WATER CONSERVATION OPPORTUNITIES IN FLORIDA'S PUBLIC SCHOOLS

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ABSTRACT

Florida Rural Water Association, partnering with the Suwannee River Water Management District, found a novel solution that addresses water conservation implementation concerns by targeting county school districts and providing documentation needed by school administrators get water conservation recommendations implemented quickly with minimal time investment. Five schools, one in each of the five school participating districts, were surveyed in the study. Elementary, middle and high schools were selected for the study, representing slightly different usage patterns and variations. Educational institutions represent an extremely large customer segment with uniform operation practices. The number of customers or students, teachers and staff in Florida's public schools approaches 2.5 million individuals. To avoid diverting school staff from their normal duties, FRWA provided flow testing and measurement of plumbing fixture and leak detection inspections in off-peak periods including summer vacations. The field data collected was analyzed and options prioritized for the most cost effective and proven water reduction measures. SRWMD then provided financial incentives to make the recommended measures attractive to the schools. The schools will see results in lower water usage and saving money on their utility bills. The program consists of using a water audit methodology that identifies water conservation measures to provide the highest potential for water conservation using a simple payback formula for each measure.

INTRODUCTION

Florida water and wastewater utilities have been very active in encouraging water conservation measures for their customers. These measures often include changes in customer management that include timely water auditing; automated metering to identify water demand and leaks; public education; and imposing conservation rates.

The water conservation study performed was a collaborative effort between Florida Rural Water Association (FRWA), Suwannee River Water Management District (SRWMD), and five school districts to determine the costs and feasibility of identifying sources of water loss and in installing water conservation measures that could significantly reduce monthly utility charges while saving water.

Five schools, one in each of the five school districts participating, were surveyed in the study. The water saving measures identified at these schools are valuable not only in saving water at the targeted schools, but are thought to be useful and indicative of water saving potential for other schools in the districts.

The initial part of this study was limited to a matching grant from SRWMD of $10,000 to assist the school districts in implementing the water conservation measures that were identified by FRWA.

FIVE KEYS TO SUCCESSFUL WATER CONSERVATION PROGRAMS

1. **Tailored Approach.** Water conservation plans must be part of a tailored approach that examines how changes in water use will impact all other areas of customer habits, decision-making, and operation. Impacts occur at two basic areas: behavioral and physical. Behavioral approaches involve changing habits and attitudes about water usage. Altering use expectations is a slow and steady process. Physical approaches may be more successful initially with lowering water uses by installing water-efficient fixtures, improved maintenance and procedures, performing water audits to accounting for water usage.

2. **Accurate Water Audit.** Any good water conservation plan depends upon accurate data. Before water saving measures are implemented, a thorough water audit should be conducted to determine where and how the water is being used. Then, water use can be monitored to track conservation progress.

3. **Action Plan follows a Logical Sequence of Events.** A successful water conservation program follows a logical sequence of events. Implementation should be prioritized and conducted in phases, starting with the most obvious and lowest-cost options. Start with the low hanging fruit first. Be practical and reasonable. The plan must include both behavioral and physical changes instituted by the customer.

4. **Recommendations the Application and Usage.** The effective plan examines not only how much water is being used where, when, and by whom, but asks if the water usage truly benefits the customer. It also scrutinizes the usage found in the water audit – not perceived usage or needs – actual patterns of use: "Do you need to use drinking quality water for this application?" The plan looks at the process and using less water or water from another source (recycled water).

5. **Set Water Savings Targets.** The key to bringing it all home to your customers will be in the bottom line – how much money will they save? Or how soon with this pay for itself? As utility professionals we may be interested in water savings but the customer feels it in the pocketbook – the pocketbook is said to be the most sensitive part of the human anatomy. Use the true cost of water and life cycle costs in the analysis for evaluating water conservation options.

PHYSICAL AND BEHAVIORAL WATER CONSERVATION EFFORTS

Indoor measures include recommendations for retrofitting older plumbing fixtures with high efficiency models. Often utility incentives are necessary to make these fixtures more economically attractive. Outdoor measures often include use of more drought tolerant turf and landscaping, and encouraging agronomic water applications. To offset groundwater withdrawals, wastewater utilities are intimately involved too, as reclaimed water is being expanded to irrigate more residential neighborhoods.

