

Quantifying Potable Water Savings Derived from a Residential Irrigation Audit Program in Seminole County

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Projected growth and associated increased groundwater withdrawals have led to growing concerns about sustainable use of groundwater resources in Central Florida. Although the Seminole County Environmental Services Department has participated consistently in water conservation education and other programs over the years, recent focus on water planning for the future has created the impetus for an expanded water conservation program. Among the conservation measures implemented by the county over the last five years is a residential irrigation audit program.

Quantifying direct potable water savings in water conservation programs can be difficult, as evidenced in the literature (Vickers, 2001). Initial attempts by the county to estimate savings from residential irrigation audits focused on the auditor's estimate of reduced irrigation system run times, but since there was no funding for follow-up with customers, there was no way of knowing if all, some, or any of the recommendations made through the audit program were fol-

lowed by the customer. There was also no independent verification of the irrigation auditor's assessment of potential potable water savings.

An analysis of Seminole County's water billing database provides a tool to evaluate and quantify potable water savings of customers who have undergone irrigation audits. To eliminate impacts of seasonal variation, billing data from the 12-month period before and after the month of the irrigation audit were used to evaluate water savings.

Once the impact of audits already conducted by the county was quantified, a statistical analysis was conducted, lending a degree of statistical certainty to the conclusions drawn from the irrigation audit data analysis. Potential targets for future residential audits within the county's service areas were then identified, based on their current potable water usage patterns. This article will offer a detailed review of the data analysis to provide a framework for municipalities seeking to conserve water by implementing a residential irrigation audit program.

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Residential Irrigation Audit Data Analysis

Seminole County's expanded residential irrigation audit program applies to Section 12.2.5.1 (e) of a Water Conservation Plan use from the St John's River Water Management Consumptive Use Permit Applicant's Handbook. The county has offered free residential irrigation audits to interested consumers since 2004, via an independent contractor (Clear Water Products and Services Inc., \$207.50 per irrigation audit). As part of the audits, the contractor makes recommendations that can save consumers potable water by modifying the operating conditions of their irrigation systems. Common recommendations include reducing run times, modifying zones, and installing rain sensors.

While conducting each audit, the contractor also estimates how much potable water could be saved if the recommendations are followed. These estimates are typically based on reduced run times of the irrigation system that are possible under the new operational scenario.

While it was likely that the audit program had resulted in potable water savings, an estimate of its actual impact on potable water consumption had not been quantified in the past. A recent analysis of billing database records, using the 12-month period prior to the date of the irrigation audit as a basis of comparison, revealed actual potable water savings in subsequent 12-month periods.

A total of 139 irrigation audits (approximately one-third of all audits performed) with a full year of billing database information before and after the date of the audit were used to estimate the actual impact of the audits on residential potable water usage. Figure 1 shows the percent reduction in

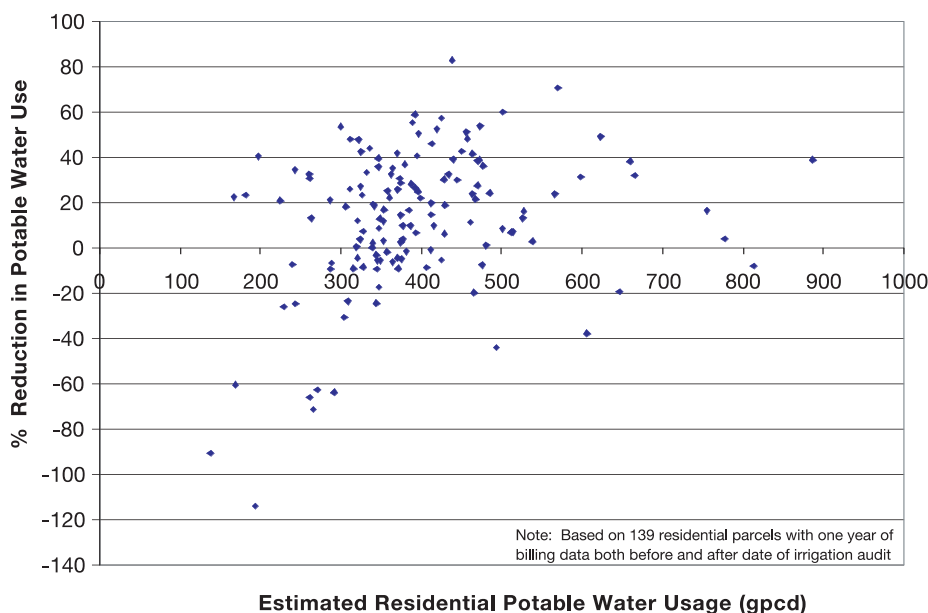


Figure 1: Percent Reduction in Potable Water Usage in the 12-Month Period Following Residential Irrigation Audits

