcel Area (gpd/sqft)	Avg Outdoor Water Use Per Irrigable Area (gpd/sqft)	Avg Total Water User Per Parcel (gpd/sqft)	StdDev of Total Water User Per Parcel (gpd/sqft)
RS1	Pre 1984	6,138	1973	11,932	1,518	1,217	0.076	0.094	0.006	0.011	0.019	0.015
	1984 - 1993	701	1986	10,857	1,453	1,118	0.069	0.085	0.009	0.019	0.024	0.019
	1994 to Present	114	1999	20,466	1,381	1,228	0.090	0.100	0.009	0.016	0.021	0.015
RS2	Pre 1984	5,340	1975	15,316	1,979	1,530	0.060	0.077	0.006	0.010	0.015	0.011
	1984 - 1993	1,533	1988	11,047	1,935	1,442	0.056	0.074	0.010	0.020	0.023	0.016
	1994 to Present	544	2000	8,537	1,771	1,359	0.065	0.084	0.012	0.030	0.030	0.020
RS3	Pre 1984	4,188	1976	19,405	2,364	1,813	0.051	0.066	0.007	0.012	0.015	0.011
	1984 - 1993	1,872	1989	14,070	2,277	1,699	0.050	0.067	0.010	0.018	0.020	0.013
	1994 to Present	1,368	1999	9,650	2,221	1,644	0.051	0.069	0.015	0.034	0.029	0.017
RS4	Pre 1984	1,653	1975	27,033	2,929	2,257	0.046	0.059	0.007	0.012	0.014	0.011
	1984 - 1993	1,264	1989	21,970	2,961	2,203	0.045	0.061	0.010	0.019	0.019	0.013
	1994 to Present	1,536	1999	12,253	2,649	1,953	0.050	0.068	0.017	0.034	0.030	0.019
RS5	Pre 1984	636	1974	49,381	4,034	3,124	0.038	0.048	0.007	0.012	0.013	0.012
	1984 - 1993	743	1990	42,654	4,202	3,080	0.041	0.055	0.010	0.017	0.016	0.012
	1994 to Present	1,483	2001	29,398	4,228	3,139	0.038	0.051	0.012	0.026	0.021	0.019
RS6	Pre 1984	1,566	1976	30,808	9,492	8,556	0.050	0.056	- *	- *	0.022	0.025
	1984 - 1993	348	1986	113,799	34,933	30,371	0.019	0.021	- *	- *	0.026	0.024
	1994 to Present	91	2000	533,593	169,073	145,046	0.009	0.010	- *	- *	0.013	0.049

* Multifamily (RS6) water use was assumed to be used primarily indoors.

Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Avg Parcel Size (sqft)	Avg Bldg Area (sqft)	Avg Heated Area (sqft)	Avg Indoor Water Use Per Building Area (gpd/sqft)	Avg Indoor Water Use Per Heated Area (gpd/sqft)	Avg Outdoor Water Use Per Parcel Area (gpd/sqft)	Avg Outdoor Water Use Per Irrigable Area (gpd/sqft)	Avg Total Water User Per Parcel (gpd/sqft)	StdDev of Total Water User Per Parcel (gpd/sqft)
RS1	Pre 1984	1,343	1955	10,767	-	1,073	-	0.185	0.005	0.008	0.018	0.018
	1984 - 1993	78	1987	6,512	-	1,042	-	0.192	0.006	0.011	0.026	0.022
	1994 to Present	93	1999	9,272	-	1,073	-	0.163	0.007	0.012	0.022	0.020
RS2	Pre 1984	600	1957	13,306	-	1,451	-	0.137	0.007	0.012	0.019	0.017
	1984 - 1993	408	1991	7,423	-	1,400	-	0.145	0.015	0.026	0.039	0.025
	1994 to Present	751	1998	6,915	-	1,384	-	0.131	0.016	0.030	0.041	0.025
RS3	Pre 1984	112	1963	18,717	-	2,000	-	0.108	0.007	0.012	0.020	0.019
	1984 - 1993	197	1991	10,908	-	1,734	-	0.114	0.017	0.029	0.036	0.019
	1994 to Present	1,346	1999	8,736	-	1,773	-	0.107	0.020	0.037	0.042	0.024
RS4	Pre 1984	42	1962	24,254	-	2,335	-	0.095	0.009	0.015	0.020	0.018
	1984 - 1993	63	1990	15,381	-	2,070	-	0.112	0.011	0.019	0.027	0.018
	1994 to Present	678	2001	10,474	-	2,062	-	0.098	0.021	0.039	0.040	0.024
RS5	Pre 1984	82	1960	41,731	-	2,665	-	0.087	0.007	0.011	0.013	0.017
	1984 - 1993	34	1989	30,003	-	3,160	-	0.077	0.009	0.015	0.019	0.017
	1994 to Present	296	2002	14,797	-	2,511	-	0.083	0.019	0.037	0.036	0.024
RS6	Pre 1984	134	1957	13,500	-	2,400	-	0.094	- *	- *	0.025	0.110
	1984 - 1993	36	1987	17,563	-	3,557	-	0.022	- *	- *	0.007	0.008
	1994 to Present	39	1999	8,594	-	2,148	-	0.032	- *	- *	0.008	0.003

Table 4.3 Leesburg Residential Benchmarks

* Multifamily (RS6) water use was assumed to be used primarily indoors.

Table 4.4 Palm Bay Residential Benchmarks												
Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Avg Parcel Size (sqft)	Avg Bldg Area (sqft)	Avg Heated Area (sqft)	Avg Indoor Water Use Per Building Area (gpd/sqft)	Avg Indoor Water Use Per Heated Area (gpd/sqft)	Avg Outdoor Water Use Per Parcel Area (gpd/sqft)	Avg Outdoor Water Use Per Irrigable Area (gpd/sqft)	Avg Total Water User Per Parcel (gpd/sqft)	StdDev of Total Water User Per Parcel (gpd/sqft)
RS1	Pre 1984	2,532	1974	10,870	1,227	-	0.076		0.003	0.006	0.013	0.008
	1984 - 1993	1,788	1987	10,682	1,269	-	0.075		0.005	0.008	0.014	0.009
	1994 to Present	188	1998	10,316	1,263	-	0.075		0.005	0.008	0.014	0.008
RS2	Pre 1984	1,828	1976	11,935	1,362	-	0.074		0.004	0.006	0.013	0.010
	1984 - 1993	3,128	1988	11,630	1,543	-	0.067		0.005	0.008	0.014	0.009
	1994 to Present	901	1999	10,479	1,557	-	0.062		0.005	0.009	0.015	0.008
RS3	Pre 1984	1,098	1978	13,335	1,575	-	0.069		0.004	0.006	0.013	0.009
	1984 - 1993	2,482	1988	12,625	1,637	-	0.067		0.005	0.009	0.014	0.009
	1994 to Present	1,288	2000	10,997	1,717	-	0.058		0.005	0.009	0.015	0.008
RS4	Pre 1984	302	1978	14,954	1,782	-	0.064		0.003	0.006	0.012	0.008
	1984 - 1993	762	1989	13,864	1,888	-	0.062		0.005	0.008	0.014	0.009
	1994 to Present	959	2002	11,936	1,943	-	0.050		0.005	0.009	0.014	0.008
RS5	Pre 1984	959	1971	24,960	2,011	-	0.061		0.003	0.005	0.009	0.006
	1984 - 1993	249	1988	18,594	2,203	-	0.054		0.004	0.007	0.011	0.007
	1994 to Present	611	2002	19,866	2,425	-	0.045		0.005	0.009	0.012	0.009
RS6	Pre 1984	80	1961	16,615	1,889	-	0.064	-	- *	- *	0.011	0.014
	1984 - 1993	20	1986	19,810	3,197	-	0.027	-	- *	- *	0.005	0.006
	1994 to Present	4	2002	15,304	2,688	-	0.043	-	- *	- *	0.009	0.007

* Multifamily (RS6) water use was assumed to be used primarily indoors.

Table 4.5 Palm Coast Residential Benchmarks												
Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Avg Parcel Size (sqft)	Avg Bldg Area (sqft)	Avg Heated Area (sqft)	Avg Indoor Water Use Per Building Area (gpd/sqft)	Avg Indoor Water Use Per Heated Area (gpd/sqft)	Avg Outdoor Water Use Per Parcel Area (gpd/sqft)	Avg Outdoor Water Use Per Irrigable Area (gpd/sqft)	Avg Total Water User Per Parcel (gpd/sqft)	StdDev of Total Water User Per Parcel (gpd/sqft)
RS1	Pre 1984	481	1980	10,854	2,215	1,383	0.042	0.066	0.004	0.007	0.012	0.007
	1984 - 1993	1,063	1988	10,548	2,063	1,343	0.046	0.071	0.004	0.006	0.012	0.007
	1994 to Present	969	1999	10,414	1,708	1,161	0.056	0.081	0.004	0.006	0.012	0.007
RS2	Pre 1984	302	1980	11,949	2,622	1,698	0.039	0.059	0.004	0.007	0.012	0.007
	1984 - 1993	1,902	1989	11,353	2,559	1,749	0.039	0.058	0.004	0.008	0.013	0.008
	1994 to Present	6,481	2001	10,673	2,267	1,603	0.045	0.063	0.004	0.007	0.013	0.007
RS3	Pre 1984	62	1980	12,106	2,832	1,912	0.033	0.051	0.004	0.007	0.011	0.005
	1984 - 1993	609	1990	13,075	3,050	2,161	0.036	0.051	0.005	0.009	0.013	0.008
	1994 to Present	5,406	2002	11,274	2,876	2,106	0.038	0.052	0.005	0.009	0.014	0.009
RS4	Pre 1984	113	1979	12,453	2,775	1,749	0.037	0.059	0.004	0.009	0.012	0.007
	1984 - 1993	639	1989	9,271	2,644	1,796	0.047	0.070	0.010	0.022	0.024	0.018
	1994 to Present	2,127	2001	12,611	3,223	2,325	0.036	0.051	0.007	0.014	0.017	0.014
RS5	Pre 1984	54	1976	22,260	2,946	1,960	0.043	0.065	0.002	0.004	0.009	0.009
	1984 - 1993	248	1989	13,072	3,546	2,292	0.036	0.057	0.008	0.024	0.019	0.018
	1994 to Present	862	2001	17,533	3,755	2,599	0.034	0.050	0.007	0.016	0.017	0.015
RS6	Pre 1984	13	1980	12,410	2,664	1,940	0.026	0.035	- *	- *	0.006	0.003
	1984 - 1993	125	1989	12,106	3,143	2,337	0.041	0.055	- *	- *	0.010	0.005
	1994 to Present	526	2003	10,912	3,411	2,472	0.035	0.048	- *	- *	0.011	0.004

* Multifamily (RS6) water use was assumed to be used primarily indoors.

Table 4.6 SJCUD Residential Benchmarks												
Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Avg Parcel Size (sqft)	Avg Bldg Area (sqft)	Avg Heated Area (sqft)	Avg Indoor Water Use Per Building Area (gpd/sqft)	Avg Indoor Water Use Per Heated Area (gpd/sqft)	Avg Outdoor Water Use Per Parcel Area (gpd/sqft)	Avg Outdoor Water Use Per Irrigable Area (gpd/sqft)	Avg Total Water User Per Parcel (gpd/sqft)	StdDev of Total Water User Per Parcel (gpd/sqft)
RS1	Pre 1984	1,665	1974	6,877	1,721	1,227	0.071	0.098	0.008	0.019	0.022	0.017
	1984 - 1993	535	1987	6,304	1,920	1,309	0.073	0.106	0.011	0.029	0.029	0.020
	1994 to Present	701	2001	6,878	1,824	1,319	0.092	0.125	0.012	0.027	0.027	0.017
RS2	Pre 1984	692	1972	9,474	2,238	1,571	0.059	0.084	0.008	0.022	0.020	0.017
	1984 - 1993	766	1989	10,362	2,320	1,583	0.062	0.090	0.008	0.024	0.022	0.018
	1994 to Present	2,122	2002	8,959	2,371	1,698	0.067	0.094	0.010	0.024	0.022	0.017
RS3	Pre 1984	520	1972	11,624	2,596	1,787	0.053	0.077	0.007	0.019	0.017	0.014
	1984 - 1993	619	1989	13,637	2,783	1,930	0.050	0.072	0.005	0.014	0.014	0.011
	1994 to Present	2,963	2003	11,034	2,886	2,084	0.061	0.084	0.010	0.023	0.020	0.017
RS4	Pre 1984	299	1972	12,998	2,834	1,921	0.048	0.072	0.007	0.019	0.016	0.013
	1984 - 1993	395	1989	14,098	3,317	2,262	0.045	0.066	0.005	0.013	0.013	0.011
	1994 to Present	1,699	2002	14,707	3,522	2,515	0.055	0.077	0.009	0.023	0.018	0.017
RS5	Pre 1984	277	1963	22,129	3,442	2,147	0.050	0.081	0.006	0.017	0.014	0.019
	1984 - 1993	215	1989	19,012	4,623	2,935	0.043	0.067	0.006	0.016	0.014	0.012
	1994 to Present	1,043	2002	18,781	4,949	3,425	0.044	0.064	0.008	0.024	0.016	0.015
RS6	Pre 1984	183	1962	17,830	2,792	1,722	0.044	0.071	- *	- *	0.017	0.011
	1984 - 1993	92	1986	14,651	2,887	2,039	0.041	0.058	- *	- *	0.019	0.016
	1994 to Present	69	1999	17,636	4,264	2,440	0.035	0.061	- *	- *	0.016	0.014

* Multifamily (RS6) water use was assumed to be used primarily indoors.

Table 4.7 Per Capita Water Use by Utility (gpcd)											
Res Class	Build-Out Condition	GRU		Leesburg		Palm Bay		Palm Coast		SJCUD	
		Avg	Std	Avg	Std	Avg	Std	Avg	Std	Avg	Std
RS1	Pre 1984	57	41	67	62	48	28	63	36	65	40
	1984 - 1993	66	48	61	52	50	28	60	35	72	44
	1994 to Present	76	51	73	77	48	24	56	32	81	48
RS2	Pre 1984	66	47	94	84	52	30	74	44	66	38
	1984 - 1993	85	54	144	98	54	29	67	41	71	37
	1994 to Present	77	50	133	82	52	27	61	36	83	56
RS3	Pre 1984	76	52	126	113	56	35	69	33	66	41
	1984 - 1993	92	58	173	95	57	34	79	50	71	41
	1994 to Present	103	63	171	94	57	36	72	45	94	73
RS4	Pre 1984	92	69	177	196	60	34	80	44	71	46
	1984 - 1993	127	79	162	104	61	35	97	57	80	47
	1994 to Present	130	79	199	117	66	46	87	58	104	88
RS5	Pre 1984	115	94	144	163	73	51	80	61	99	109
	1984 - 1993	183	123	177	128	63	36	102	87	114	84
	1994 to Present	162	125	210	139	76	57	107	91	120	97
RS6	Pre 1984	41	77	37	153	31	26	23	9	56	43
	1984 - 1993	52	63	10	10	14	15	37	18	48	33
	1994 to Present	24	85	14	8	30	18	34	16	75	57
	Range	159	84	201	188	62	42	84	82	73	76
	Weighted Average	84		132		55		70		85	

Table 4.8 Average and Peak Use for Residential Categories by Utility (gallons per month)

Res Class	Build-Out Condition	GRU		Leesburg		Palm Bay		Palm Coast		SJCUD	
		Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
RS1	Pre 1984	5,077	13,063	4,886	7,287	3,818	7,936	3,890	8,515	3,890	8,811
	1984 - 1993	4,661	10,991	4,561	6,231	4,401	8,914	3,959	8,657	4,558	9,736
	1994 to Present	5,719	13,816	5,592	7,427	4,182	8,418	3,991	8,869	5,379	11,504
RS2	Pre 1984	5,724	14,726	6,629	10,478	4,152	9,113	4,276	10,186	4,244	10,235
	1984 - 1993	6,032	14,898	8,729	11,855	4,773	10,108	4,401	10,269	4,615	10,149
	1994 to Present	5,831	13,943	8,075	12,337	4,460	8,836	4,258	9,490	5,269	11,863
RS3	Pre 1984	6,457	16,931	8,368	13,383	4,515	10,719	3,926	8,911	4,252	10,168
	1984 - 1993	6,713	17,246	10,768	17,377	5,092	11,914	4,999	11,573	4,494	10,094
	1994 to Present	7,468	18,799	10,477	16,375	4,567	9,541	4,882	10,820	5,825	13,657
RS4	Pre 1984	7,754	20,629	11,826	20,151	4,737	10,812	4,527	11,727	4,228	11,244
	1984 - 1993	9,325	24,953	10,532	17,940	5,343	12,498	5,790	13,787	4,796	10,922
	1994 to Present	9,035	22,447	12,119	18,839	4,639	9,912	5,618	12,707	6,431	15,180
RS5	Pre 1984	9,662	27,238	9,550	14,249	5,420	14,302	4,878	16,015	5,192	16,207
	1984 - 1993	12,862	34,545	12,274	23,299	5,501	12,996	6,002	19,048	6,281	17,760
	1994 to Present	10,979	28,675	12,240	18,690	5,241	12,163	6,442	15,450	7,116	17,324
RS6	Pre 1984	14,504	27,785	6,877	58,687	3,654	7,940	2,082	5,445	3,734	8,790
	1984 - 1993	19,732	38,733	2,431	5,606	2,585	6,866	3,902	8,806	3,566	7,981
	1994 to Present	46,068	76,440	2,081	5,844	3,496	5,749	3,593	7,531	4,514	11,516

Table 4.9 compares indoor water use for dual-metered accounts and the estimated indoor water use for single-metered accounts. As shown, the estimated indoor water uses are comparable but there are differences, which are a reflection of the variability in water use and the challenges of separating indoor and outdoor water use. As indicated earlier, the Leesburg dual-metered accounts suggest that the indoor/outdoor separation technique may be over predicting indoor water use. After collaborating with Leesburg staff, Jones Edmunds used the dual-metered accounts as the basis for calculating indoor water use in estimating conservation potential.