Unfortunately, significant water savings measures must be proactively introduced and require extensive and time-consuming interaction between the customer and the utility. Reductions in

commercial water use frequently require operational changes resulting in additional administrative and capital costs. Changing business practices to conserve water divert staff and management from their core mission. Thus the conservation measures and Best Management Practices (BMPs) recommended by utility are not always well received or are ignored.

Broad 'one-size-fits-all' recommendations rarely affect significant water use reductions. In order to induce reductions in water usage patterns a one-to-one relationship is necessary between the utility and the customer – particularly with large users such businesses, schools, and other institutions. The utility works closely with the individual customer and together they tailor physical and behavioral conservation measures and fit recommendations to match the individual user profile. This means that a limited number of customers can be reached.

The carrot or stick approach. It is understandable that more passive measures are used by utilities, which include conservation rates as a financial disincentive or penalties. Increasing block rates do not improve utility relationships with its customers as they often end up paying more in their utility bills. In addition to using the stick of higher costs as an incentive for large users cooperation can give water conservation a sense of pride for conserving natural resources.

BEHAVIORAL WATER CONSERVATION EFFORTS (BMPs)

Adoption of Best Management Practices (BMPs) for water efficiency by the school maintenance staff provides an effective water conservation practice that can be implemented at no or little cost. Best management practices for school buildings have been established by Federal Agencies such as the Department of Energy (DOE). These suggestions have been adapted and edited to cover the types of plumbing fixtures surveyed and tested in the work conducted by FRWA and are included below:

Operation and Maintenance BMPs for Plumbing Fixtures

- Check plumbing fixtures for proper functioning and water leaks every six months.
- Establish a user-friendly method for reporting leaks by administrative staff and teachers
- Encourage cleaning or custodial crews to report problems.
- Fix Leaks and Malfunctions in a timely manner
- Maintain spare cartridges and diaphragms that are specified for the flow rates
- Periodically replace non-operative flush valves components or flush-valves. Generally, a good practice is replacement of spring components every other year.
- Replace fill valves in tank-type toilets every year.
- When performing maintenance, examine nearby fixtures and replace worn parts and adjust mechanisms to ensure that the water consumed per flush meets manufacturer equipment specifications.
- If non-water urinals are used, clean and replace the sealant, cartridges or material in accordance with manufacturer recommendations.

Management Practices to Ensure Engagement of Students and Staff

- Establish a written preventative maintenance procedure that requires maintenance personnel to test and evaluate plumbing fixtures the FRWA specified on the basis provided above.
- Establish guidelines for teachers and staff to assist with identification of plumbing problems.
- Install visual reminders to students and staff (postures) of the importance of conserving water. Hold a poster contest or art project. Example posters can be found online.
- Involve students in water conservation activities by using educational resource materials in the classroom provided by EPA for high school students are available online at: http://water.epa.gov/learn/kids/drinkingwater/kids_9-12.cfm.
- Promote water conservation using the EPA WaterSense program. Involve students in these activities by using educational resource materials available and prepared for classroom use by EPA: http://www.epa.gov/watersense/our_water/learn_more.html#tabs-6.

GENERAL DISCUSSION WATER CONSERVATION IN PUBLIC SCHOOLS

It has been estimated that nearly half (45%) of the water used in schools is related to restroom use. Landscape irrigation, cooling and heating, and kitchen uses make up the major portion of all other uses. These uses are shown in the figure below:

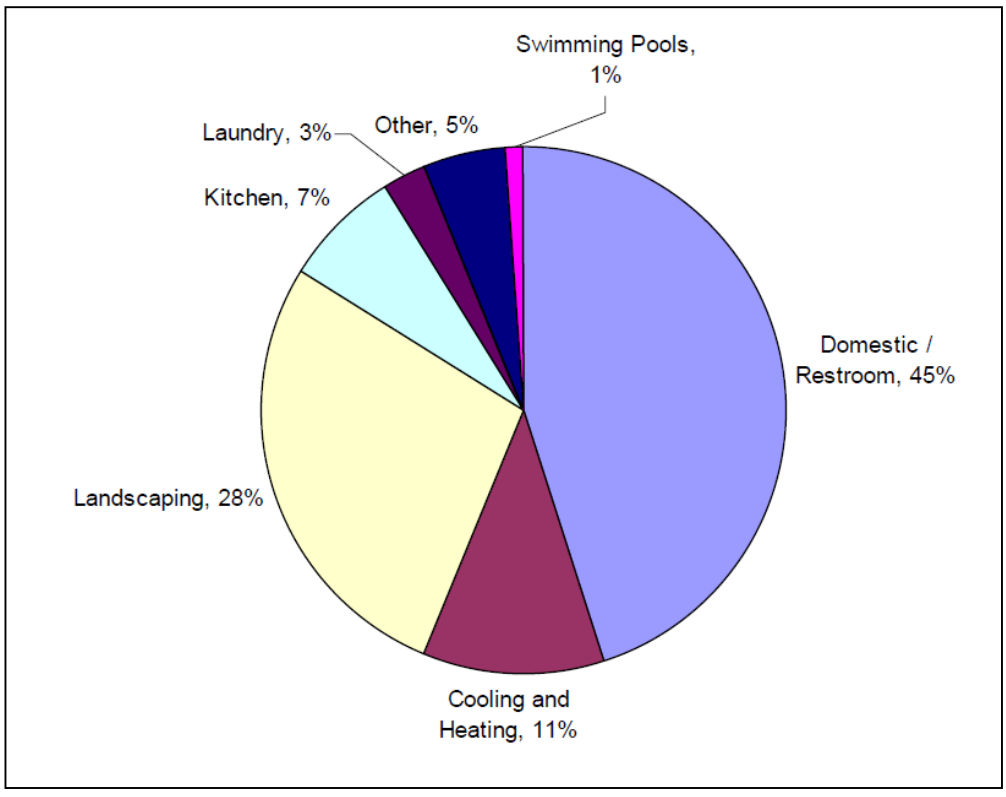

Figure 1: Typical Water Use Patterns for Schools [i]

Water savings for school facilities are generally targeted at three areas. These are

1. Restroom fixture replacement
2. Cooling tower retrofits, and
3. Irrigation efficiency improvements -- weather and moisture based irrigation controllers

Table 1 ~ Estimated Potential Water Saving Opportunities By Retrofitting School Plumbing Fixtures

Fixture Type	Minimum Water Savings	Maximum Water Savings
Toilet (tank and valve type)	20%	65%
Urinals	50%	100%
Faucets (0.5 gpm aerator)	30%	75%
Faucet (sensor control)	10%	50%
Shower Heads	20%	30%
Cooling Tower (once thru)	95%	100%
Dishwashers	15%	50%
Ice Machines (air cooled)	15%	20%
Ice Machine (water cooled)	85%	95%

The Florida Department of Environmental Protection's (FDEP) Conserve Florida Water Clearinghouse (CFWC) has developed benchmarks based on the size of HVAC school building space and the number of students. These estimated are shown below:

Table 2 ~ Benchmark Ranges for Annual Water Use for Schools in Florida

Metric	Minimum Water Use	Maximum Water Use
HVAC Space	12 gal/sqft/day	0.019 gal/sqft/day
Number of Students	1,700 gal/student/month	2,700 gal/student/month

Although these ranges are important for estimating purposes, actual water use will vary according to building's occupancy, the number of students, faculty, employees and the size and presence of water-using equipment such as cooling towers, cafeterias and irrigated areas.

The South Florida Water Management District, *Water Efficiency Improvement Self-Assessment Guide for Commercial and Institutional Building Facility Managers* (2011) provides many useful tools for identifying water use and water saving opportunities in school facilities. Successful water conservation in school buildings generally consists of three major opportunities:

1. Vigorous attention to leaks and routine leak detection. These activities can save from tens of thousand to hundreds of thousand of gallons of water per year.
2. Sub-metering where practical. These measures are best used where there are significant uses of water such as irrigation systems, cooling towers and kitchen facilities.