Residential Irrigation Audit Target Selection

With the effectiveness of individual residential irrigation audits quantified, it was necessary to determine the number and location of residential parcels in Seminole County that use at least 300 gpcd of potable water to determine potential potable water savings. Parcels targeted for a reuse retrofit program the county is planning were not included as potential irrigation audit targets. Figure 3 shows the percentage of single-family residences that fall into each water usage category.

Figure 3 indicates that 11 percent of all single-family residences (totaling 4,310 parcels) currently use more than 300 gpcd, based on actual usage from the billing database. Out of these high water-using residences, 1,255 are identified as future users of reclaimed water via retrofits, to be used for irrigation. This leaves 3,055 single-family residences as targets for residential irrigation audits among existing customers.

The locations of these customers are graphically displayed in Figure 4. Note that significant numbers of irrigation audit target parcels are located within the county's northeast, southwest, and southeast service areas, which use much less water on average than the high water-using northwest service area.

In addition to its current potable water customers, unincorporated Seminole County is expected to have approximately 8,000 new single-family residences built by 2025, based on the latest population projections. If the

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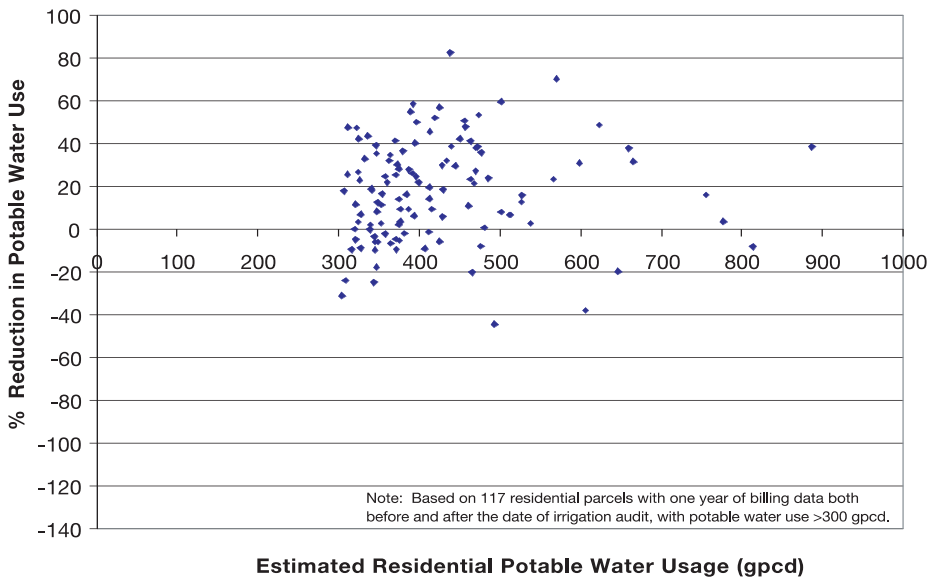


Figure 2: Impact of Residential Irrigation Audits on Residences which Consume More Than 300 gpcd

potable water consumption from the 12-month period prior to the audit date compared to the 12-month period following each of the 139 audits. The negative savings shown on the figure represent increases in overall usage (a decrease in savings).

Figure 1 indicates that as residential per-capita usage drops below 300 gallons per capita day (gpcd), residential irrigation audits have less impact upon potable water usage. This is a reasonable observation, as one would expect less water to be saved by residential parcels that use less water in general.

A more detailed analysis of the billing database, focusing on just those irrigation audits conducted on residences which use more than 300 gpcd (117 audits in total), is displayed graphically in Figure 2.

Analysis of the data shown in Figure 2 indicates that the average irrigation audit on residences that use more than 300 gpcd reduces potable water usage. Specifically, these 117 high water-using customers who received irrigation audits in 2004 and 2005 averaged a 19 percent reduction in total potable water use. This reduction represents a total of 84,600 gallons per residence per year, and a drop of 80.8 gpcd for homes that received audits.