Table 4.9 Comparison of Indoor Water Use for Dual Metered Accounts and Single Metered Accounts (gpcd)

Res Class	Build-Out Condition	GRU		Leesburg		Palm Coast	
		Accounts with Dual Meter	Accounts with Single Meters	Accounts with Dual Meter	Accounts with Single Meters	Accounts with Dual Meter	Accounts with Single Meters
RS1	Pre 1984	38	36	38	48	49	44
	1984 - 1993	34	40	NA	46	48	43
	1994 to Present	NA	51	NA	46	51	40
RS2	Pre 1984	45	38	65	58	55	52
	1984 - 1993	52	45	44	87	55	46
	1994 to Present	49	44	44	79	63	44
RS3	Pre 1984	52	40	NA	76	55	48
	1984 - 1993	55	46	97	90	55	51
	1994 to Present	52	46	57	89	62	49
RS4	Pre 1984	62	46	NA	85	61	51
	1984 - 1993	70	54	NA	98	59	59
	1994 to Present	63	56	93	97	64	54
RS5	Pre 1984	25	52	NA	71	59	58
	1984 - 1993	56	70	99	94	56	63
	1994 to Present	54	65	95	101	67	63

The analysis includes 1220, 497, and 5361 dual metered accounts for GRU, Leesburg and Palm Coast, respectively.

Figures 4.2 through 4.5 show the five utility ranges for several benchmarks, calculated as part of the study, and the average for each category for the five utilities.

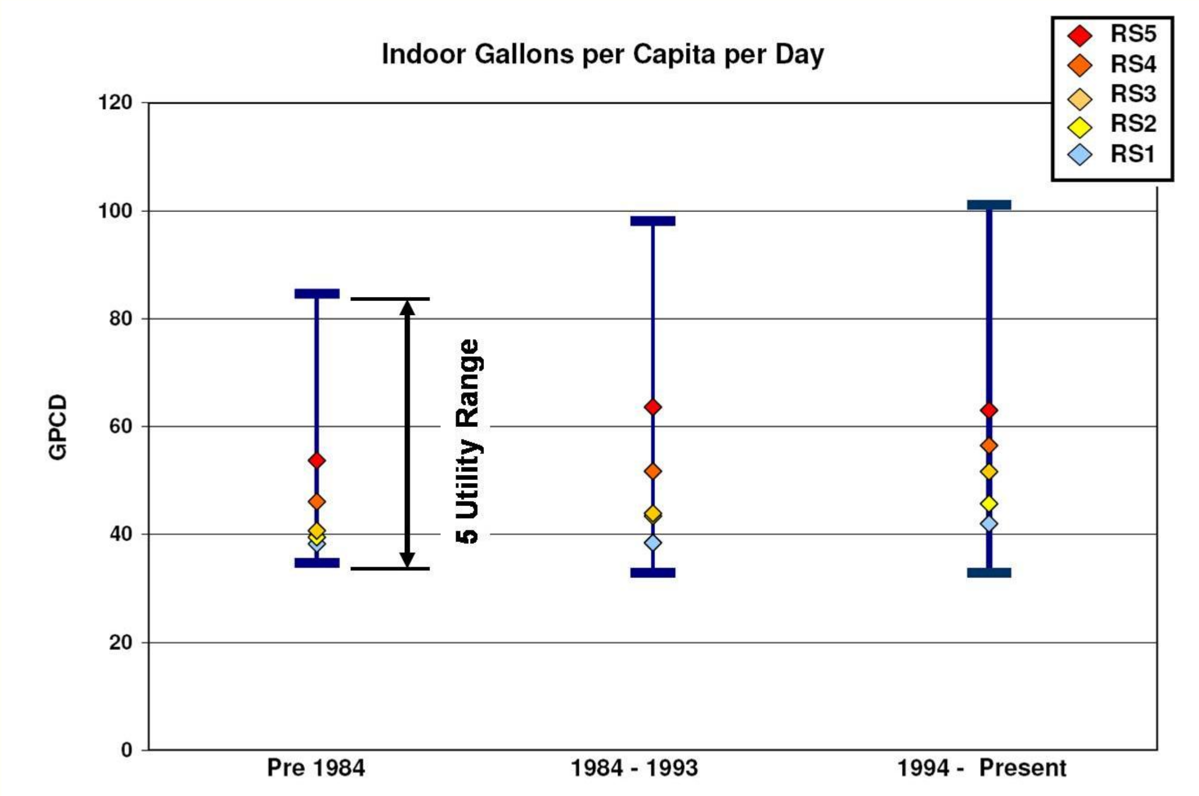


Figure 4.2 Indoor Per Capita Water Use for Single Family Categories

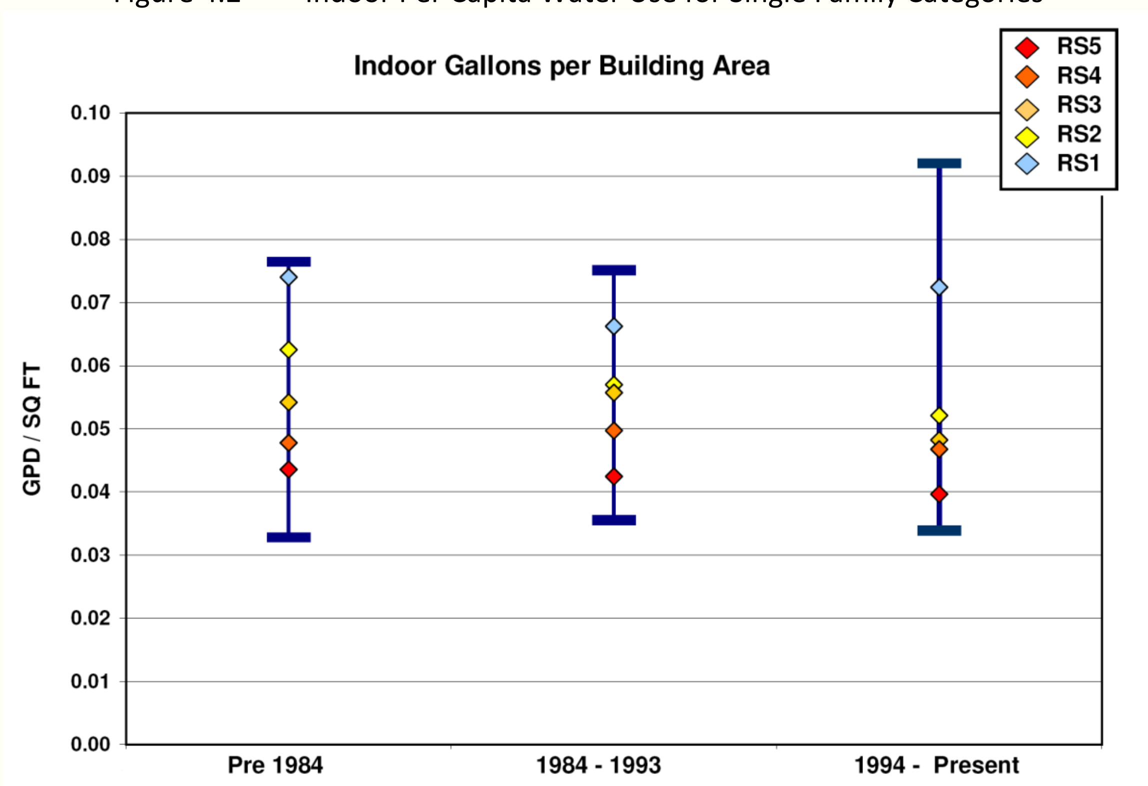


Figure 4.3 Indoor Water Use per Building Area for Single Family Categories

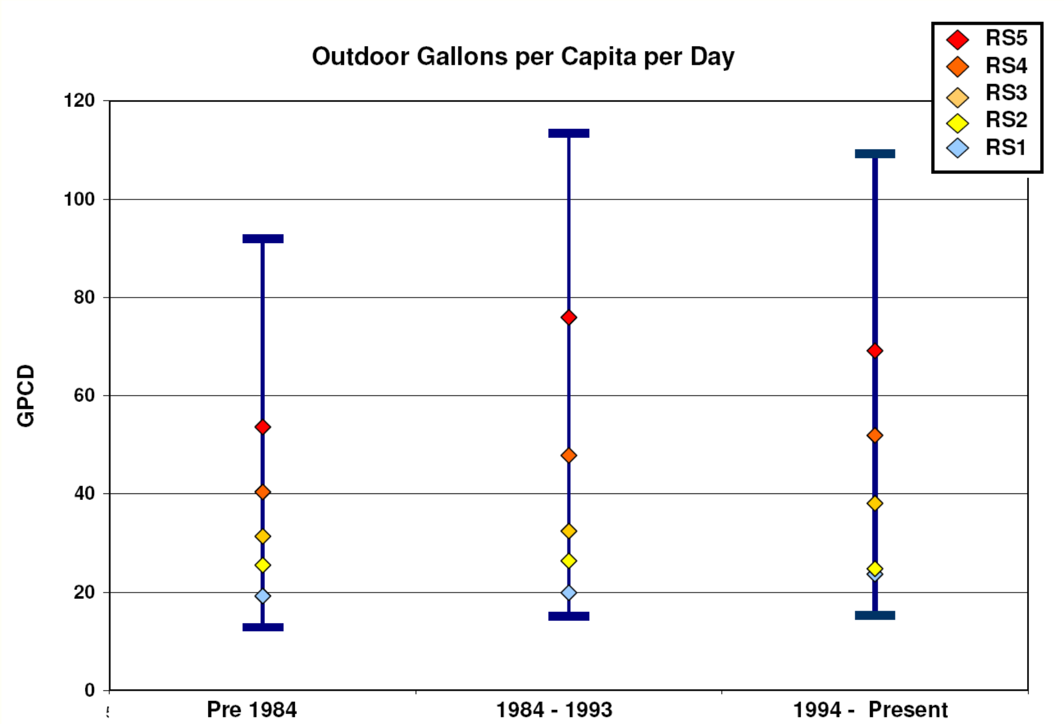


Figure 4.4 Outdoor Per Capita Water Use for Single Family Categories

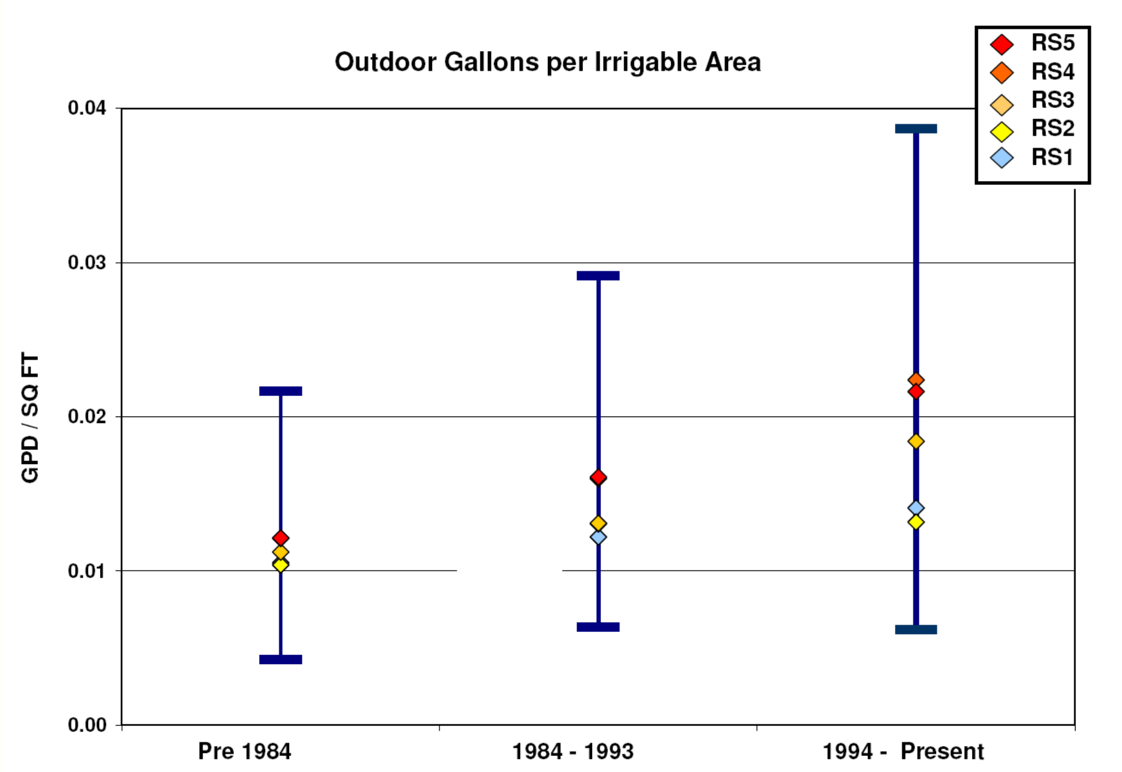


Figure 4.5 Indoor Water Use per Irrigable Area for Single Family Categories

Table 4.10 provides a quartile analysis of the residential accounts within the study. The table shows the ranges in water use metrics across the six residential categories.

Table 4.10 Residential Water Use Quartiles [1,2]

Residential Category	Quartile	WU per Parcel (GPD)	WU/Parcel Area (gpd/sqft)	WU/Building Area (gpd/sqft)	WU/Heated Area (gpd/sqft)
RS1	25%	81	0.009	0.054	0.071
	50%	127	0.015	0.086	0.110
	75%	190	0.024	0.131	0.166
RS2	25%	105	0.009	0.049	0.065
	50%	158	0.014	0.076	0.097
	75%	234	0.023	0.113	0.144
RS3	25%	110	0.009	0.042	0.054
	50%	164	0.014	0.065	0.081
	75%	242	0.023	0.103	0.124
RS4	25%	112	0.009	0.043	0.056
	50%	169	0.014	0.069	0.088
	75%	251	0.023	0.107	0.141
RS5	25%	118	0.008	0.041	0.056
	50%	174	0.014	0.066	0.090
	75%	267	0.022	0.102	0.143
RS6	25%	116	0.012	0.027	0.067
	50%	238	0.028	0.044	0.151
	75%	468	0.054	0.078	0.266

1. Analysis based on billing information provided by 5 pilot utilities and property appraiser data.
2. Months where parcel water use was less than 500 gallons were omitted from the analysis.

The results indicate that the methods for separating residential water use capture unique water-using patterns. The tables and figures also show the wide range or variability that occurs with the residential categories. This variability is consistent with the findings of others (Mayer, 1999 and Dziegielewski and Keifer, 2010) and suggests that each utility has unique factors that are influencing water use in each category. As an example, differences in rate structures are likely to have a significant influence on outdoor water use and the penetration of irrigation wells. The averages presented for each category do not consider these utility specifics. General conclusions drawn from the benchmarks for the residential categories include the following:

- Newer homes with more building square footage are using more water in total but less water on a per-square-foot basis.
- Total outdoor water use has trended upwards and has become more variable in each category
- Higher-value homes are using more water both indoors and outdoors.

4.1.3 In-ground Irrigation Systems

Figures 4.6 to 4. 10 show the penetration of accounts grouped by the year the house was built that are likely to have in-ground irrigation systems using water from the potable water supply. As expected from the results of the benchmarks, Palm Coast and Palm Bay have the fewest irrigation systems connected to the potable supply, but this does not infer that there is less water use from in-ground irrigation systems within these service areas. Comparing the outdoor benchmarks in Figure 4.5 against the trend in homes built with in-ground irrigation gives some insight as to why the new homes are using more water. In addition to estimating the number of systems, it is important to quantify what volume of water these customers are using. Table 4.11 summarizes the percentage of outdoor water that homes identified as using in-ground irrigation systems consumer per utility.