3. Cooling towers are often the single greatest point of water conservation opportunities.

Energy Policy Act of 1982

The Energy Policy Act of 1992, effective on January 1, 1994, has become the accepted baseline for measuring the savings of new water conserving plumbing fixtures as well as establishing the baseline for water conservation performance under programs such as the United States Green Building Council's LEED rating program and the Environmental Protection Agency's WaterSense program. Performance standards for the 1992 Energy Policy Act are shown below:

Table 3 ~ Federal Energy Policy Act of 1992 Standards for Water Use

Fixture Type	Flow Rate
Toilets	1.6 gal./flush
Urinals	1.0 gal/flush
Showerheads	2.5 gpm @ 80 psi 2.2 gpm @ 60 psi
Lavatory Faucets	2.2 @ 60 psi
Public Faucets	0.5 gpm (max)
Kitchen Faucets	2.2 @ 60 psi

PERFORMING THE WATER AUDIT

A water audit is a systematic evaluation of the use of water by the school building. A water audit identifies the total water supplied to a water system and then identifies how water is consumed. The water that is consumed by the system consists of the amount of water that is measured by meters or sub-meters that are installed at the school. FRWA then estimated the expected use of water from all forms of water use based on the number of students, faculty, employees and other outside uses of the building. Other uses such as food preparation, dishwashing, cleaning, flushing and irrigation are estimated using investigation and estimates based on normal practices.

These categories were then broken down by water uses that can be identified as actual authorized uses and water that is apparently lost by unauthorized consumption, metering inaccuracies and various forms of leakage.

The water audit found water use in the five schools was primarily confined to potable uses by students, faculty, and staff with shower facilities in the middle and high schools. Usage was limited to general business hours. School visitors did not significantly contribute to water use.

The age and condition of schools and the plumbing fixtures were part of the audit. The five schools were all older than ten years – portions being constructed in the mid-1970s, the newer additions constructed in the 1980s or 1990s. Toilet fixtures in the school include an equal mix of tank and flushing valve toilets. In the older buildings, toilets were 3.0 gallons per flush valve design or the standard 3.5 gallons per gravity flapper type water closets. Newer 1.6 gallons per flush toilets tended to be in more recent construction. Faucets, like the toilets were an equal mix of conventional manually operated a faucets and metered faucets.

Plumbing facilities were found to be in generally excellent condition with few leaks discovered during the survey. Fixtures were very well maintained and it was obvious that plumbing problems were corrected immediately after they were discovered or reported.

Potable water supply to the schools was typically supplied by the adjacent municipality through one or two metered connections. Five to ten years or water meter readings where obtained from the municipality providing in-depth demand analysis and determine of base flows –notably under summer conditions when the school has very limited use. Newer records over the last 24 months were used to determine the average water use trends at the school.