The total reduction in potable water consumption for these 117 residences approached 9.9 million gallons over the 12 months following an irrigation audit, but the large variability (as evidenced by the large standard deviation in the data set) makes it difficult to predict with any reasonable degree of certainty the potable water savings for an individual residence audited in the future.

Fortunately, a paired difference analysis

(Mendenhal and Sincich, 1995) of this data set results in statistically valid conclusions that have practical applications for future residential irrigation audits. Using the paired difference statistical test, it can be said with 99 percent certainty that irrigation audits cause at least a 13.4 percent reduction in potable water use at residences that previously used more than 300 gpcd. This 13.4 percent reduction translates into nearly 60,000 gallons per year of potable water savings per residence, or 57.3 gpcd.

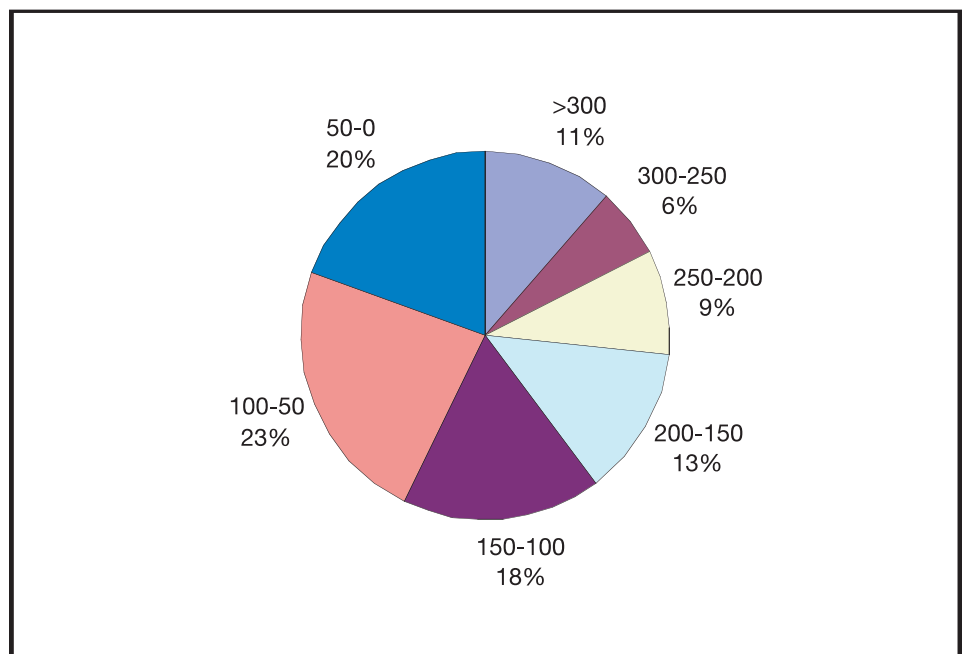


Figure 3: Residential Potable Water Use in Seminole County (gpcd)