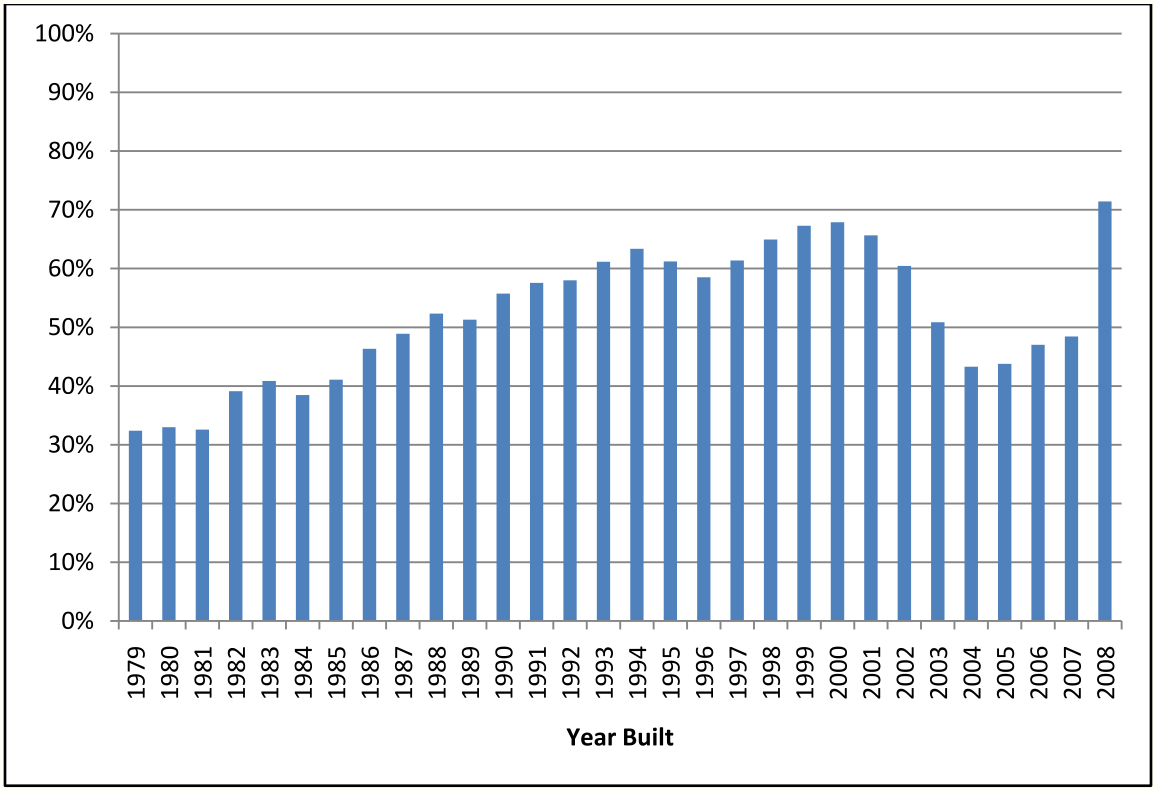


Figure 4.6 GRU – Accounts Likely Using an In-Ground Irrigation System Connected to the Public Water Supply by Year Built

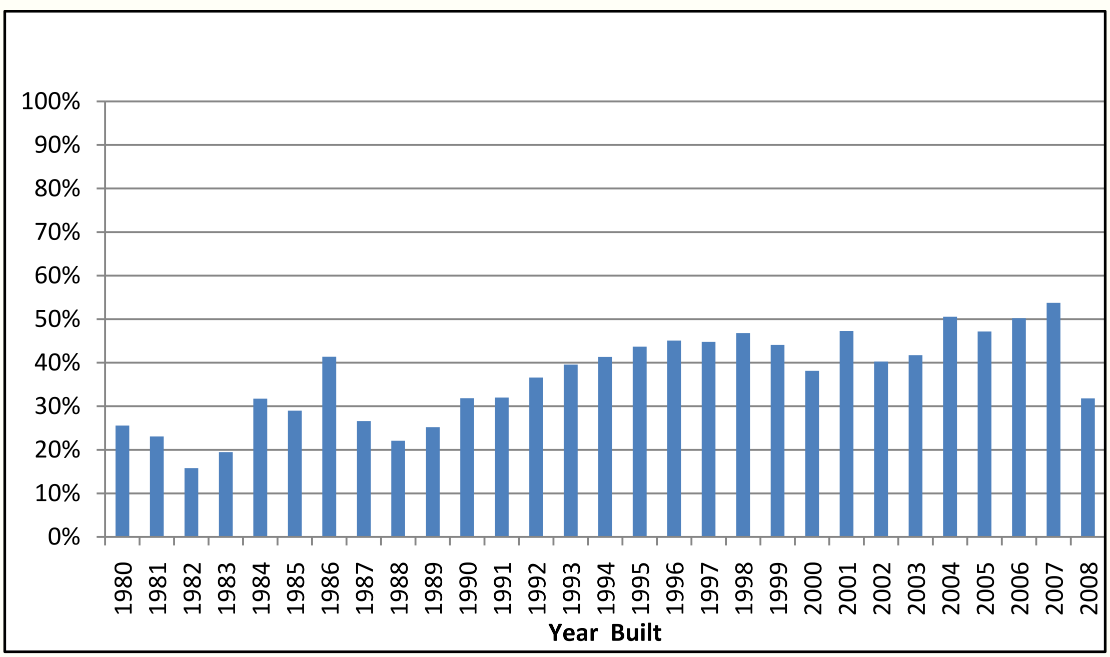


Figure 4.7 Leesburg – Accounts Likely Using an In-Ground Irrigation System Connected to the Public Water Supply by Year Built

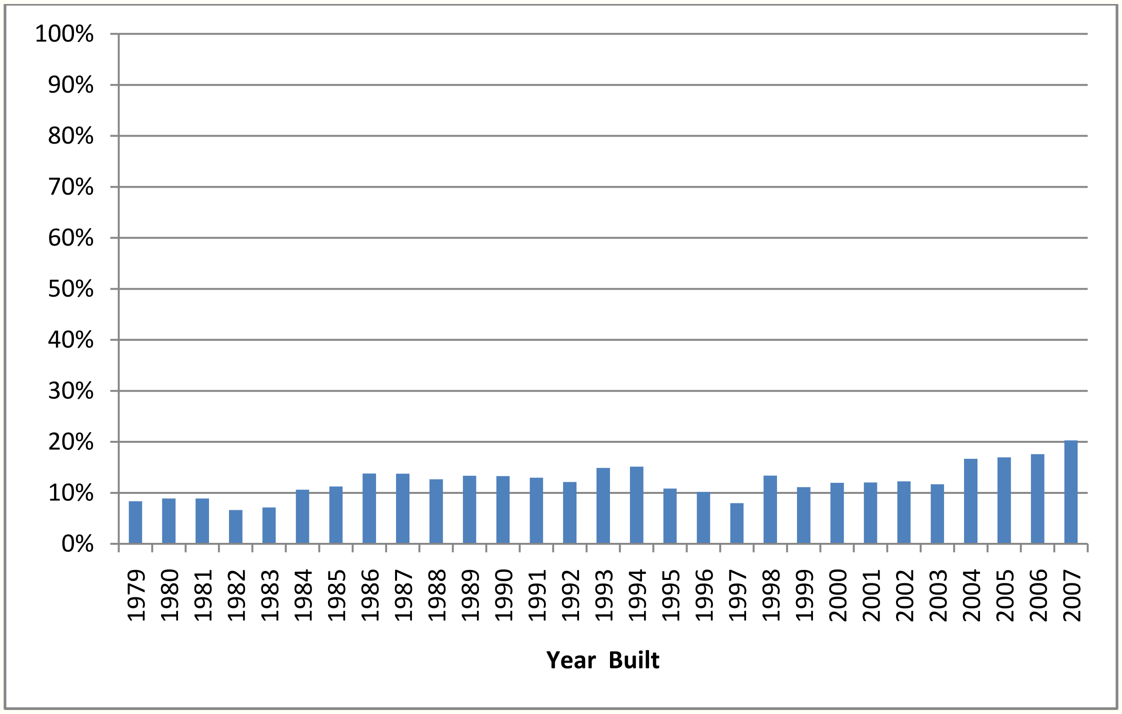


Figure 4.8 Palm Bay – Accounts Likely Using an In-Ground Irrigation System Connected to the Public Water Supply by Year Built

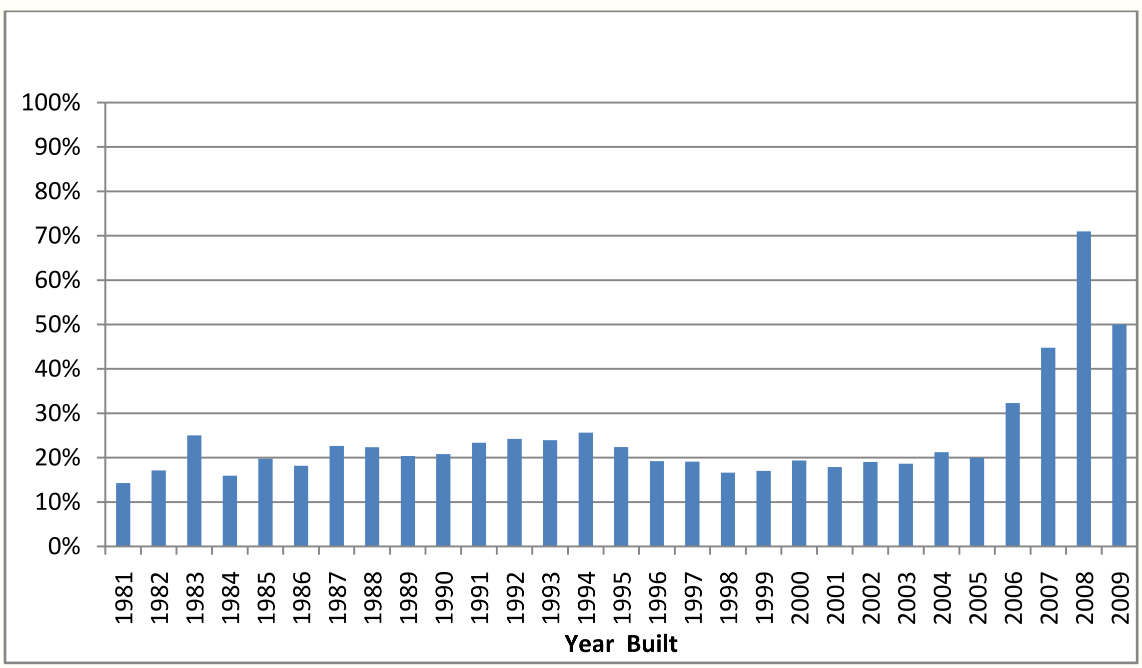


Figure 4.9 Palm Coast – Accounts Likely Using an In-Ground Irrigation System Connected to the Public Water Supply by Year Built

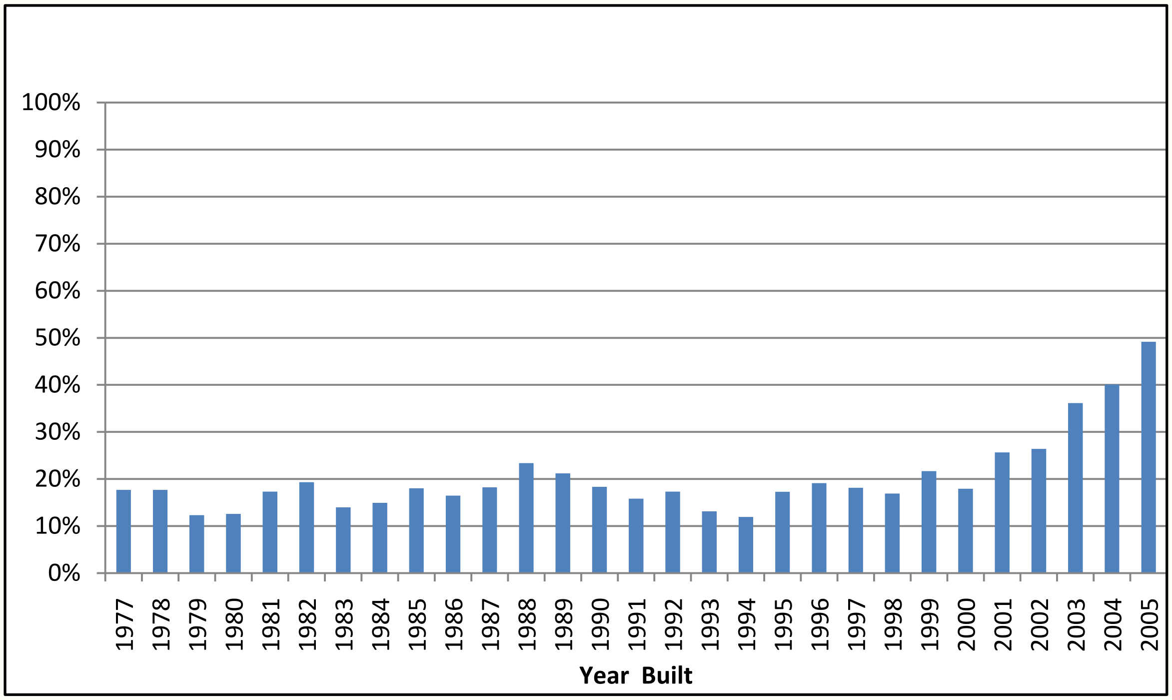


Figure 4.10 SJCUD – Accounts Likely Using an In-Ground Irrigation System Connected to the Public Water Supply by Year Built

Table 4.11 Percentage of Outdoor Water Use by Homes Using In-Ground Irrigations Systems Connected to the Potable Water Supply						
Res Class	Build-Out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RS1	Pre 1984	84%	54%	23%	38%	40%
	1984 - 1993	75%	37%	30%	32%	39%
	1994 to Present	80%	40%	23%	30%	57%
RS2	Pre 1984	89%	67%	27%	41%	42%
	1984 - 1993	84%	67%	33%	41%	39%
	1994 to Present	85%	66%	29%	39%	64%
RS3	Pre 1984	91%	71%	35%	36%	38%
	1984 - 1993	89%	81%	39%	51%	38%
	1994 to Present	94%	78%	34%	47%	72%
RS4	Pre 1984	94%	84%	40%	58%	49%
	1984 - 1993	96%	83%	43%	72%	48%
	1994 to Present	96%	85%	35%	61%	73%
RS5	Pre 1984	97%	80%	49%	50%	67%
	1984 - 1993	98%	85%	45%	75%	68%
	1994 to Present	96%	82%	39%	74%	76%

From the results shown in Table 4.11, customers likely to have in-ground irrigation systems use a significant portion of the outdoor water.

4.2 Commercial Benchmarks

Tables 4.12 through 4.16 include the benchmarks for each utility's top water-using commercial categories. Figure 4.11 displays the range of results for the top five commercial categories across the five utilities. Commercial water use is more variable than residential use, and the number of accounts within each category is small. It is not uncommon for a category to have fewer than 10 accounts that represent water use in a commercial category.

Table 4.12 GRU – Commercial Benchmarks											
	Build- Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	108	1972	397	517,484	10,563	9,161	0.089	0.123	0.018	0.055
	1984 - 1993	44	1987	471	63,549	8,616	6,879	0.087	0.100	0.012	0.021
	1994 to Present	38	1999	894	90,304	10,453	8,918	0.215	0.276	0.021	0.040
HOTELS	Pre 1984	17	1970	5,130	101,706	38,679	30,277	0.161	0.208	0.060	0.047
	1984 - 1993	9	1987	6,635	140,153	54,911	41,721	0.135	0.170	0.046	0.017
	1994 to Present	9	2000	6,154	111,345	64,024	59,989	0.106	0.114	0.062	0.024
INDOOR RECREATION	Pre 1984	113	1966	394	102,831	10,004	8,922	0.055	0.062	0.011	0.018
	1984 - 1993	50	1988	658	166,396	16,855	15,165	0.056	0.060	0.015	0.030
	1994 to Present	31	2000	934	585,734	25,429	23,362	0.056	0.057	0.010	0.019
MANUFACTURING	Pre 1984	39	1971	1,814	227,453	21,379	20,183	0.084	0.095	0.008	0.012
	1984 - 1993	17	1987	756	106,717	33,180	29,669	0.056	0.066	0.010	0.012
	1994 to Present	8	1999	1,345	180,396	32,544	32,138	0.049	0.053	0.014	0.022
OFFICE BUILDINGS	Pre 1984	325	1973	1,045	385,541	17,385	16,521	0.087	0.099	0.020	0.053
	1984 - 1993	249	1988	1,526	561,394	14,878	13,218	0.114	0.136	0.027	0.067
	1994 to Present	149	1999	997	70,628	15,458	14,335	0.094	0.111	0.026	0.046
RESTAURANTS	Pre 1984	64	1968	1,120	21,361	4,758	3,834	0.298	0.377	0.083	0.094
	1984 - 1993	44	1988	1,484	34,608	3,910	3,522	0.455	0.537	0.055	0.049
	1994 to Present	39	1999	1,658	43,591	5,177	4,334	0.367	0.438	0.058	0.097
RETAIL	Pre 1984	179	1971	383	42,317	10,952	8,964	0.063	0.080	0.024	0.090
	1984 - 1993	80	1988	697	186,707	47,796	41,952	0.057	0.065	0.027	0.160