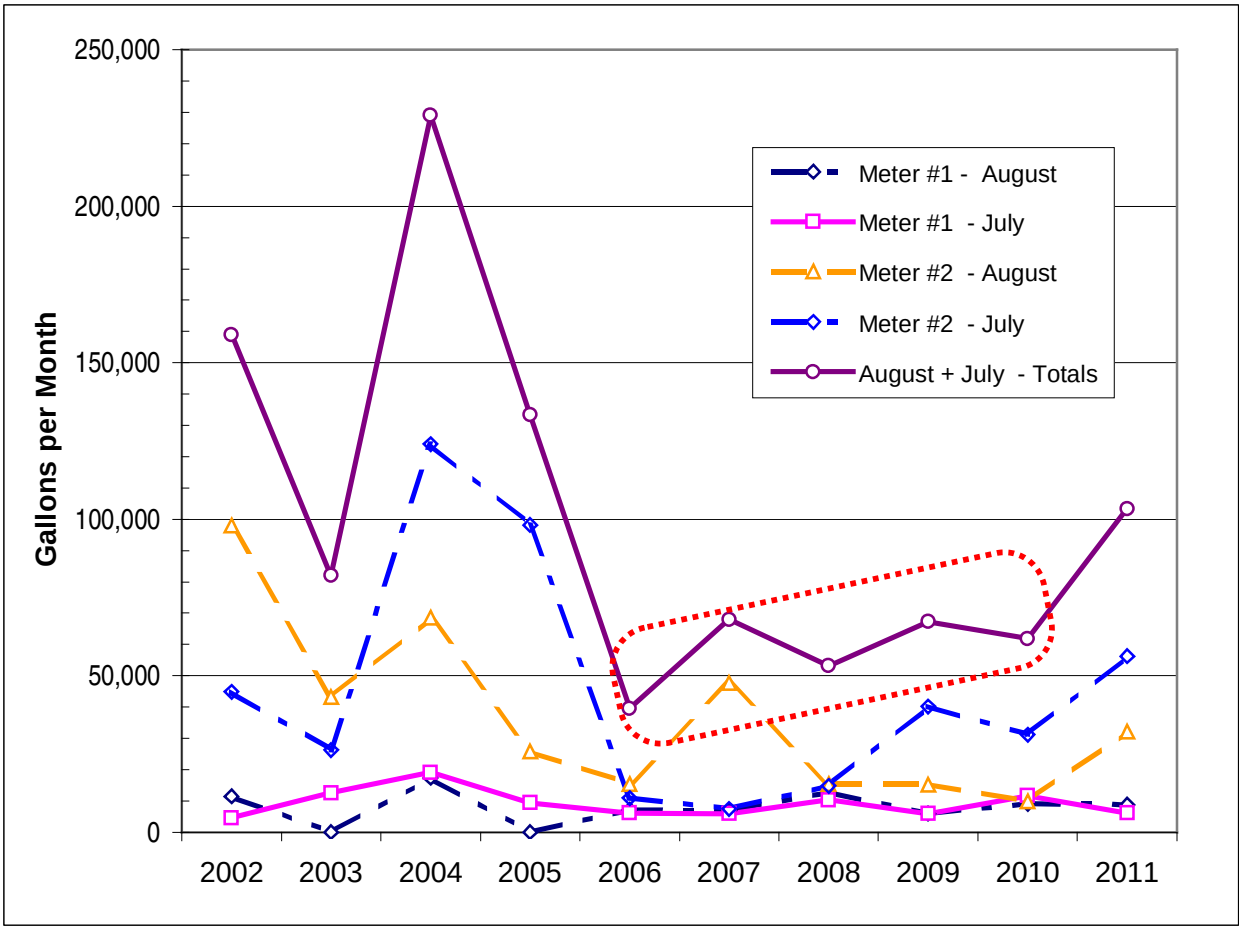

Figure 3: Plot of July/Aug Base Water Demand for the sample school

Based on the analysis above, the base water use for any one month is about 25,000 gallons (50,000 gallons / 2 months) as shown in the circled area in Figure 3. The 25,000 gallons per month represents base water use at the school assumed to be water used by janitorial employees and staff visits during the summer months and any water lost by outside leaks or leaking plumbing fixtures that might be discovered in the survey.

ACTION PLAN AND RECOMMENDATIONS

The action plan embodies mostly physical water conservation efforts. The plan is a natural development of the process and grows out of site inspection and observations. The water audit identifies problems (or challenges) and the data collection and tabulation highlights areas for improvement. From this activity conservation measures are classified, alternatives are considered, and the action plan is formulated in three recommended phases.

PHASE ONE MEASURES

The First Phase is the easiest to be implemented with immediate water saving benefits. Theses recommendations achieve the highest cost savings at the lowest cost. Phase one recommendations represent the lowest hanging fruit or those measures with a payback of 5 years or less – also complying with the promised $15,000 matching grant allotment from SRWMD. Schools may use in-kind services to purchase, maintain or install new parts or plumbing fixtures that fit within the first year of the budgeted amount. This gives the equivalent $30,000 project for the school. The maintenance staff installs plumbing fixtures. For this phase FRWA also provides an estimate of the amount of irrigation water being applied and suggests lower agronomic rates for irrigating.