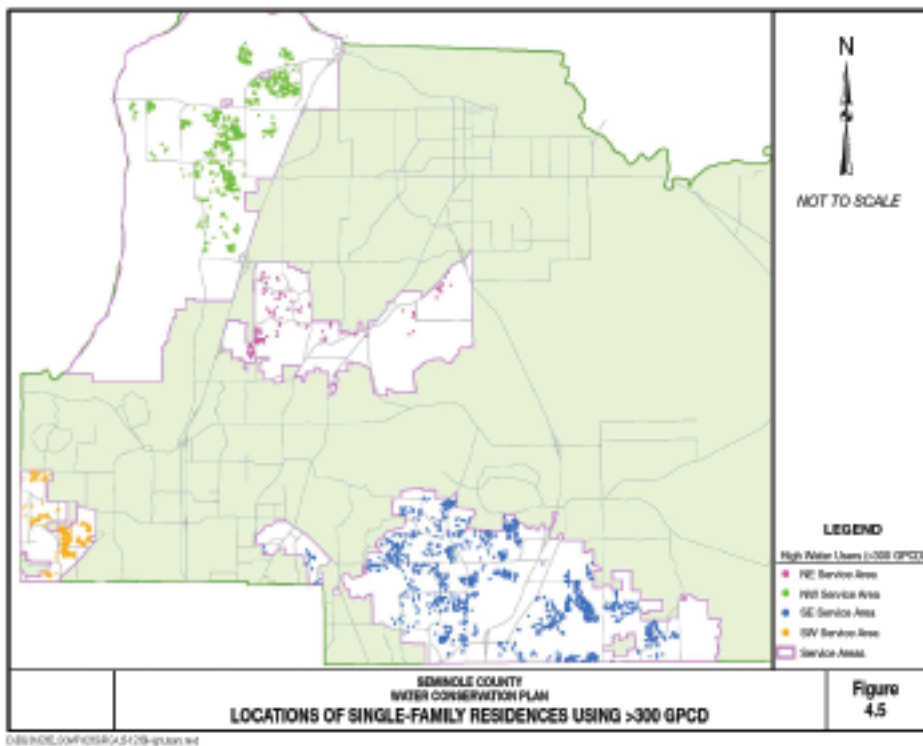


Figure 4: Locations of Single Family Residences Using > 300 gpcd

Table 1: Annual Potable Water Savings/Costs of a Residential Irrigation Audit Program

Year	Number of Irrigation Audits	Potable Flow Savings (mgd)	Annual Cost ¹ (\$/yr)	Unit Cost (\$/gpd)
2007	500	0.082	\$103,750	\$1.27
2008	500	0.082	\$107,900	\$1.32
2009	500	0.082	\$112,216	\$1.37
2010	500	0.082	\$116,705	\$1.42
2011	500	0.082	\$121,373	\$1.48
2012	500	0.082	\$126,228	\$1.54
2013	62	0.010	\$16,278	\$1.63
2014	62	0.010	\$16,929	\$1.69
2015	62	0.010	\$17,607	\$1.76
2016	62	0.010	\$18,311	\$1.83
2017	62	0.010	\$19,043	\$1.90
2018	62	0.010	\$19,805	\$1.98
2019	62	0.010	\$20,597	\$2.06
2020	62	0.010	\$21,421	\$2.14
2021	62	0.010	\$22,278	\$2.23
2022	62	0.010	\$23,169	\$2.32
2023	62	0.010	\$24,096	\$2.41
2024	62	0.010	\$25,060	\$2.51
2025	62	0.010	\$26,062	\$2.61
Total	3,806	0.622	\$958,828	\$1.54
Present Value	3,806	0.622	\$789,745	\$1.27

1 Assumes 4 percent inflation increase per year

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water-usage characteristics of these 8,000 new residences mirror that of current customers, then approximately 10 percent of these new homes (800) will use more than 300 gpcd of potable water and would be targets for future audits.

Residential Irrigation Audit Implementation

Table 1 lists the potential water savings and costs of implementing a residential irrigation audit program for targeted high water-using residences through the year 2025. It is assumed that the existing 3,055 high water-using customers are audited at the rate of 500 audits per year until all have been audited (six years). Audits of new high water-using single-family parcels (800 total by 2025) would be split evenly among the remaining years after the current residences are audited.

Conclusions

Under the assumptions outlined in this article, Seminole County could expect to conserve 622,000 gallons of potable water per day by implementing a residential irrigation audit program that targets high water-using residences, at a present-value cost of \$789,745, and a unit cost of \$1.27/gpd saved. This represents a 2.3 percent savings in the amount required to meet the county's potable water needs in the year 2025.

A residential irrigation audit program also compares favorably to other conservation measures, such as a toilet replacement program. For example, a toilet replacement program could have a unit cost (in \$/gpd saved) over six times that calculated for residential irrigation audits, not including toilet installation costs.

In October 2006, the Seminole County Board of County Commissioners unanimously approved funding (\$150,000 per year) for the first six years of this program. This year the Seminole County Environmental Services Department begins formal implementation of the program and development of monitoring tools to continuously assess the relative success of these conservation efforts.

References

- Mendenhall, William, Sincich, Terry (1995). *Statistics for Engineering and the Sciences*, Prentice Hall, Inc., Upper Saddle River, New Jersey.
- Vickers, Amy (2001). *Handbook of Water Use and Conservation*. WaterPlow Press, Amherst, Massachusetts.