Table 4.12 GRU – Commercial Benchmarks											
	Build- Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
	1994 to Present	56	2000	1,040	157,646	37,555	32,460	0.047	0.058	0.012	0.017
SCHOOLS	Pre 1984	37	1970	510	210,283	22,482	21,698	0.087	0.096	0.014	0.016
	1984 - 1993	47	1988	2,022	824,583	15,484	13,307	0.159	0.187	0.012	0.022
	1994 to Present	11	1999	602	161,273	22,567	21,899	0.045	0.050	0.008	0.011
VACANT OR UNDEFINED	Pre 1984	9	1978	469	235,325	5,116	3,321	0.201	0.618	0.004	0.005
	1984 - 1993	143	1987	729	182,860	3,074	2,306	0.669	2.031	0.030	0.095
	1994 to Present	13	2002	1,007	216,760	4,596	3,553	0.278	0.523	0.018	0.027
WAREHOUSES/STORAGE	Pre 1984	156	1974	262	56,389	12,076	11,320	0.035	0.037	0.008	0.014
	1984 - 1993	56	1988	806	175,623	21,442	20,698	0.088	0.094	0.028	0.110
	1994 to Present	50	1999	571	131,053	20,945	19,887	0.111	0.118	0.008	0.016

Table 4.13 Leesburg – Commercial Benchmarks

	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area[1] (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area[1] (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	72	1961	175	40,847	na	6,462	na	0.068	0.009	0.024
	1984 - 1993	22	1987	248	65,711	na	5,256	na	0.063	0.008	0.010
	1994 to Present	17	2003	810	100,841	na	8,498	na	0.194	0.015	0.027
HOSPITALS	Pre 1984	4	1951	730	80,721	na	42,292	na	0.038	0.013	0.008
	1984 - 1993	7	1987	4,577	251,704	na	7,219	na	3.936	0.074	0.173
	1994 to Present	na	na	na	na	na	na	na	na	na	na
INDOOR RECREATION	Pre 1984	44	1956	318	60,434	na	7,640	na	0.049	0.012	0.018
	1984 - 1993	39	1988	683	117,370	na	8,078	na	0.025	0.012	0.021
	1994 to Present	10	2002	171	242,299	na	9,451	na	0.023	0.003	0.004
LIVE-IN CARE	Pre 1984	8	1952	3,988	73,220	na	16,316	na	0.317	0.068	0.052
	1984 - 1993	2	1991	4,836	172,045	na	35,165	na	0.441	0.054	0.047
	1994 to Present	4	1999	1,004	91,892	na	13,629	na	0.085	0.011	0.003
MANUFACTURING	Pre 1984	32	1966	743	179,777	na	24,915	na	0.053	0.010	0.025
	1984 - 1993	15	1989	739	83,824	na	15,545	na	0.130	0.008	0.008
	1994 to Present	18	2000	1,271	174,821	na	10,607	na	0.173	0.007	0.011
MISCELLANEOUS	Pre 1984	32	1952	1,376	287,370	na	7,476	na	0.380	0.027	0.040
	1984 - 1993	7	1987	2,002	2,238,749	na	5,737	na	0.790	0.282	0.727
	1994 to Present	na	na	na	na	na	na	na	na	na	na
OFFICE BUILDINGS	Pre 1984	165	1959	422	25,936	na	5,587	na	0.129	0.023	0.034
	1984 - 1993	103	1988	982	152,613	na	5,543	na	0.238	0.064	0.303
	1994 to Present	82	2002	285	218,483	na	7,021	na	0.053	0.011	0.019

Table 4.13 Leesburg – Commercial Benchmarks											
	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area[1] (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area[1] (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
RESTAURANTS	Pre 1984	26	1963	849	25,060	na	2,675	na	0.335	0.039	0.026
	1984 - 1993	11	1988	2,138	119,405	na	17,370	na	0.447	0.037	0.022
	1994 to Present	13	2001	2,375	58,994	na	4,840	na	0.479	0.064	0.090
RETAIL	Pre 1984	119	1954	603	54,709	na	12,657	na	0.059	0.019	0.045
	1984 - 1993	26	1987	670	156,537	na	33,508	na	0.101	0.011	0.019
	1994 to Present	47	2002	321	114,590	na	18,980	na	0.076	0.008	0.018
WAREHOUSES/STORAGE	Pre 1984	42	1960	680	70,647	na	16,020	na	0.074	0.011	0.022
	1984 - 1993	8	1985	223	78,744	na	23,211	na	0.014	0.003	0.004
	1994 to Present	40	2002	170	75,418	na	14,894	na	0.012	0.003	0.004
1 Building Area attribute is not available in the County Appraisal Data											

Table 4.14 Palm Bay – Commercial Benchmarks

	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated[1] Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area[1] (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	13	1973	135	47,652	4,229	na	0.032	na	0.004	0.004
	1984 - 1993	18	1987	176	31,723	4,390	na	0.059	na	0.008	0.011
	1994 to Present	14	2000	830	93,435	12,716	na	0.268	na	0.029	0.067
HOTELS	Pre 1984	2	1965	2,203	136,686	32,045	na	0.157	na	0.014	0.009
	1984 - 1993	2	1986	5,985	179,561	59,405	na	0.094	na	0.034	0.026
	1994 to Present	1	2000	3,734	97,655	29,301	na	0.127	na	0.038	0.000
INDOOR RECREATION	Pre 1984	20	1967	343	145,025	12,726	na	0.041	na	0.008	0.011
	1984 - 1993	15	1988	345	168,688	10,429	na	0.031	na	0.003	0.004
	1994 to Present	11	2002	177	308,052	10,705	na	0.017	na	0.001	0.001
LIVE-IN CARE	Pre 1984	2	1972	6,501	211,437	39,442	na	0.191	na	0.041	0.049
	1984 - 1993	1	1986	7,548	209,660	61,311	na	0.123	na	0.036	0.000
	1994 to Present	4	2002	7,959	255,631	45,266	na	0.143	na	0.029	0.018
MANUFACTURING	Pre 1984	10	1971	2,096	618,347	190,799	na	0.025	na	0.006	0.008
	1984 - 1993	4	1987	4,608	301,549	64,227	na	0.457	na	0.016	0.022
	1994 to Present	5	2002	454	4,691,180	33,223	na	0.017	na	0.003	0.004
OFFICE BUILDINGS	Pre 1984	45	1975	259	126,995	11,437	na	0.040	na	0.005	0.007
	1984 - 1993	72	1987	571	152,433	9,269	na	0.068	na	0.006	0.008
	1994 to Present	38	2003	649	439,463	12,689	na	0.078	na	0.008	0.018

Table 4.14 Palm Bay – Commercial Benchmarks											
	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated[1] Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area[1] (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
RESTAURANTS	Pre 1984	16	1972	837	30,638	3,008	na	0.301	na	0.034	0.035
	1984 - 1993	9	1988	1,374	30,922	3,396	na	0.403	na	0.041	0.037
	1994 to Present	15	2001	1,887	47,464	3,707	na	0.499	na	0.038	0.025
RETAIL	Pre 1984	31	1972	263	81,205	14,863	na	0.044	na	0.007	0.010
	1984 - 1993	54	1987	446	105,413	19,439	na	0.094	na	0.010	0.015
	1994 to Present	42	2002	485	90,112	19,350	na	0.046	na	0.006	0.009
SCHOOLS	Pre 1984	5	1976	2,441	758,206	92,151	na	0.047	na	0.004	0.002
	1984 - 1993	7	1989	6,567	1,823,899	159,103	na	0.037	na	0.003	0.003
	1994 to Present	6	2002	895	712,968	26,311	na	0.044	na	0.006	0.011
WAREHOUSES/STORAGE	Pre 1984	22	1979	370	106,904	29,713	na	0.035	na	0.004	0.005
	1984 - 1993	23	1986	223	61,680	14,689	na	0.022	na	0.004	0.004
	1994 to Present	25	2002	87	110,036	24,920	na	0.013	na	0.002	0.002
1 Heated Area attribute is not available in the County Appraisal Data											

Table 4.15 Palm Coast – Commercial Benchmarks

	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	2	1980	234	39,936	4,354	2,222	0.051	0.114	0.006	0.004
	1984 - 1993	4	1990	520	45,052	4,052	3,298	0.160	0.186	0.013	0.006
	1994 to Present	18	1999	898	99,927	8,464	6,789	0.163	0.203	0.014	0.026
HOTELS	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	na	na	na	na	na	na	na	na	na	na
	1994 to Present	7	2002	5,093	170,127	48,501	47,098	0.126	0.135	0.032	0.011
INDOOR RECREATION	Pre 1984	1	1983	221	219,526	7,400	6,800	0.030	0.032	0.001	0.000
	1984 - 1993	5	1989	422	206,057	12,707	12,008	0.039	0.042	0.002	0.002
	1994 to Present	13	2000	840	253,740	11,746	11,201	0.065	0.069	0.004	0.004
LIVE-IN CARE	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	na	na	na	na	na	na	na	na	na	na
	1994 to Present	4	2000	4,409	464,693	48,209	38,240	0.093	0.114	0.015	0.017
MANUFACTURING	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	11	1989	1,886	172,017	27,868	27,530	0.045	0.045	0.009	0.014
	1994 to Present	7	1998	159	86,648	14,410	14,324	0.021	0.022	0.004	0.003
OFFICE BUILDINGS	Pre 1984	2	1976	89	12,684	1,442	1,366	0.065	0.072	0.005	0.007
	1984 - 1993	17	1989	653	210,645	7,019	6,429	0.092	0.103	0.007	0.007
	1994 to Present	71	2001	825	117,336	9,166	8,066	0.115	0.149	0.013	0.021
OUTDOOR RECREATION	Pre 1984	1	1980	7,324	485,032	13,932	12,829	0.526	0.571	0.015	0.000
	1984 - 1993	1	1992	112	1,008,967	399	399	0.282	0.282	0.000	0.000
	1994 to Present	2	2007	5,045	1,492,093	6,214	4,372	0.583	0.815	0.398	0.563

Table 4.15 Palm Coast – Commercial Benchmarks

	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
RESTAURANTS	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	3	1988	1,229	34,300	4,317	3,848	0.298	0.339	0.035	0.018
	1994 to Present	14	2000	2,780	65,577	4,740	4,573	0.647	0.664	0.040	0.021
RETAIL	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	1	1992	746	345,825	58,553	54,211	0.013	0.014	0.002	0.000
	1994 to Present	41	2001	1,739	159,092	37,747	26,197	0.048	0.055	0.009	0.011
SCHOOLS	Pre 1984	na	na	na	na	na	na	na	na	na	na
	1984 - 1993	3	1985	3,852	1,476,550	51,906	51,906	0.045	0.045	0.007	0.007
	1994 to Present	4	2005	7,027	2,154,412	88,012	83,651	0.630	0.646	0.004	0.002

Table 4.16 SJCUD – Commercial Benchmarks

	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	16	1968	264	57,292	9,312	3,210	0.045	0.099	0.009	0.011
	1984 - 1993	8	1987	320	31,961	8,163	6,529	0.078	0.087	0.018	0.022
	1994 to Present	15	2003	1,880	179,914	21,081	11,216	0.105	0.138	0.016	0.046
HOTELS	Pre 1984	12	1965	6,380	119,821	46,057	15,794	0.134	0.431	0.059	0.028
	1984 - 1993	7	1989	3,177	53,370	26,458	19,126	0.138	0.189	0.277	0.634
	1994 to Present	9	2001	7,353	57,242	47,135	40,305	0.149	0.225	0.694	0.921
LIVE-IN CARE	Pre 1984	1	1974	5,880	530,449	31,836	2,483	0.185	2.368	0.011	0.000
	1984 - 1993	5	1987	4,641	200,335	30,256	27,303	0.171	0.194	0.022	0.018
	1994 to Present	2	2001	17,755	907,510	253,579	29,736	0.085	3.737	0.041	0.033
MISCELLANEOUS	Pre 1984	13	1967	2,043	186,545	6,016	2,158	0.187	1.422	0.023	0.026
	1984 - 1993	10	1987	1,687	277,300	5,916	3,486	0.419	0.873	0.036	0.075
	1994 to Present	14	2002	539	764,386	12,136	5,452	0.088	0.137	0.015	0.021
OFFICE BUILDINGS	Pre 1984	36	1971	220	61,732	6,222	3,284	0.068	0.094	0.010	0.013
	1984 - 1993	34	1987	549	144,162	8,250	7,312	0.084	0.120	0.012	0.022
	1994 to Present	70	2002	365	166,061	10,424	8,754	0.047	0.057	0.009	0.013
OUTDOOR RECREATION	Pre 1984	4	1964	1,248	590,700	17,339	2,643	0.134	0.616	0.005	0.007
	1984 - 1993	5	1988	3,356	603,770	5,468	5,468	0.020	0.020	0.090	0.168
	1994 to Present	1	1998	5,018	107,954	97,733	40,989	0.051	0.122	0.046	0.000

Table 4.16 SJCUD – Commercial Benchmarks											
	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg Parcel Size (sqft)	Avg Bld Area (sqft)	Avg Heated Area (sqft)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)	Stdev WU/ Parcel Area (gpd/sqft)
RESTAURANTS	Pre 1984	20	1962	1,393	23,076	3,612	2,828	0.382	0.471	0.182	0.242
	1984 - 1993	12	1987	1,469	264,848	10,970	4,794	0.263	0.316	0.057	0.057
	1994 to Present	20	2000	1,970	66,595	4,636	3,914	0.372	0.467	0.046	0.039
RETAIL	Pre 1984	27	1973	226	28,638	5,065	3,417	0.053	0.077	0.013	0.018
	1984 - 1993	27	1987	1,590	101,386	37,333	13,508	0.064	0.115	0.016	0.019
	1994 to Present	50	2003	1,171	123,992	37,742	19,132	0.091	0.134	0.018	0.032
SCHOOLS	Pre 1984	7	1968	886	186,225	12,772	11,215	0.129	0.226	0.007	0.005
	1984 - 1993	3	1990	4,138	560,178	60,919	27,910	0.069	0.265	0.011	0.013
	1994 to Present	6	2004	1,417	1,640,277	102,658	102,193	0.024	0.025	0.003	0.003
UNKNOWN	Pre 1984	1	1980	437	342,364	58,812	17,392	0.007	0.025	0.001	0.000
	1984 - 1993	77	na	742	175,546	na	na	na	na	0.020	0.041
	1994 to Present	na	na	na	na	na	na	na	na	na	na

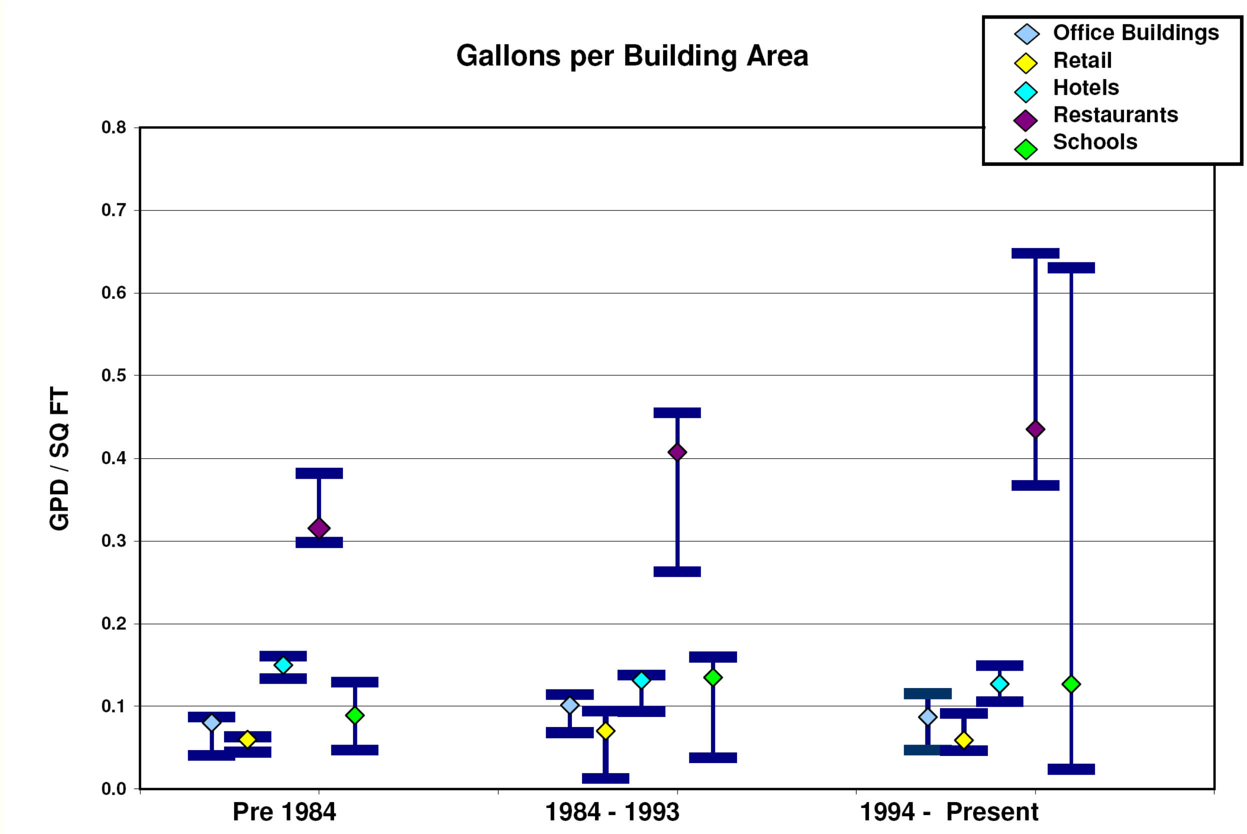


Figure 4.11 Top Five Commercial Category Benchmark Ranges

Table 4.17 provides a quartile analysis of all the accounts within the study for the top commercial categories. The table shows the ranges in water-use metrics across the top commercial categories.