1. **Leaks.** The maintenance procedures used at the five schools were generally outstanding and few leaks were discovered during this survey. Leaks were confined primarily to portable buildings. Fixtures were found to leak only when activated – toilets and urinals. Units easily repaired but not in common view of the maintenance staff.

2. **Base Water Loss.** The water audit established the benchmark base water for each school, which was typically about 25,000 gallons per day or about 25% of the average monthly use. Identifying the base water flow becomes the target for conservation recommendations. This use is approximately the amount of water that would be lost by one sticking metering faucet valve or a non-sealing toilet tank flapper. For this reason FRWA recommended additional maintenance procedures to catch these leaks early.

3. **Self-Regulating / Metering Faucets** are used to service about 40% of the lavatories surveyed in this study. For the most part, the metering faucets were providing good water and cost savings. FRWA found less than ten-percent (10%) of metering faucet valves that were significantly exceeding the manufacturers stated 0.2 gallons per flush flow rate. These valves are likely scaled and the valve inserts need replacing.

4. **Adjusting Metering Faucets.** On the low water use end, it was discovered that about 40% of the metering faucets were operating with a cycle time of less than 5 seconds. Manufacturer recommendations for these valves set the acceptable flow duration between 5 to 10 seconds. The Americans with Disabilities Act (ADA) guidelines set the acceptable flow duration restroom faucets at 10 seconds. When metering valves do not provide sufficient cycle time, there is a tendency to punch the valve several times to get enough water to wash one’s hands. This results in excessive water use defeating water conservation goals.

For this reason FRWA recommended self-regulating / metering faucets be adjusted to an original setting or a flow rate of eight (8) seconds. It was also recommended that metering valve inserts be replaced at this time. The unusually high amount of short-cycling valves was likely due to normal scaling and fouling that occurs after extended periods of use.

5. **Manual Faucets** were in excellent operating condition with only one or two faucets found to be inoperative in each school. About 60% of the faucets that served restrooms were of the manual type. Only a handful of these faucets had flow rates in excess of the EPA 1992 guidelines of 2.2 gallons per minute with only one or two manual faucets producing a low flow rate under the current standard of 0.5 gallons per minute.

   Manual faucets can easily and inexpensively be retrofitted using a low-flow aerator. The aerator costs typically less than two dollars ($2) and reduces faucet flow to 0.25 gallons per cycle. It is likely that some of the restroom faucets will not accept the new aerator and need to be replaced. The cost of conventional faucet replacement to accommodate an aerator was estimated at $50 per unit versus the $250 per unit for retrofitting a metering faucet. Where replacement is needed, it will fit directly in the same slot as the old faucet.

6. **Toilets** represent the greatest water loss and have the most potential for water savings compared to any other plumbing fixture. Most of the toilets used in the five school used flushing valves. The older flush valve toilets deliver a maximum volume of 3.5 gallons per flush whereas newer varieties deliver 1.6 gallons per flush – about 20% were of the newer low-flow style.

   The survey showed that Sloan manufactured toilet flush valve was commonly used and the metering insert is interchangeable between valve units. Sloan recommends against retrofitting 3.5 gpm valves with 1.6 gpm because of poor flushing action and solids removal, however independent studies indicate that good flushing results can be successfully achieved with floor mounted toilet tanks.

   FRWA recommended that the school pilot test a few toilets and record the results. If the valves could be downsized to accommodate lower flow, water savings would be over 50% for each toilet and represent an immediate water savings of over ten-percent (10%) of the current water used each month at the school.

7. **Tank Toilets.** About half of the toilets identified in the study were water closet / tank design. Most of the water closets were of the 3.5-gallon per flush variety. New standards require the tank toilets to use 1.38 gallons per flush (1.6 gallons under normal pressure conditions). Although testing of the tank toilets did not identify any leaks, after a number of years the flapper valves that are exposed to chlorine and more aggressive chloramines will start to develop leaks. Because of the age of these toilets more than years old it was likely that leaks would be imminent. Water closet leaks are not immediately obvious or noticed – the toilet will be inactive as in leaks for several hours and then periodically comes on to refill the water closets. These leaks are silent but significant.