Table 4.17 Quartile Analysis of Top Commercial Water Using Categories[1,2]

Commercial Category	Quartile	WU per Parcel (GPD)	WU/Parcel Area (gpd/sqft)	WU/Building Area (gpd/sqft)	WU/Heated Area (gpd/sqft)
OFFICE BUILDINGS	25%	91	0.003	0.021	0.025
	50%	236	0.009	0.044	0.051
	75%	577	0.021	0.095	0.120
RETAIL	25%	87	0.002	0.010	0.012
	50%	190	0.007	0.025	0.031
	75%	489	0.014	0.061	0.080

Table 4.17 Quartile Analysis of Top Commercial Water Using Categories[1,2]					
Commercial Category	Quartile	WU per Parcel (GPD)	WU/Parcel Area (gpd/sqft)	WU/Building Area (gpd/sqft)	WU/Heated Area (gpd/sqft)
RESTAURANTS	25%	526	0.022	0.184	0.220
	50%	1,075	0.042	0.307	0.362
	75%	1,973	0.076	0.537	0.613
HOTELS	25%	2,394	0.029	0.094	0.111
	50%	4,103	0.052	0.126	0.170
	75%	7,775	0.071	0.182	0.262
SCHOOLS	25%	348	0.002	0.024	0.031
	50%	748	0.005	0.055	0.072
	75%	2,098	0.013	0.124	0.164
MANUFACTURING	25%	101	0.001	0.008	0.011
	50%	289	0.003	0.018	0.023
	75%	756	0.008	0.045	0.060
LIVE-IN CARE	25%	916	0.008	0.066	0.079
	50%	2,057	0.030	0.133	0.149
	75%	6,902	0.045	0.206	0.322
AUTO & REPAIR	25%	86	0.003	0.022	0.023
	50%	191	0.005	0.041	0.048
	75%	414	0.011	0.085	0.114
INDOOR RECREATION	25%	109	0.001	0.016	0.020
	50%	234	0.004	0.032	0.038
	75%	524	0.010	0.067	0.073
WAREHOUSES/STORAGE	25%	63	0.002	0.007	0.009
	50%	145	0.004	0.017	0.018
	75%	338	0.008	0.033	0.037

1. Analysis based on billing information provided by 5 pilot utilities and property appraiser data.

2. Months where parcel water use was less than 500 gallons were omitted from the analysis.

4.3 Fixtures

Tables 4.18 through 4.23 summarize the number of fixtures in each build-out condition for both residential and commercial users. Table 4.22 and 4.23 summarize the fixture counts for the commercial categories. The calculations and summary tables for commercial fixture estimates are included in Appendix F. Fixtures for miscellaneous, unknown, and vacant or undefined categories were not calculated. It should also be noted that the appraisal geodatabases are not consistent with tracking fixture information.

Table 4.18 Estimated Residential Toilets

Category	Build-out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RES - 1	Pre -1984	13,466	3,688	8,064	2,310	5,036
	1984 - 1993	1,394	326	4,328	5,744	1,664
	1994 - Present	380	288	2,280	7,372	2,804
RES - 2	Pre -1984	11,538	2,526	4,546	376	1,730
	1984 - 1993	3,008	692	6,744	2,876	2,024
	1994 - Present	667	1,174	1,184	5,920	3,214
RES - 3	Pre -1984	9,336	666	2,970	136	1,200
	1984 - 1993	4,063	558	6,052	1,550	1,538
	1994 - Present	3,506	3,880	4,174	13,002	8,072
RES - 4	Pre -1984	4,136	332	776	402	762
	1984 - 1993	2,963	297	1,704	1,510	1,002
	1994 - Present	4,204	2,314	5,754	7,742	4,790
RES - 5	Pre -1984	12,423	5,806	1,540	840	2,400
	1984 - 1993	10,615	10,318	2,044	4,148	1,820
	1994 - Present	11,632	2,856	6,540	9,966	5,073
RES - 6	Pre -1984	11,258	1,174	400	70	800
	1984 - 1993	3,960	946	8,502	2,144	26,512
	1994 - Present	5,426	1,300	1,222	2,344	1,702

Table 4.19 Estimated Residential Bathroom Sinks

Category	Build-out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RES - 1	Pre -1984	13,466	3,688	8,064	2,310	5,036
	1984 - 1993	1,394	326	4,328	5,744	1,664
	1994 - Present	380	288	2,280	7,372	2,804
RES - 2	Pre -1984	11,538	2,526	4,546	376	1,730
	1984 - 1993	3,008	692	6,744	2,876	2,024
	1994 - Present	667	1,174	1,184	5,920	3,214

Table 4.19 Estimated Residential Bathroom Sinks						
Category	Build-out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RES - 3	Pre -1984	9,336	666	2,970	136	1,200
	1984 - 1993	4,063	558	6,052	1,550	1,538
	1994 - Present	3,506	3,880	4,174	13,002	8,072
RES - 4	Pre -1984	4,136	332	776	402	762
	1984 - 1993	2,963	297	1,704	1,510	1,002
	1994 - Present	4,204	2,314	5,754	7,742	4,790
RES - 5	Pre -1984	12,423	5,806	1,540	840	2,400
	1984 - 1993	10,615	10,318	2,044	4,148	1,820
	1994 - Present	11,632	2,856	6,540	9,966	5,073
RES - 6	Pre -1984	11,258	1,174	400	70	800
	1984 - 1993	3,960	946	8,502	2,144	26,512
	1994 - Present	5,426	1,300	1,222	2,344	1,702

Table 4.20 Estimated Residential Kitchen Sinks						
Category	Build-out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RES - 1	Pre -1984	6,733	1,844	4,032	1,155	2,518
	1984 - 1993	697	163	2,164	2,872	832
	1994 - Present	190	144	1,140	3,686	1,402
RES - 2	Pre -1984	5,769	1,263	2,273	188	865
	1984 - 1993	1,504	346	3,372	1,438	1,012
	1994 - Present	647	956	1,184	5,920	3,214
RES - 3	Pre -1984	4,666	328	1,485	68	600
	1984 - 1993	2,028	279	3,026	775	769
	1994 - Present	1,753	1,940	2,087	6,501	4,036
RES - 4	Pre -1984	2,064	160	388	201	381
	1984 - 1993	1,480	148	852	755	501
	1994 - Present	2,102	1,154	2,877	3,871	2,395
RES - 5	Pre -1984	2,474	1,153	308	168	480
	1984 - 1993	2,400	2,153	511	1,037	455
	1994 - Present	3,787	924	2,180	3,322	1,691
RES - 6	Pre -1984	5,629	587	200	35	400
	1984 - 1993	1,980	473	4,251	1,072	13,256
	1994 - Present	2,713	650	611	1,172	851

Table 4.21 Estimated Residential Showers						
Category	Build-out Condition	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
RES - 1	Pre -1984	13,466	3,688	8,064	2,310	5,036
	1984 - 1993	1,394	326	4,328	5,744	1,664
	1994 - Present	380	288	2,280	7,372	2,804
RES - 2	Pre -1984	8,654	1,895	3,410	282	1,298
	1984 - 1993	2,256	519	5,058	2,157	1,518
	1994 - Present	344	696	592	2,960	1,607
RES - 3	Pre -1984	7,003	502	2,228	102	900
	1984 - 1993	3,049	419	4,539	1,163	1,154
	1994 - Present	2,630	2,910	3,131	9,752	6,054
RES - 4	Pre -1984	3,104	252	582	302	572
	1984 - 1993	2,223	223	1,278	1,133	752
	1994 - Present	3,153	1,737	4,316	5,807	3,593
RES - 5	Pre -1984	11,186	5,230	1,386	756	2,160
	1984 - 1993	9,415	9,242	1,789	3,630	1,593
	1994 - Present	9,739	2,394	5,450	8,305	4,228
RES - 6	Pre -1984	11,258	1,174	400	70	800
	1984 - 1993	3,960	946	8,502	2,144	26,512
	1994 - Present	5,426	1,300	1,222	2,344	1,702

Table 4.22 Total Number of Commercial Toilets					
Year Structure Built	Utility				
	GRU	Leesburg	Palm Bay	Palm Coast	SJCUD
Pre-1984	6,135	1,943	1,300	53	1,720
1984 - 1993	3,627	784	1,701	458	1,042
1994 - Present	3,220	885	1,013	2,822	3,118

Table 4.23 Number of Commercial Plumbing Fixtures in Top Water Using Categories[1, 2]					
Utility	Year Structure Built	Plumbing Fixture			
		Urinals	Bathroom Sinks	Kitchen Sinks	Showers
GRU	Pre-1984	2,040	5,639	735	1,755
	1984 - 1993	1,122	3,379	348	1,240
	1994 - Present	874	3,038	238	1,363

Table 4.23 Number of Commercial Plumbing Fixtures in Top Water Using Categories[1, 2]					
Utility	Year Structure Built	Plumbing Fixture			
		Urinals	Bathroom Sinks	Kitchen Sinks	Showers
Leesburg	Pre-1984	745	1,718	367	495
	1984 - 1993	309	664	134	175
	1994 - Present	285	824	148	337
Palm Bay	Pre-1984	528	1,207	139	276
	1984 - 1993	677	1,630	140	368
	1994 - Present	436	947	126	293
Palm Coast	Pre-1984	20	43	7	9
	1984 - 1993	208	418	52	47
	1994 - Present	986	2,729	151	1,076
SJCUD	Pre-1984	201	1,648	83	1,311
	1984 - 1993	324	999	56	493
	1994 - Present	1,062	3,059	97	1,487

1. Estimates number of fixtures in top ten commercial users for each utility.
2. Excludes miscellaneous, unknown, and undefined categories.

4.4 Reclaimed Water

The amount of reuse within each utility is provided in Table 4.24 and was determined by referencing FDEP's 2008 Reuse Inventory Report (FDEP, 2010).

Table 4.24 Reuse Flow within Each Utility[1]	
Utility	Reuse System (MGD)
GRU	3.631
Leesburg	3.2
Palm Bay	0.707
Palm Coast	4.53
SJCUD	1.273

1. *Source data: FDEP's 2008 Reuse Inventory Report*

4.5 Private Wells

Table 4.25 shows the percentage of domestic and private wells per active account and the number of domestic and private wells per square mile in each service area.

Table 4.25 Domestic and Private Wells per Service Area

Pilot Utility	Domestic & Private Wells	Active Accounts	Percentage of Domestic & Private Wells / Active Accounts	Wells / SQMI
GRU	259	65,772	0.39%	1.39
Leesburg	181	25,044	0.72%	2.05
Palm Bay	4,290	32,745	13.10%	21.24
Palm Coast	108	42,384	0.25%	0.78
SJCUD	1,368	26,357	5.19%	3.09

Table 4.26 shows the percentage of irrigation wells per active accounts and the number of wells per square mile in each service area.

Table 4.26 Irrigation Wells per Service Area

Pilot Utility	Irrigation Wells	Active Accounts	Percentage of Irrigation Wells / Active Accounts	Wells / SQMI
GRU	95	65,772	0.14%	0.51
Leesburg	16	25,044	0.06%	0.18
Palm Bay	2,296	32,745	7.01%	11.37
Palm Coast	737	42,384	1.74%	5.35
SJCUD	1,259	26,357	4.78%	2.84

The District can use the percentages or wells per square mile in the tables above to estimate the number of wells per account District-wide. Table 4.26 illustrates that there are different densities of private wells within different service areas. Based on the benchmark analyses, the utilities with a higher irrigation well density have lower outdoor usage than the utility supply. It is also important to note the limitations of the data. The number of wells within the datasets is considered low and likely only reflects fairly recent installations. The District will need additional information to make an accurate assessment of irrigation wells in the utility SABs.

5.0 Estimating Water Conservation Potential

5.1 Retail Water Use

5.1.1 Existing Retail Water Use

Jones Edmunds used the benchmarks for residential and commercial water use for estimating existing and future water use within each category. Tables 5.1 and 5.2 compare the estimates to the billing data summary for each utility. There are several reasons for the differences in each utility:

- Residential parcels that have accounts without property information are assigned a build-out condition of 2 and a residential category representative of the dwelling unit densities for the parcel.
- For high-density residential and some commercial parcels, water use is generally underestimated because meters servicing the high-density or commercial property fall outside the parcel or are only attributed to one of many parcels that are a part of the multifamily complex.
- For commercial accounts without property information, the parcel is dropped from the analysis. This is most notable in the GRU service area, where property data is limited on many state- and federally-owned properties (Table 5.2).
- For commercial water use, only the top 10 water-use categories re accounted for in the analysis.

Table 5.1 Estimated Retail Use vs. Billing Data				
Utility	2010 Estimated Retail Use (MGD)			2008-2009 Meter Readings (MGD)
	Residential	Commercial	Total	
Gainesville	12.0	2.9	14.9	18.7
Leesburg	5.1	1.1	6.2	6.6
Palm Bay	5.3	0.7	6.0	4.9
Palm Coast	5.5	0.6	6.1	6.5
SJCUD	5.6	0.8	6.4	6.7

Table 5.2 Non Residential Retail Water Use		
Utility	Estimated Retail Use (MGD) [1]	Avg. 2008-2009 Meter Readings (MGD)[2]
Gainesville	2.9	6.0
Leesburg	1.1	1.5
Palm Bay	0.7	1.6
Palm Coast	0.6	0.7
SJCUD	0.8	1.2

1 Retail water use includes the top ten water using categories for each utility
2 Non-residential meter readings include utility, government, construction, commercial, industrial, and other non-residential categories.

5.1.2 Future Retail Water Use

Jones Edmunds estimated the future retail use in each category for each utility by applying the methods in Section 3 and the benchmarks for the most recent build-out categories (Table 5.3). The estimated retail use excludes outdoor water use to be served by reclaimed water and only projects the top 10 water-using categories for each utility. It should be noted that the method used in projecting future water use relies on a spatial dataset that has a different geometry than the billing data. This results in parcels being incorrectly attributed as currently served and future-served parcels. In areas that have experienced significant growth, such as Flagler County (Palm Coast), there are inconsistencies caused by land that has been subdivided that are not reflected in the population dataset.

Table 5.3 Estimated Increases in Retail Water Use (2010 to 2030)		
Utility	Increase in Retail Use (MGD)	
	Residential	Commercial
Gainesville	3.7	0.8
Leesburg	1.6	0.7
Palm Bay	4.3	0.8
Palm Coast	3.6	1.4
SJCUD	7.2	2.0

5.2 Conservation Potential

After calculating water use for each existing and future parcel, Jones Edmunds calculated water savings potential and implementation costs for each applicable conservation practice. During this phase there were several interactions with the District and the utilities, and changes were made to accommodate the issues raised. The results shown in this section are summarized from the results for each utility provided in Appendices H to L.

5.2.1 Passive Savings

Table 5.4 provides the passive replacement rates for each of the conservation practices. The rates are derived from market saturation studies (EBMUD, 2002 and Orange County, 2002) and correspondence with local irrigation contractors.

Table 5.4 Passive Savings Rates	
BMP	PASSIVE REPLACEMENT RATE (%/YR)
Low Flow Volume Showerhead Replacement - INDOOR	5
High Efficiency Showerhead Replacement – INDOOR	2.5[1]
Low Flow Faucet Aerator Replacement – INDOOR	5
Ultra Low Flush Toilet Replacement Program - INDOOR	4
High Efficiency Toilet Replacement Program - INDOOR	2[2]
High Efficiency Clothes Washer Replacement - INDOOR	6.7
High Efficiency Dishwashers - INDOOR	6.7
Urinal Replacement Program - INDOOR	3
Waterless Urinal Replacement Program - INDOOR	0
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0
Water Reuse/Recycling Laundry Machines – INDOOR	0

Table 5.4 Passive Savings Rates	
BMP	PASSIVE REPLACEMENT RATE (%/YR)
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0
Submetering Billing of Apartment Units - INDOOR	0
Efficient Irrigation Systems (non turf) - OUTDOOR	0
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0
Landscape Replacement Program - OUTDOOR	0
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0

1 Assumed to be ½ of the low flow volume shower head replacement rate from EBMUD and Orange County (2002).
2 Assumed to be ½ of the ultra low flow volume shower head replacement rate from EBMUD and Orange County (2002).

5.2.2 Saturation Rates

The assumed saturation rates are one factor that received considerable discussion during this phase of the project. Initial results assumed a 90% saturation rate for all conservation practices. After additional discussion and comparisons to other similar efforts by SWFWMD and saturation standards applied in other states, the team modified the saturation rates as follows:

- All indoor practices were set to achieve a saturation goal of 75%.
- Outdoor BMPs—where savings are applied to irrigation water, such as soil moisture sensors, single-family ET controllers, and non-turf irrigation systems—were set to a 75% saturation goal.
- Other outdoor BMPs (landscape replacement) were set to a saturation goal of 50% to acknowledge that there are additional challenges with implementing these particular BMPs, such as public perception and health, practicality, and conducive site conditions.

While the saturation rates were reduced, it is believed they still represent the potential savings that would be achieved with an aggressive implementation program.

5.2.3 Implementation Periods

Jones Edmunds analyzed four implementation scenarios (1-, 5-, 10-, and 20-year) as part of the Pilot Study. For each scenario, it was assumed that all conservation practices had the same implementation period. The implementation period affects the split between passive savings and program savings and the program implementation costs. The longer the implementation period, the more passive savings accumulate, thereby reducing program savings and program implementations, which in turn reduce the cost of conservation. Therefore, the longer the implementation period, the lower the costs of achieving savings related to conservation and more efficient water use. Table 5.5 summarizes the differences in passive savings and program savings as the implementation period changes. Table 5.6 summarizes the costs associated with each implementation period.

Table 5.5 Passive and Program Savings for 1, 5, 10, and 20-year Implementation Periods (GPD)[1]

Utility	1-yr		5-yr		10-yr		20-yr	
	Passive Savings	Program Savings	Passive Savings	Program Savings	Passive Savings	Program Savings	Passive Savings	Program Savings
GRU	741,000	2,750,000	717,000	2,646,000	973,000	2,515,000	1,065,000	2,346,000
Leesburg	199,000	1,339,000	231,000	1,305,000	271,000	1,265,000	301,000	1,210,000
Palm Bay	485,000	1,073,000	539,000	1,019,000	611,000	947,000	664,000	585,000
Palm Coast	298,000	1,227,000	342,000	1,180,000	400,000	1,124,000	450,000	1,057,000
SJCUD	330,000	2,104,000	377,000	2,055 ,000	437,000	1,998,000	487,000	1,926,000
Total	2,053,000	8,493,000	2,206,000	6,150,000	2,692,000	7,849,000	2,967,000	7,124,000

1. Program Savings at 2030 including O&M Savings

Table 5.6 Present Value Program Costs for 1-, 5-, 10-, and 20-year Implementation Periods[1,2]				
Utility	1-year	5-year	10-year	20-year
GRU	$16,506,000	$15,373,000	$13,962,000	$12,007,000
Leesburg	$5,376,000	$5,016,000	$4,572,000	$3,946,000
Palm Bay	$10,262,000	$9,546,000	$8,618,000	$7,474,000
Palm Coast	$8,718,000	$8,168,000	$7,502,000	$6,666,000
SJCUD	$8,315,000	$7,926,000	$7,480,000	$6,830,000

1. 20% Contingency added to Program Costs
2. Includes O&M Costs

5.2.4 Cost-Effective Analysis

The 20-year implementation scenario is the most cost effective and is presented in this section for each utility. Tables 5.7 to 5.11 provide a summary of the 20-year implementation scenarios with a cost threshold of $4.00/kgal. A 20% cost contingency has been applied to the bottom-line costs.

Table 5.7 GRU Cost Effective Analysis Summary (20-year Implementation)

Global Conservation Practice - O&M	Annual Cost ($/yr)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Conservation Coordinator and Customer Education – GLOBAL	$65,000	141,000	$810,000	$1.26
Aggressive Meter Monitoring Program - GLOBAL	$399,000	283,000	$4,974,000	$3.86
Subtotals	$464,000	424,000	$5,784,000	$3.00

Residential Conservation Practice	Passive Savings (gpd)	Program Savings (gpd)	Program Capital Cost (PV)	Unit Cost ($/kgal)
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	145,000	62,000	$676,000	$2.40
Ultra Low Flush Toilet Replacement Program - INDOOR	337,000	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	0	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	281,000	0	$0	$0.00
High Efficiency Clothes Washer Replacement - INDOOR	91,000	0	$0	$0.00
High Efficiency Dishwashers - INDOOR	33,000	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	91,000	$0	$0.00
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0	876,000	$3,190,000	$0.80
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0	0	$0	$0.00
Submetering Billing of Apartment Units - INDOOR	0	0	$0	$0.00
Efficient Irrigation Systems (non turf) - OUTDOOR	0	0	$0	$0.00
Landscape Replacement Program - OUTDOOR	0	0	$0	$0.00
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0	726,000	$0	$0.00
Subtotals	887,000	1,836,000	$3,866,000	$0.46

Commercial Conservation Practice	Passive Savings (gpd)	Program Savings (gpd)	Program Capital Cost (PV)	Unit Cost ($/kgal)
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	4,000	1,000	$15,000	$3.30
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	55,000	21,000	$296,000	$3.10
Low Flow Faucet Aerator Replacement - INDOOR	83,000	0	$0	$0.00
Urinal Replacement Program - INDOOR	36,000	2,000	$22,000	$2.42
Waterless Urinal Replacement Program - INDOOR	0	0	$0	$0.00
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0	27,000	$23,000	$0.19
Water Reuse/Recycling Laundry Machines – INDOOR	0	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	32,000	$0	$0.00
Subtotals	178,000	86,000	$356,000	$0.94

Summary	Passive Savings (gpd)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Total Savings and Program Cost over 20-yr Horizon	1,065,000	2,346,000	$10,006,000	$0.94
Costs with 20% Contingency			$12,007,000	$1.13

Table 5.8 Leesburg – Cost Effective Analysis Summary (20-year Implementation)

Global Conservation Practice - O&M	Annual Cost ($/yr)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Conservation Coordinator and Customer Education – GLOBAL	$65,000	61,000	$810,000	$2.92
Aggressive Meter Monitoring Program - GLOBAL	$91,000	122,000	$1,140,000	$2.05
Subtotals	$156,000	183,000	$1,950,000	$2.34
Residential Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	35,000	17,000	$243,000	$3.14
Ultra Low Flush Toilet Replacement Program - INDOOR	90,000	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	0	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	87,000	0	$0	$0.00
High Efficiency Clothes Washer Replacement - INDOOR	24,000	0	$0	$0.00
High Efficiency Dishwashers - INDOOR	9,000	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	26,000	$0	$0.00
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0	469,000	$1,020,000	$0.48
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0	0	$0	$0.00
Submetering Billing of Apartment Units - INDOOR	0	0	$0	$0.00
Efficient Irrigation Systems (non turf) - OUTDOOR	0	500	$7,350	$3.58
Landscape Replacement Program - OUTDOOR	0	0	$0	$0.00
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0	422,000	$0	$0.00
Subtotals	245,000	981,452	$1,270,350	$0.28
Commercial Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	2,000	1,100	$3,000	$0.60
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	17,000	8,000	$47,000	$1.29
Low Flow Faucet Aerator Replacement - INDOOR	25,000	0	$0	$0.00
Urinal Replacement Program - INDOOR	12,000	1,500	$12,000	$1.76
Waterless Urinal Replacement Program - INDOOR	0	0	$0	$0.00
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0	16,000	$6,000	$0.08
Water Reuse/Recycling Laundry Machines – INDOOR	0	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	19,000	$0	$0.00
Subtotals	56,000	45,600	$68,000	$0.33
Summary	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Program Capital + Annual O&M**	**Unit Cost ($/kgal)**
Total Savings and Program Cost over 20-yr Horizon	301,000	1,210,000	$3,288,000	$0.60
Costs with 20% Contingency			$3,946,000	$0.72

Table 5.9 Palm Bay – Cost Effective Analysis Summary (20-year Implementation)

Global Conservation Practice - O&M	Annual Cost ($/yr)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Conservation Coordinator and Customer Education – GLOBAL	$65,000	86,000	$810,000	$2.07
Aggressive Meter Monitoring Program - GLOBAL	$337,000	173,000	$4,204,000	$5.34
Subtotals		259,000	$5,014,000	$4.26

Residential Conservation Practice	Passive Savings (gpd)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	90,000	32,000	$357,000	$2.45
Ultra Low Flush Toilet Replacement Program - INDOOR	273,000	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	0	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	192,000	0	$0	$0.00
High Efficiency Clothes Washer Replacement - INDOOR	52,000	0	$0	$0.00
High Efficiency Dishwashers - INDOOR	19,000	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	191,000	$0	$0.00
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0	92,000	$838,000	$2.00
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0	0	$0	$0.00
Submetering Billing of Apartment Units - INDOOR	0	0	$0	$0.00
Efficient Irrigation Systems (non turf) - OUTDOOR	0	0	$0	$0.00
Landscape Replacement Program - OUTDOOR	0	0	$0	$0.00
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0	217,000	$0	$0.00
Subtotals	626,000	556,000	$1,195,000	$0.47

Commercial Conservation Practice	Passive Savings (gpd)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	1,000	500	$5,000	$2.20
Ultra Low Flush Toilet Replacement Program - INDOOR	14,000	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	0	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	16,000	0	$0	$0.00
Urinal Replacement Program - INDOOR	7,000	600	$8,000	$2.93
Waterless Urinal Replacement Program - INDOOR	0	0	$0	$0.00
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0	9,000	$6,000	$0.15
Water Reuse/Recycling Laundry Machines – INDOOR	0	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	33,000	$0	$0.00
Subtotals	38,000	43,100	$19,000	$0.10

Summary	Passive Savings (gpd)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Total Savings and Program Cost over 20-yr Horizon	664,000	858,000	$6,228,000	$1.60
Costs with 20% Contingency			$7,474,000	$1.92

Table 5.10 Palm Coast – Cost Effective Analysis Summary (20-year Implementation)

Global Conservation Practice - O&M	Annual Cost ($/yr)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Conservation Coordinator and Customer Education – GLOBAL	$65,000	81,000	$810,000	$2.20
Aggressive Meter Monitoring Program - GLOBAL	$236,000	163,000	$2,947,000	$3.97
Subtotals	$301,000	244,000	$3,757,000	$3.39
Residential Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	33,000	16,000	$211,000	$2.90
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	136,000	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	179,000	0	$0	$0.00
High Efficiency Clothes Washer Replacement - INDOOR	53,000	0	$0	$0.00
High Efficiency Dishwashers - INDOOR	18,000	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	129,000	$0	$0.00
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0	175,000	$1,574,000	$1.98
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0	0	$0	$0.00
Submetering Billing of Apartment Units - INDOOR	0	0	$0	$0.00
Efficient Irrigation Systems (non turf) - OUTDOOR	0	0	$0	$0.00
Landscape Replacement Program - OUTDOOR	0	0	$0	$0.00
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0	442,000	$0	$0.00
Subtotals	419,000	762,000	$1,785,000	$0.51
Commercial Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	1,000	200	$3,000	$3.30
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	7,000	0	$3,000	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	17,000	0	$0	$0.00
Urinal Replacement Program - INDOOR	6,000	200	$1,000	$1.10
Waterless Urinal Replacement Program - INDOOR	0	0	$0	$0.00
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0	10,000	$6,000	$0.13
Water Reuse/Recycling Laundry Machines – INDOOR	0	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	37,000	$0	$0.00
Subtotals	31,000	51,400	$13,000	$0.06
Summary	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Total Savings and Program Cost with 20% Contingency over 20-yr Horizon	450,000	1,057,000	$5,555,000	$1.16
Costs with 20% Contingency			$6,666,000	$1.39

Table 5.11 SJCUD – Cost Effective Analysis Summary (20-year Implementation)

Global Conservation Practice - O&M	Annual Cost ($/yr)	Program Savings (gpd)	Capital (PV)	Unit Cost ($/kgal)
Conservation Coordinator and Customer Education – GLOBAL	$65,000	115,000	$810,000	$1.55
Aggressive Meter Monitoring Program - GLOBAL	$274,415	230,000	$3,420,000	$3.27
Subtotals	$339,415	345,000	$4,230,000	$2.70
Residential Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	45,000	19,000	$170,000	$1.97
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	142,000	0	$0	$0.00
Low Flow Faucet Aerator Replacement - INDOOR	186,000	0	$0	$0.00
High Efficiency Clothes Washer Replacement - INDOOR	52,000	0	$0	$0.00
High Efficiency Dishwashers - INDOOR	18,000	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	246,000	$0	$0.00
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	0	221,000	$1,247,000	$1.24
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	0	0	$0	$0.00
Submetering Billing of Apartment Units - INDOOR	0	0	$0	$0.00
Efficient Irrigation Systems (non turf) - OUTDOOR	0	0	$0	$0.00
Landscape Replacement Program - OUTDOOR	0	0	$0	$0.00
Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR	0	994,000	$0	$0.00
Subtotals	443,000	1,480,000	$1,417,000	$0.21
Commercial Conservation Practice	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Low Flow Volume Showerhead Replacement - INDOOR	0	0	$0	$0.00
High Efficiency Showerhead Replacement - INDOOR	4,000	600	$7,000	$2.56
Ultra Low Flush Toilet Replacement Program - INDOOR	0	0	$0	$0.00
High Efficiency Toilet Replacement Program - INDOOR	12,000	2,000	$26,000	$2.86
Low Flow Faucet Aerator Replacement - INDOOR	21,000	0	$0	$0.00
Urinal Replacement Program - INDOOR	7,000	400	$4,000	$2.20
Waterless Urinal Replacement Program - INDOOR	0	0	$0	$0.00
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	0	13,000	$8,000	$0.14
Water Reuse/Recycling Laundry Machines – INDOOR	0	0	$0	$0.00
Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR	0	85,000	$0	$0.00
Subtotals	44,000	101,000	$45,000	$0.10
Summary	**Passive Savings (gpd)**	**Program Savings (gpd)**	**Capital (PV)**	**Unit Cost ($/kgal)**
Total Savings and Program Cost over 20-yr Horizon	487,000	1,926,000	$5,692,000	$0.65
Costs with 20% Contingency			$6,830,000	$0.78

Table 5.12 summarizes the amount of savings and costs that come from the existing customer base. The average equivalent unit cost of programs focused on existing customers is $1.90/kgal.

Table 5.12 Cost Effective Conservation Savings from Existing Customers

Utility	Program Savings (gpd)	Program Capital Costs[1]	Annual O&M Costs[1]	Percent Savings of Existing Retail Use
GRU	1,313,000	$5,066,000	$516,000	9%
Leesburg	651,000	$1,606,000	$172,000	10%
Palm Bay	277,000	$1,457,000	$346,000	5%
Palm Coast	349,000	$2,158,000	$287,000	6%
SJCUD	408,000	$1,754,000	$308,000	6%

1. Includes a 20% contingency

The most cost-effective water savings associated with future water use can be achieved by adopting high-efficiency ordinances and modifying land development codes. These practices make up between 21% and 56% of the total water-savings potential in 2030 across the five utilities.

There are nearly 500 combinations of water use and conservation practices. From these combinations it is interesting to see the lower range of the equivalent unit cost and present-value costs divided by water savings by 2030 as shown in Table 5.13. Generally, the most cost-effective practices for residential conservation are soil moisture sensors, high-efficiency showerheads, and faucet aerators. Non-turf efficiency programs and toilet retrofits, are the next level of cost-effective alternatives, while programs like landscape replacement, clothes washers, dishwashers, and submetering are the most expensive.

The costs for commercial are much less than those for residential. This is likely the result of inaccurate estimates of end uses and fixtures within the commercial categories.

Table 5.13 Lowest Equivalent Units and Present Value Costs for Each Conservation Practice (1-year Implementation)		
Conservation Practice	$/kgal	$/GPD
Residential		
Low Flow Volume Showerhead Replacement - INDOOR	$2.36	$10.76
High Efficiency Showerhead Replacement - INDOOR	$1.41	$6.40
Low Flow Faucet Aerator Replacement - INDOOR	$1.18	$5.37
Ultra Low Flush Toilet Replacement Program - INDOOR	$5.08	$23.13
High Efficiency Toilet Replacement Program - INDOOR	$6.95	$31.63
High Efficiency Clothes Washer Replacement - INDOOR	$13.84	$62.95
High Efficiency Dishwashers - INDOOR	$113.74	$517.38
Submetering Billing of Apartment Units - INDOOR	$59.54	$270.81
Efficient Irrigation Systems (non turf) - OUTDOOR	$3.58	$16.27
Install Soil Moisture Sensor Shut-off Devices - OUTDOOR	$0.23	$1.02
Install Single Family Advanced ET Irrigation Controllers - OUTDOOR	$0.30	$1.37
Landscape Replacement Program - OUTDOOR	$8.51	$38.73
Commercial		
Low Flow Volume Showerhead Replacement - INDOOR	$0.04	$0.18
High Efficiency Showerhead Replacement - INDOOR	$0.02	$0.10
Low Flow Faucet Aerator Replacement - INDOOR	$0.04	$0.17
Ultra Low Flush Toilet Replacement Program - INDOOR	$0.43	$1.96
High Efficiency Toilet Replacement Program - INDOOR	$0.51	$2.30
Urinal Replacement Program - INDOOR	$0.42	$1.90
Waterless Urinal Replacement Program - INDOOR	$0.47	$2.13
Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR	$0.03	$0.12
Water Reuse/Recycling Laundry Machines – INDOOR	$8.47	$38.51

5.2.5 Maximum Water Savings

Table 5.14 provides a summary of the maximum water-savings potential that can be achieved regardless of cost, assuming a 90% saturation rate for all conservation practices. It is important to note that maximum water-savings potential is greater than cost-effective water savings potential because cost is not a limiting factor when determining maximum potential.