Replacing the existing water closet toilets with newer higher efficiency toilets would cost from $9,000 to $12,000 but would save a minimum of 90,000 gallons of water per year – the payback is minimal. Better water savings were anticipated by replacing the flapper valves with more durable materials. These high efficiency tank toilets provide the same water savings as installing flush valve toilets at a fraction of the cost. Additional water savings would be accomplished because the tank flush control mechanisms that have served their useful life would also be replaced.

8. **Urinals**. The survey typically found one-gallon per flush urinals installed at the schools. The majority of units were found to be in excellent operating condition. Urinals are an extremely effective way to reduce water use since they use as little as 0.5 gallons per flush versus the 1.6 gallons per flush by a flushing valve or high efficiency tank toilet. Installing new urinals in existing restrooms was not recommended because of high cost – retrofitting the toilets with a low-flush tank was found to be more cost effective. Urinal installation was estimated at $3,000 each versus the $500 cost for the new low-flush tank. The water savings provided by the urinals currently in use was marginal when compared to the low flow toilets now available.

9. **Urinal Retrofits.** It is not recommended that existing urinals be retrofitted with the lower flow 0.5- gallons per flush valves that would replace the 1.0- gallons per flush valves currently in place. This would likely cause poor flushing conditions and would lead to unpleasant odors. In addition, the cost of retrofitting to waterless urinals was not recommended because of the high cost and maintenance that would be required.

10. **Showerheads.** Some of the showerheads identified in the survey were nonfunctioning because of calcification and valves problems -- only one or two had an aerator attached and had a flow rate of about 10% of the others. Tests indicated that the single aerator lowered the average shower from 5.9 gpm for the group to 0.9 gpm. FRWA recommended that all showerheads be repaired and retrofitted with 1.3 gpm aerators.

11. **Kitchen, Laundering and Athletic Facilities.** Kitchen, laundering, and athletic facilities use significant amounts of water for rinsing, cleaning, wash down and ice-making. Significant attention in recent years by DOE and EPA have encouraged public schools to replace these aging devices with new appliances and fixtures that meet EPA WaterSense guidelines. The survey included a visual inspection and flow test of faucets as well as inspection of appliances that included recording the serial/model numbers for future reference.

12. **School Ground and Athletic Field Irrigation.** Irrigation at school grounds and athletic fields was typically provided by on-site wells. The wells are operated manually and are maintained by the maintenance staff at the school. The wells are operated about 20 minutes per day, one day per week, and feed preprogrammed zones to maintain adequate pressure for the sprinkler heads. During hot dry periods, the wells are manually run, and activited more frequnetly to maintain the the health and apprearance of the turf. The irrigation requirement for the athletic fields relates to the amount of rainfall received. Although the area receives substantial rainfall, dry periods are common in the late spring and fall. The

dry period in the spring coincides with peak plant water needs due to increasing temperatures, solar radiation, and day length. Due to relatively shallow roots, turfgrasses typically require irrigation at least once a week to maintain quality. On sandy soils, some grasses may need to be irrigated at least two days a week to ensure acceptable quality (Shedd et al., 2008). This requirement occurs about 42% of the time.

PHASE TWO AND THREE MEASURES

The Second Phase of the program identifies capital outlays that exceed $150,000. The recommendations identify future projects should the school install replacement fixtures due to maintenance issues or disruptions, or a potential funding source is found (such as the home utility that may want to participate by providing rebates for inefficient toilets).

The Last Phase (Phase Three) is generally associated with reclaimed water projects and requires a significant capital investment greater than $250,000. Schools have large irrigated athletic areas ideal for water reuse. FRWA identifies the potential sources of reclaimed water; provides a cost opinion to expand the wastewater treatment plant and reuse system; and proposes a reclaimed water main route to the educational institution and where additional customers may be picked up along the route. The groundwork is laid for future reuse projects some for which the Suwannee River Water Management District previously participated.