Table 5.14 Summary of Maximum Water-Savings Potential		
Utility	Maximum Savings Potential (gpd)	Conservation Practices with Maximum Water Savings Potential
GRU	3,805,000	High Efficiency Showerhead, High Efficiency Toilet, High Efficiency Clothes Washer, High Efficiency Dishwasher, Low Faucet Aerator, Submetering of Apartment Units, Waterless Urinals, Water Reuse/Recycling Laundry Machines, Commercial Kitchen Pre-Rinse Spray Valve Replacement, Aggressive Meter Monitoring Program, Conservation Coordinator and Customer Education
Leesburg	1,958,000	Landscape Replacement Program, High Efficiency Showerhead, High Efficiency Toilet, High Efficiency Clothes Washer, High Efficiency Dishwasher, Low Faucet Aerator, Submetering of Apartment Units, Waterless Urinals, Water Reuse/Recycling Laundry Machines, Commercial Kitchen Pre-Rinse Spray Valve Replacement, Aggressive Meter Monitoring Program, Conservation Coordinator and Customer Education
Palm Bay	1,3434,000	Landscape Replacement Program, High Efficiency Showerhead, High Efficiency Toilet, High Efficiency Clothes Washer, High Efficiency Dishwasher, Low Faucet Aerator, Submetering of Apartment Units, Waterless Urinals, Water Reuse/Recycling Laundry Machines, Commercial Kitchen Pre-Rinse Spray Valve Replacement, Aggressive Meter Monitoring Program, Conservation Coordinator and Customer Education
Palm Coast	1,526,000	Landscape Replacement Program, High Efficiency Showerhead, High Efficiency Toilet, High Efficiency Clothes Washer, High Efficiency Dishwasher, Low Faucet Aerator, Submetering of Apartment Units, Waterless Urinals, Water Reuse/Recycling Laundry Machines, Commercial Kitchen Pre-Rinse Spray Valve Replacement, Aggressive Meter Monitoring Program, Conservation Coordinator and Customer Education
SJCUD	2,455,000	Landscape Replacement Program, High Efficiency Showerhead, High Efficiency Toilet, High Efficiency Clothes Washer, High Efficiency Dishwasher, Low Faucet Aerator, Submetering of Apartment Units, Waterless Urinals, Water Reuse/Recycling Laundry Machines, Commercial Kitchen Pre-Rinse Spray Valve Replacement, Aggressive Meter Monitoring Program, Conservation Coordinator and Customer Education

5.2.6 Using Computerized Systems to apply BMPs

Customer information systems (CIS) or computer maintenance management systems (CMMS) can be utilized by a utility to target, monitor and direct water conservation efforts. Jones Edmunds developed a CMMS mock-up demonstrating how benchmarks can be used as thresholds that trip and flag water-use accounts (Appendix M). The output includes a set of twelve monthly maps representing periods of use in which water use is above and below the thresholds developed during this phase of the study, and demonstrates how a conservation measure might be applied.

5.3 Conclusions

Based on the results of the Pilot Study analysis, the total retail water-savings potential that can be achieved cost effectively for the five utilities equals 10.3 MGD by 2030. Jones Edmunds estimates that the total present-value cost to achieve this potential is $12,041,000 with an annual O&M cost of $1,630,000. This represents a significant number of retail water demands that can be offset through conservation practices.

While the results present the most cost-effective alternatives for each utility using the methods develop as part of the study, it is not implied that these results are the most optimum solution or the only unique solution of achieving water savings. Successfully implementing conservation practices will be unique to each utility's customers and will require piloting different practices to see which are most effective. The results of this study can be used as a starting point to focus future conservation efforts. Based on the Pilot Study, Jones Edmunds recommends that utilities evaluate how to achieve savings from future users by adopting ordinances and modifying land development requirements. The next practices to consider depend on the utility. The results show that utilities with fewer private irrigation wells (i.e., GRU and Leesburg) have a higher savings potential with outdoor conservation practices.

6.0 Application of Study to the DWSP Process

As part of the water supply planning process, the District's goal is to apply the results of the Pilot Study to estimate water conservation potential for all other utilities within the District. This section summarizes the methodology used to incorporate the results of the Pilot Study into the DWSP 2010.

As described in Section 3, the governing concept for the study was to join geospatial property attributes (typically in square feet) to a water-use benchmark (gallons per day per square feet) to estimate conservation potential for various BMPs applicable to the category, build-out condition, and type of use, as shown in the Equation 3.1 (repeated here for convenience).

Equation 3.1

$$[CP = U * WU * BMP_i]_{C,B,T\,]}$$

$$CP = Conservation\ Potential\ (typcially\ in\ gallons\ per\ day)$$

$$U = Spatial\ Attribute\ (typically\ in\ units\ of\ area)$$

$$WU = Water\ Use\ Metric\ \left(\frac{gpd}{unit\ of\ area}\right)$$

$$BMP = Percent\ Water\ Saving\ from\ Conservation\ Measure\ i$$

$$C = Category\ of\ Use\ (Resential, Commercial, etc)$$

$$B = Build - out\ condition\ (Applicable\ plumbing\ standard\ years)$$

$$T = Type\ of\ Water\ Use\ (typically\ indoor\ or\ outdoor)$$

As described in Section 3, Jones Edmunds used account-level information joined with property-appraisal data to sector billing data by category of use, build-out condition, and type of use. The categories of water use include six residential profiles and the top 10 water-using commercial uses for each utility. From the relationships with the property-appraisal attributes, such as building square footage and parcel area, water-use metrics were calculated for each account and developed benchmarks that summarized the metrics by utility, category, build-out condition, and type. With the water use sectored, Jones Edmunds estimated conservation potential by associating conservation BMPs with the specific end uses. For the pilot utilities, numerous combinations of BMPs and end uses over different implementation periods and cost thresholds were evaluated.

By assuming that the utilities in the Pilot Study were a representative subset of other utilities in the District, the results of the Pilot Study can be generalized and applied to calculate conservation potential for the other utilities in the District. There are two primary steps to applying the results of the Pilot Study to the other utilities:

1. Applying Pilot Study benchmarks to estimate water that has conservation potential.
2. Applying cost-effective BMPs from the Pilot Study to estimate water savings and costs.

6.1 Applying Pilot Study Benchmarks to Non-Pilot Study Utilities

Benchmarks calculated for the Pilot Study represent statistical summaries of water-use metrics calculated for each utility by category, build-out condition, and type of use. The benchmarks calculated for each utility are provided in Section 4. It is important to recall that the water-use metrics and benchmarks are representative of retail or water that is recorded at the customer meter. It does not represent delivery system or treatment losses. It should also be stated that Jones Edmunds developed the benchmarks for this study with the intent to estimate conservation potential.

Ideally, water-use metrics from representative utilities would be applied to non-pilot utilities based on similarities of influencing factors, such as home value, well densities, billing rates, weather, soil types, irrigable area, or socioeconomic statistics. At the outset of the Pilot Study, the concept was to assign benchmarks from the Pilot Study based on similar private well densities. After initial analyses of available data sources (County Departments of Health and District well completion databases) for private wells in the pilot utilities' areas, there was not enough information to accurately characterize the differences in private wells within the utility SABs. For example, initial analyses indicated that SJCUD (St. Johns County) had a lower density of wells than Leesburg and GRU (Lake County and Alachua County), which Jones Edmunds considered to be erroneous. Because of data limitations and time constraints for inventorying and processing additional well completion information, the decision was made to aggregate the five utilities into a common benchmark that would be applied to the remaining utilities within the District. To arrive at the aggregated benchmarks provided in Tables 6.1 and 6.2, Jones Edmunds combined the benchmarks in each category and build-out condition for the five utilities using a parcel weighted average. The District can apply these benchmarks to parcels in the non-Pilot-Study utilities, but it will be impossible for the District to know which parcels in the SABs are not currently served by the utility.

Table 6.1 District Residential Water Use Benchmarks									
Res Class	Build-Out Condition	Number of Records	Avg Yr Built	Average Monthly Average (gal/month)	Average Per Capita Indoor (gpcd)	Average Indoor Water Use Per Building Area (gpd/sqft)	Average Indoor Water Use Per Heated Area (gpd/sqft)	Average Outdoor Water Use Per Parcel Area (gpd/sqft)	Average Outdoor Water Use Per Irrigable Area (gpd/sqft)
RS1	Pre 1984	12,159	1972	4,584	38.25	0.074	0.106	0.006	0.011
	1984 - 1993	4,165	1987	4,355	38.47	0.066	0.087	0.006	0.012
	1994 to Present	2,065	2000	4,647	41.98	0.072	0.103	0.007	0.014
RS2	Pre 1984	8,762	1974	5,291	39.48	0.063	0.082	0.006	0.010
	1984 - 1993	7,737	1989	5,124	43.40	0.057	0.076	0.007	0.013
	1994 to Present	10,799	2001	4,819	45.71	0.052	0.076	0.006	0.013
RS3	Pre 1984	5,980	1976	5,918	40.68	0.054	0.068	0.006	0.011
	1984 - 1993	5,779	1989	5,737	43.88	0.056	0.068	0.007	0.013
	1994 to Present	12,371	2001	5,970	51.64	0.048	0.069	0.009	0.018
RS4	Pre 1984	2,409	1975	6,858	46.07	0.048	0.061	0.006	0.012
	1984 - 1993	3,123	1989	7,082	51.73	0.050	0.066	0.008	0.016
	1994 to Present	6,999	2001	7,061	56.47	0.047	0.068	0.011	0.022
RS5	Pre 1984	1,167	1970	7,943	53.71	0.044	0.061	0.006	0.012
	1984 - 1993	1,489	1989	9,525	63.61	0.042	0.058	0.008	0.016
	1994 to Present	4,295	2001	8,401	62.99	0.040	0.057	0.010	0.022
RS6	Pre 1984	1,976	1973	12,469	-	0.05	0.06	-	-
	1984 - 1993	621	1987	12,595	-	0.03	0.03	-	-
	1994 to Present	729	2002	8,901	-	0.03	0.04	-	-

Table 6.2 District Commercial Water Use Benchmarks							
Commercial Category	Build-Out Condition	Number of Records	Avg Yr Built	Avg Use Per Account (gpd)	Avg WU/ Building Area (gpd/sqft)	Avg WU/ Heated Area (gpd/sqft)	Avg WU/ Parcel Area (gpd/sqft)
AUTO & REPAIR	Pre 1984	211	1968	294	0.08	0.10	0.013
	1984 – 1993	96	1987	354	0.08	0.09	0.011
	1994 to Present	102	2000	1,017	0.19	0.22	0.019
HOSPITALS	Pre 1984	4	1951	730	0.00	0.04	0.013
	1984 – 1993	7	1987	4,577	0.00	3.94	0.074
	1994 to Present	0	na	na	na	na	na
HOTELS	Pre 1984	31	1967	5,425	0.15	0.30	0.057
	1984 – 1993	18	1988	5,218	0.13	0.18	0.135
	1994 to Present	26	2001	6,190	0.13	0.16	0.272
INDOOR RECREATION	Pre 1984	178	1964	368	0.05	0.06	0.010
	1984 – 1993	109	1988	613	0.05	0.04	0.012
	1994 to Present	65	2000	670	0.05	0.05	0.006
LIVE-IN CARE	Pre 1984	11	1958	4,617	0.19	0.55	0.058
	1984 – 1993	8	1988	5,053	0.16	0.26	0.032
	1994 to Present	14	2000	6,357	0.11	0.83	0.022
MANUFACTURING	Pre 1984	81	1969	1,426	0.07	0.08	0.009
	1984 – 1993	47	1988	1,343	0.10	0.08	0.010
	1994 to Present	38	2000	974	0.03	0.11	0.007
MISCELLANEOUS	Pre 1984	45	1956	1,569	0.19	0.68	0.026
	1984 – 1993	17	1987	1,816	0.42	0.84	0.137
	1994 to Present	14	2002	539	0.09	0.14	0.015
OFFICE BUILDINGS	Pre 1984	573	1969	749	0.08	0.11	0.019
	1984 – 1993	475	1988	1,162	0.10	0.16	0.030
	1994 to Present	410	2001	684	0.09	0.10	0.016
OUTDOOR RECREATION	Pre 1984	5	1967	2,463	0.21	0.61	0.007
	1984 – 1993	6	1989	2,816	0.06	0.06	0.075
	1994 to Present	3	2004	5,036	0.41	0.58	0.281
RESTAURANTS	Pre 1984	126	1966	1,071	0.32	0.38	0.083
	1984 – 1993	79	1988	1,551	0.41	0.48	0.050
	1994 to Present	101	2000	2,002	0.44	0.49	0.051
RETAIL	Pre 1984	356	1965	434	0.06	0.07	0.020
	1984 – 1993	188	1987	750	0.07	0.08	0.018
	1994 to Present	236	2002	947	0.06	0.08	0.011
SCHOOLS	Pre 1984	49	1970	761	0.09	0.12	0.012
	1984 – 1993	60	1988	2,750	0.13	0.18	0.010
	1994 to Present	27	2002	1,800	0.13	0.16	0.006
UNKNOWN	Pre 1984	1	1980	437	0.01	0.03	0.001
	1984 – 1993	77	0	742	0.00	0.00	0.020
	1994 to Present	0	na	na	na	na	na
VACANT OR UNDEFINED	Pre 1984	9	1978	469	0.20	0.62	0.004
	1984 – 1993	143	1987	729	0.67	2.03	0.030
	1994 to Present	13	2002	1,007	0.28	0.52	0.018
WAREHOUSES/STORAGE	Pre 1984	220	1972	352	0.03	0.05	0.008
	1984 – 1993	87	1987	598	0.07	0.08	0.019
	1994 to Present	115	2001	326	0.08	0.07	0.005

For estimating future retail water use and baseline future consumption, Jones Edmunds recommends benchmarks that represent the most recent build-out conditions. In the Pilot Study, several methods were tested to project future water use. The method that can be used by the District to estimate commercial and residential water in the non-pilot utilities is summarized as follows:

- Calculate theoretical growth rates (parcel area per year) from 1980 to present day for each benchmark category using the property appraisal year-built data.
- Calculate theoretical 2030 parcel areas for future commercial growth for each category.
- Determine percent relative-growth rates for each category.
- Distribute future parcels between commercial and residential and select as candidates for growth in each benchmark category based on relative-growth rates.
- Calculate a theoretical 2030 area in each category and compared with the amount of area in the candidate parcels. If the candidate area is less than the theoretical 2030 area, cap the parcel growth by the candidate area in each category.
- Calculate residential growth rates at 5-year increments (2015, 2020, 2025, and 2030) using the population data. Assume commercial parcels fill in based on residential growth rates.
- Use residential growth rates to grow the available area in each benchmark category in 5-year increments.
- Apply the most recent build-out condition benchmark for each category to the future parcel area to estimate future water use.

6.2 Applying Conservation Potential and Costs to Non-Pilot Study Utilities

The primary focus of this study was to calculate the water savings potential associated with applicable BMPs. As described in Section 3, Jones Edmunds considered several factors in the process of estimating water conservation potential for the Pilot Study utilities, including passive savings, passive replacement, program savings, saturation, percent-water savings, efficiency, equivalent unit cost, cost thresholds, mutually exclusive alternatives, and implementation periods. Combined with estimated water use, Jones Edmunds used these factors to calculate water savings over the planning horizon for each pilot utility in a two-step process. The first step established the amount of water savings potential that existed for each BMP in each use category, build-out condition, and use type. The second step evaluated how much of the water savings potential was achieved through passive and/or program savings for each BMP under a given implementation period, saturation, and cost-effectiveness threshold. Key elements for estimating water conservation potential are highlighted below.

For this study, BMPs were organized into three groups: Global, Indoor, and Outdoor. *Global BMPs* are general practices implemented by the utility that address water use within all sectors. *Indoor BMPs* are generally retrofits to plumbing fixtures. *Outdoor BMPs* include practices that address irrigation water use.

For the Pilot-Study utilities, Jones Edmunds matched up water use in each category, build-out condition, and use type with applicable BMPs with associated passive replacement, efficiency, and water savings factors. The numerous combinations were ranked by the equivalent unit cost for each alternative and selected the BMPs that fell below the cost threshold. For mutually exclusive BMPs, the program with the lower equivalent unit cost that is under the cost threshold was selected. Costs for conservation practices were determined from the perspective that the utility will bear the burden of all program costs. Rebates and cost sharing were not considered in the analysis. Once installed, these practices would continue to achieve savings by virtue that non-conserving fixtures or practices would be no longer available or allowed.

To apply the results of the Pilot Study to the non-pilot utilities in the DWSP, it was assumed that the water-savings potential experienced by the five utilities was representative of other utilities in the District. As mentioned above, it would be preferable to apply the results of the conservation potential based on common influencing factors. However, given the limitations on finding a method to assign water use, the conservation potential results for the Pilot Study were aggregated together to apply the water-savings potential to other utilities. To arrive at the percent savings term in Equation 7.1, the water saved in each category for each cost-effective BMP for each utility was divided by the water use in each benchmarked category, build-out condition, and use type for each utility. The Pilot Study scenarios that were used in generating the aggregated savings rates shown in Table 6.3 (residential) and Table 6.4 (commercial) were based on a 20-year implementation period, a cost threshold of $4.00/kgal, and the saturation rate of 90%. A cost contingency is not applied to the cost presented in Table 6.3 and 6.4.

Table 6.3 Residential Lookup Table for Estimating Percent Water Savings and $/GPD for Non-Pilot Study Utilities [1,2,3,4,5]														
		High Efficiency Showerhead Replacement - INDOOR		Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR		Install Soil Moisture Sensor Shut-off Devices - OUTDOOR		Efficient Irrigation Systems (non turf) - OUTDOOR		Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR		Operations and Maintenance		Passive Savings
Residential Category	Build-Out Condition	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings
RS1	1	2.25%	$14.62	0.00%	$0.00	12.08%	$4.47	0.00%	$0.00	0.00%	$0.00	2.41%	$13.20	13.08%
	2	2.34%	$14.95	0.00%	$0.00	8.12%	$7.40	0.12%	$17.01	0.00%	$0.00	2.41%	$14.73	15.51%
	3	0.00%	$0.00	0.00%	$0.00	8.53%	$7.62	0.00%	$0.00	0.00%	$0.00	2.41%	$13.54	8.52%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	33.20%	$0.00	2.41%	$5.14	0.00%
RS2	1	2.25%	$12.05	0.00%	$0.00	14.54%	$4.14	0.00%	$0.00	0.00%	$0.00	2.41%	$11.47	13.08%
	2	2.34%	$12.16	0.00%	$0.00	10.57%	$6.13	0.00%	$0.00	0.00%	$0.00	2.41%	$12.37	15.51%
	3	0.00%	$0.00	0.00%	$0.00	10.94%	$6.68	0.00%	$0.00	0.00%	$0.00	2.41%	$12.38	8.52%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	33.20%	$0.00	2.41%	$6.35	0.00%
RS3	1	2.25%	$11.68	0.00%	$0.00	15.91%	$4.03	0.00%	$0.00	0.00%	$0.00	2.41%	$10.14	13.08%
	2	2.34%	$11.69	0.00%	$0.00	12.87%	$5.59	0.00%	$0.00	0.00%	$0.00	2.41%	$11.14	15.51%
	3	0.00%	$0.00	0.00%	$0.00	13.59%	$5.60	0.00%	$0.00	0.00%	$0.00	2.41%	$10.39	8.52%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	33.20%	$0.00	2.41%	$6.07	0.00%
RS4	1	2.25%	$10.78	0.00%	$0.00	17.06%	$3.61	0.00%	$0.00	0.00%	$0.00	2.41%	$8.12	13.08%
	2	2.34%	$10.25	0.00%	$0.00	16.26%	$4.69	0.00%	$0.00	0.00%	$0.00	2.41%	$8.53	15.51%
	3	0.00%	$0.00	0.00%	$0.00	14.64%	$4.98	0.00%	$0.00	0.00%	$0.00	2.41%	$9.24	8.52%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	33.20%	$0.00	2.41%	$3.78	0.00%
RS5	1	2.25%	$15.38	0.00%	$0.00	17.58%	$2.20	0.00%	$0.00	0.00%	$0.00	2.41%	$5.45	13.08%
	2	2.34%	$11.94	0.00%	$0.00	17.56%	$2.67	0.00%	$0.00	0.00%	$0.00	2.41%	$5.10	15.51%
	3	0.00%	$0.00	0.00%	$0.00	16.35%	$3.39	0.00%	$0.00	0.00%	$0.00	2.41%	$6.73	8.52%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	33.20%	$0.00	2.41%	$3.32	0.00%

Table 6.3 Residential Lookup Table for Estimating Percent Water Savings and $/GPD for Non-Pilot Study Utilities [1,2,3,4,5]														
		High Efficiency Showerhead Replacement - INDOOR		Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR		Install Soil Moisture Sensor Shut-off Devices - OUTDOOR		Efficient Irrigation Systems (non turf) - OUTDOOR		Modifications to Land Development Regulations (LDR) Limiting Water Use - OUTDOOR		Operations and Maintenance		Passive Savings
Residential Category	Build-Out Condition	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings
RS6	1	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	2.41%	$50.01	13.08%
	2	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	2.41%	$128.99	15.51%
	3	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	2.41%	$27.79	4.07%
	4	0.00%	$0.00	4.14%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	2.41%	$54.69	0.00%

1. Percent water savings and costs associated with a 20-yr planning horizon and an equivalent annual cost threshold of $4.00/kgal for implementing conservation.

2. The table is based on the weighted results obtained for the pilot study utilities.

3. Cost/GPD saved is equal to the total present value cost for cost effective BMPs in each build-out condition and residential category divided by the sum of the program savings by 2030.

4. Operations and maintenance savings and costs include costs and savings for commercial programs.

5. Percent savings from indoor BMPs and passive savings should be applied to indoor water use. Percent savings from outdoor BMPs should be applied to outdoor water use. Percent savings from operations and maintenance practices should be applied to the sum of indoor and outdoor water use.

Table 6.4 Commercial Lookup Table for Estimating Percent Water Savings and $/GPD for Non-Pilot Study Utilities [1,2,3,4]

		High Efficiency Showerhead Replacement - INDOOR		High Efficiency Toilet Replacement Program - INDOOR		Urinal Replacement Program - INDOOR		Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR		Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR		Passive Savings
Commercial Category	Build-out Condition	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings
HOSPITALS	1	1.16%	$7.05	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	6.42%
	2	1.22%	$0.07	2.76%	$2.30	0.65%	$3.27	0.00%	$0.00	0.00%	$0.00	7.42%
	3	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
HOTELS	1	1.31%	$11.12	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	6.50%
	2	1.37%	$13.37	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	7.73%
	3	1.23%	$14.19	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	5.32%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
INDOOR RECREATION	1	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	7.19%
	2	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	8.52%
	3	0.00%	$0.00	0.00%	$0.00	0.58%	$16.50	0.00%	$0.00	0.00%	$0.00	5.63%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
LIVE-IN CARE	1	1.31%	$3.70	0.00%	$0.00	0.00%	$0.00	3.91%	$0.59	0.00%	$0.00	7.25%
	2	1.37%	$4.13	0.00%	$0.00	0.00%	$0.00	3.91%	$0.40	0.00%	$0.00	8.38%
	3	1.23%	$8.78	0.00%	$0.00	0.00%	$0.00	3.91%	$1.53	0.00%	$0.00	5.93%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
OFFICE BUILDINGS	1	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	7.19%
	2	0.00%	$0.00	3.98%	$13.15	0.94%	$12.29	0.00%	$0.00	0.00%	$0.00	8.52%
	3	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	5.63%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
RESTAURANTS	1	0.00%	$0.00	0.00%	$0.00	0.80%	$12.28	11.48%	$0.87	0.00%	$0.00	6.97%
	2	0.00%	$0.00	3.87%	$9.51	0.92%	$6.77	11.48%	$0.43	0.00%	$0.00	8.27%
	3	0.00%	$0.00	0.00%	$0.00	0.57%	$11.44	11.48%	$0.45	0.00%	$0.00	5.47%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%

Table 6.4 Commercial Lookup Table for Estimating Percent Water Savings and $/GPD for Non-Pilot Study Utilities [1,2,3,4]												
		High Efficiency Showerhead Replacement - INDOOR		High Efficiency Toilet Replacement Program - INDOOR		Urinal Replacement Program - INDOOR		Commercial Kitchen Pre-Rinse Spray Valve Replacement - INDOOR		Ordinances Adopting Higher Indoor Efficiency Standards - INDOOR		Passive Savings
Commercial Category	Build-out Condition	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings	Cost ($/gpd)	Percent Savings
RETAIL	1	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	5.50%
	2	0.00%	$0.00	3.05%	$11.80	0.72%	$12.87	0.00%	$0.00	0.00%	$0.00	6.52%
	3	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.31%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
SCHOOLS	1	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	3.18%	$1.81	0.00%	$0.00	9.30%
	2	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	3.18%	$1.84	0.00%	$0.00	11.03%
	3	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	3.18%	$1.99	0.00%	$0.00	7.29%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%
WAREHOUSES/ STORAGE	1	0.00%	$0.00	2.60%	$12.23	0.83%	$13.22	0.00%	$0.00	0.00%	$0.00	7.19%
	2	0.00%	$0.00	3.98%	$10.00	0.94%	$5.50	0.00%	$0.00	0.00%	$0.00	8.52%
	3	0.00%	$0.00	1.46%	$8.26	0.58%	$6.97	0.00%	$0.00	0.00%	$0.00	5.63%
	4	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	0.00%	$0.00	4.77%	$0.00	0.00%

1. Percent water savings and costs associated with a 20-yr planning horizon and an equivalent annual cost threshold of $4.00/kgal for implementing conservation.

2. The table is based on the weighted results obtained for the pilot study utilities.

3. Cost/GPD saved is equal to the total present value cost for cost effective BMPs in each build-out condition and commercial category divided by the sum of the program savings by 2030.

4. Operations and maintenance savings and costs for commercial programs are included in the savings and costs for residential programs.

7.0 Summary Recommendations

This study shows that several complex spatial databases can be joined together to create new relationships that can be leveraged to increase our understanding of water consumption and estimate conservation potential. As with any pilot project, many new processes and methods were introduced to achieve the study objectives. The experiences and findings of this work show there are opportunities to improve and enhance the methods and processes for future efforts.

7.1 Data Collection and Preparation

The foundation of this work is the spatial data. It would be beneficial if improvements to streamline and maintain the processes were considered. The most essential improvements include:

- Establishing a common geometry among the various data sources.
- Developing a standard data schema to store and transmit billing data.
- Making routine and consistent updates to population and billing geodatabases to accommodate changes in spatial geometries and new information.
- Working with county property appraisers to collect and update information related to tracking water use and conservation including fixture counts, irrigation systems, and comparable area measurements.
- Developing metadata for all datasets.

These improvements will require collaboration between the District, the utilities, the county appraisal offices, and other organizations involved with this effort.

7.2 Methods

Estimating conservation potential requires an understanding of the end uses of water. While there have been extensive studies on end uses (Mayer et al., 1999, and Dziegielewski et al., 2000), the typical metering equipment and data collection methods are not adequate to define a customer's end uses. Jones Edmunds developed several methods in this study to overcome this limitation, which can be improved with additional data and end-use studies.

Workflow and Processes – One continual challenge that Jones Edmunds encountered during the study was developing common processes, valid screens, and uniform assumptions to apply to all five utilities. Methods and assumptions that could be applied to one utility were not always valid for the remaining four. As the District continues to pursue additional account-level data, it would be advantageous for common data standards and non-unique processes to be developed and applied.

Residential Categories and End Use – The study indicates that residential customers can be categorized into groups to capture differences in water consumption. Categorizing is necessary to make better estimates of end uses and to match the appropriate conservation practices with the water use. The methods applied in this study were based on just value for each property. While this provided unique characteristics within each of the pilot utilities, it was difficult to relate one category to the same category of another utility. The variability of water use within these groupings and the factors that drive water use were unique to each utility. As utilities continue to link CIS with GIS and other information systems, the District should invest in additional analyses to better understand the water use and the best categories to compare water use across utilities.

An updated end-use study for the District would be beneficial to confirm the water use patterns within each category. This type of study would also help define the distinguishing factors to categorize water use. These factors should be reviewed and related to how future water use is estimated. Additionally, the metrics and benchmarks will need to be updated over time.

Indoor/Outdoor Separation – For residential water use, splitting indoor from outdoor consumption is an important step in estimating water conservation potential. For the utilities in this Pilot Study, most residential accounts were served by a single meter, making it necessary to employ a minimum-month method for estimating the split between indoor and outdoor use. While a comparison of indoor and outdoor water use for dual-metered accounts compared favorably with the indoor/outdoor split estimate for single-metered accounts, it is important to note that there are limitations to any method that estimates the split. To improve the understanding of the indoor/outdoor split, the District should consider:

- Gathering additional data on dual-metered accounts across the District to provide a better understanding of the indoor and outdoor water use.
- Performing an end-use study to better define outdoor and indoor end uses.

Irrigation Systems – The penetration of in-ground irrigation systems has impacted outdoor water use. To better estimate the number of these systems, the District should consider:

- Working with county and/or city building departments to track new or improved in-ground irrigation systems that links to a utility’s account identifier.

- Performing an end-use study to better define outdoor irrigation patterns.
- Working with utilities to identify accounts known to have irrigation systems to verify relationships between consumption patterns and in-ground irrigation systems.
- Continuing to build a dataset from more advanced metering systems.

Commercial End Uses – Commercial end uses are the most variable and challenging to quantify into meaningful categories and end uses. Within common industrial categories, water use is specific to the types of machinery, products, and services being provided. These variables can change dramatically as economic drivers change. Additionally, the sources of commercial water use are variable and do not always come from a utility. It is unlikely that appraisal databases or utility records can be updated to reflect changes that occur within a commercial landuse. The best method to improve our understanding of commercial uses is to engage the major water users within the commercial categories to understand their sources and end uses. This could lead to an industry specific end use study and dedicated programs for each industry type.

Fixtures – The number of fixtures are used in calculating costs. While residential fixtures can reasonably be approximated based on building square footage relationships, commercial fixture counts are not easily approximated. To improve the estimate of fixtures, the District should consider the following:

- Work with the top water using commercial users to develop better relationships for estimating fixture counts
- Work with county appraisers to track and record fixture information more accurately.

Conservation Potential Variables - Many of the calculations and methods developed in this study are based on assumptions and data derived in other areas of Florida or other States such as California. To provide a common comparison, the water savings is presented on an annual average daily flow basis. Peaking factors for some conservation practices will be important to implementation. The following efforts will provide a better understanding of these factors within the District and will improve the accuracy of these calculations:

- Conduct or sponsor utility surveys to determine the passive and passive replacement factors for key conservation practices.
- Incorporate new knowledge on the effort and costs needed to maintain savings from pilot conservation programs.

- Promote tracking of conservation practices at the account level to understand the actual water savings rates.
- Develop a consistent costing methodology for comparing conservation projects and traditional supply side projects.
- Work with utilities to develop actual market saturation factors for various conservation programs.
- Evaluate the temporal peaking factor impacts of conservation practices.

7.3 Water Use Metrics and Benchmarks

The water use metrics and benchmarks developed from this pilot study are effective at estimating conservation potential within each utility. Applying these benchmarks to identify the efficient water users is not possible without additional information. While Palm Bay has one of the lowest per capita water uses in this study, it is indeterminate as to whether the customers in Palm Bay represent the most efficient water users in the study due the influence of private wells. Without an accurate accounting of all the sources of water being supplied to each customer within the utility service area boundaries, it is not possible to compare water use efficiency.

The study is based on two years of data. The general consumption patterns across the five utilities followed similar trends such has lower water use in wet periods and higher water use in dry periods. However as additional account level data is gathered, a normalization process should be conducted to make long term comparisons after removing the influences of common water consumption drivers such as temperature, rainfall, and rates.

7.4 Existing versus Future Conservation Potential

The account level data provides the best information for estimating conservation potential within each utility's existing customer base. While joining the geodatabases results in mismatches and data anomalies, these challenges can be overcome with reasonable assumptions and coordination with the utilities. Estimating the volume of water savings potential from the existing customer base can be done with a higher level of confidence than estimating water savings from future customers. Since the volume of future water savings is directly dependent on the projected future water use, it is important to accurately predict future water use to accurately estimate water conservation potential. As future water use changes, water savings potential will change.

For the pilot study, future water use is estimated based on the population spatial growth model used by the District and relative growth rates within aggregated commercial categories and the benchmarks developed for the most recent build-out condition in each use category. For residential water use, linkages are made from water use to future growth model using dwelling unit densities. The account level data provides new information that can be used to make the following improvements to the spatial growth model:

- Incorporate the ability to distinguish served and un-served populations
- Relate and assign water using attributes like dwelling unit densities.
- Incorporate commercial growth and water use.

7.5 Self Supply and Irrigation Wells

It is apparent from the benchmarks for each utility, that private irrigation wells influence the amount of irrigation. Utilities thought to have a higher density of private irrigation wells (Palm Coast and Palm Bay) have significantly less (30 to 50%) water use than utilities known to have fewer irrigation wells (GRU and Leesburg). Several data sources were researched to estimate the penetration of irrigation wells within utility service area boundaries. These sources are insufficient to make any reasonable estimate on how many private irrigation wells exists with the District. However, relative comparisons of well densities within the service areas are insightful. While well inventories can be labor intensive, it is recommended that the District evaluate ways to collect or track information on the number of existing irrigation wells within the District at the parcel level. The District and most counties are tracking new wells being installed, but this information is not readily converted to a geodatabase that can be joined with the information sources used in this study.

7.6 Standardization

After going through the experiences of processing multiple utility datasets, joining water use to landuse, and reviewing and applying industry methods to estimating conservation potential, it is apparent that there is a lack of standardization throughout the water industry in defining and analyzing water use. In addition, there is a lack of standard methods for estimating conservation potential. To overcome these challenges, the District should consider the following:

- Work with utilities on developing standard schemas and terminology for analyzing water use data.
- Continue to support Conserve Florida in the development of a statewide framework and methodology for estimating conservation potential.

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