Table 4 ~ Phase One Recommendations

Category & Description	Estimated Cost	Water Savings (gal) Day/Mo/Yr.	Cost Savings / year	Payback Period
1. Metering Faucets				
a. Replace all Inserts on Metering Faucets.	$2,650 Parts $2,650 Labor $5,300	69 gpd 1,000 gpmo 12, 000 gpyr	$30 Proactive Normal Maintenance	3 to 5 yrs
b. Reset metering Faucets to 8 sec with short duration.	Costs included in a. above.	69 gpd 1,000 gpmo 12, 000 gpyr	$30 Proactive Normal Maintenance	Immediate
c. Address faucets with sticking valves by replacing cartridge.	Costs included in a. above.	22.5 gpd 340 gpmo 4, 000 gpyr	$10 Proactive Normal Maintenance	Immediate
2. Manual Faucets. Install aerators on all manual faucets in locations that serve bathrooms	$380 Parts $1,900 Labor $2,500	104 gpd 1,560 gpmo 19,000 gpyr	$50	3 to 5 yrs
2. Metering Toilets				
a. Replace diaphragms on Flushing Valves in 83 locations.	$4,200 Parts $4,200 Labor $8,400	-0-	Proactive Normal Maintenance	Immediate
b. Replace Flapper Valves and float assembly on tank toilets.	$ 225 Parts $ 225 Labor $ 450	22.5 gpd 340 gpmo 4, 000 gpyr	Proactive Normal Maintenance	Immediate

Category & Description	Estimated Cost	Water Savings (gal) Day/Mo/Yr.	Cost Savings / year	Payback Period
4. Water Fountains - Repair non-operable fountains.	$450 Parts $450 Labor $900	Normal Maintenance	Normal Maintenance	Immediate
Total	**$16,550**	**47,000**	**$290**	**> 30 yrs**

Table 5~ Phase Two Recommendations

Category & Description	Estimated Cost	Water Savings (gal) Day/Mo/Yr.	Cost Savings / year	Payback Period
1. Manual Faucets Replace manual faucets in locations that serve bathrooms (31 locations)	$10,000 Parts $ 3,000 Labor $39,600	300 gpd 5,000 gpmo 55,000 gpyr	$140	< 30 yr.
2. Toilets Replace tank type toilets with high efficiency models in 15 locations.	$ 5250 $ 1,500 $ 6,750	372 gpd 5,600 gpmo 67,000 gpyr	$170	> 30 yrs
3. Urinals Add Urinals in 10 Locations	$17,500	200 gpd 3,000 gpmo 15,000 gpyr	$35	> 30 yrs
Summary of Water Savings & Costs	**$63,850**	**137,000 gpyr**	**$345**	**> 30 yrs**

Table 6~ Phase Three Recommendations

Category & Description	Estimated Cost	Water Savings (gal) Day/Mo/Yr.	Cost Savings / year	Payback Period
Reclaimed Water ~ 8,500-ft 6"& 8" PVC main for irrigation service.	$200,000	4.3 M-gallons	- - -	> 30 yrs

CONCLUSION & MOVING FORWARD. This program is carried forward from year to year, with the only stipulation in using the SRWMD funds being that the measure has been identified in the FRWA report. Similar conservation measures may be installed at any school within the district or throughout Florida. The steps employed in the survey, the forms and mathematical analysis used and the findings will be presented in this paper.

END NOTES

i-Source: Created from analyzing data in: New Mexico Office of the State Engineer, *Water Conservation Guide for Commercial, Institutional, and Industrial Water Users*, July 1999 (original source: City of San Jose Environmental Services Department); Dziegielewski, et. al., *Commercial and Institutional End Uses of Water*, 2000; East Bay Municipal Utility District, *WaterSmart Guidebook: A Water Use Efficiency Plan Review Guide for New Businesses*, 2008; American Water Works Association, *Helping Businesses Manage Water Use, A Guide for Water Utilities.*

Bibliography and references available upon request