



WASTE
REDUCTION
PARTNERS

ABC Elementary School

Water Efficiency Assessment

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Big City, Water Resources Department

DATES

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Executive Summary

This report identifies the major source of water consumption by the ABC Elementary School located in Gary, NC, and provides options for reducing water consumption. This investigation also references how energy efficiency interfaces with water usage for the equipment and appliances examined on this assessment. Considerations for recycling of typical waste streams for Smith County Schools are also reviewed.

Summary

The major pieces of equipment used for heating and cooling the facility are high-quality, relatively modern units, both water- and energy-efficient, and are well maintained. Kitchen appliances are also well-designed pieces of equipment with efficient, dependable performance histories. Greatest opportunities for water conservation exist in the upgrade of the many bathroom fixtures found throughout the building. This improvement in domestic water usage will afford an estimated 55.5% reduction in consumption.

Water Consumption Snapshot

The total water usage for the school year July, 2008, through June, 2009, is **1,744,336 gallons**. The total cost of water for that same period is **\$16,644.12**; (Water \$7523; Sewer \$9121).

Daily water consumption per student (2008-2009)*: 5.9gpd
 Annual water consumption per student (2008-2009)*: 2,146gpy

* Based on 365 days per year

Benchmark for daily water consumption per student: 4.7 – 7.4gpd / student
 Benchmark for annual water consumption per student: 1,700 – 2,700gpy / student

Water Efficiency Recommendations

Opportunity Area	Recommended Action	Savings (Gallons per year- (gpy))	Savings (\$/yr)	Investment (\$)	Simple Payback (Yr)
All student and staff bathrooms	Replace 60 old-style 3.5 gpf toilets with 1.28 gpf high efficiency toilets.	693,163	6,152	12,000	2.0
All men's and boys' bathrooms in all locations.	Replace 21 old-style 3.5gpf or 1.6gpf urinals with 0.13gpf ultra high efficiency urinals.	190,717	1,692	5,250	3.1
All bathrooms	Replace all faucets with metered 0.5gpm high efficiency faucets.	84,225	748	3,750	5.0
Total		*968,105	8,592	21,000	2.4

Gpf = gallons per flush; gpm = gallons per minute
 * 55.5% improvement in overall consumption

Water-Efficiency Assessment Report

1.0 Introduction

On March 9, 2010, the ABC Elementary School participated in the Water Efficiency Assessment Program sponsored by the Water Resources Department of the City of Big City (COC). The goal of this program is to promote cost-effective water conservation techniques among the major users served by COC. As part of this program the Waste Reduction Partners (WRP) Program, administered by the Land-of-Sky Regional Council, provided ABC Elementary School with on-site technical assistance on March 9, 2010. WRP assessors, David Monroe and Jill Duke, and ABC Elementary School maintenance engineer, Joe Smith, conducted a water efficiency assessment to identify major water use areas and develop water-reduction options. Joe Smith led a tour of requested areas within the facility and answered questions from the assessors about the facility operations. Other members of the school staff were called upon when needed for additional information.

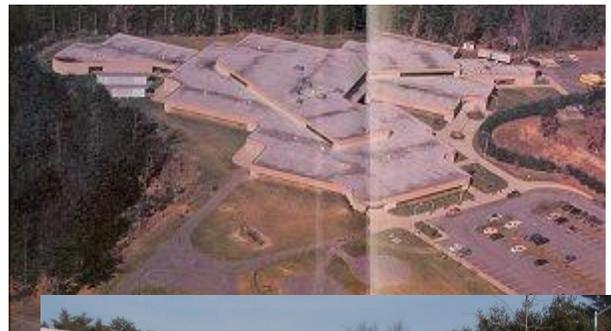
The following report, prepared by WRP staff, contains a description of the facility, arrangement of classroom sections, historical water use, a water-balance chart, options for water reduction, and potential savings calculations. Other waste reduction, energy conservation, and important resource information has been included where applicable.

2.0 Facility Description

2.1 Early History

ABC Elementary School was built and established in 1980 as a kindergarten through fifth grade school in the Roberson School District. The school was named after Robert Davis, its first principal. The architectural design featured a central core, containing the library, theater, and gymnasium, with eight pods, which contained the classrooms, branching from the core. Each of the pods was named to highlight some historical area of Gary and its surroundings. The pods are aptly named as follows: Richman Pod, Burke Pod, Buena Vista Pod, English River Pod, Indian Pod, Robin Pod, Springs Pod, Carnegie Pod. The pod concept was particularly helpful in this assessment, because the bathroom facilities are identical in each of the pods. Thus, it was necessary to inspect only one of the pods in detail and then to expand those findings to include the fixtures in all of the pods. Buena Vista Pod was the area examined in detail.

Aerial View of ABC Elementary Pods



Approaching ABC from the parking lot

2.2 Facility Size

ABC Elementary School is a single-story structure with a 115,153 square-foot footprint and a rather irregular perimeter. No additions to the original size have occurred.

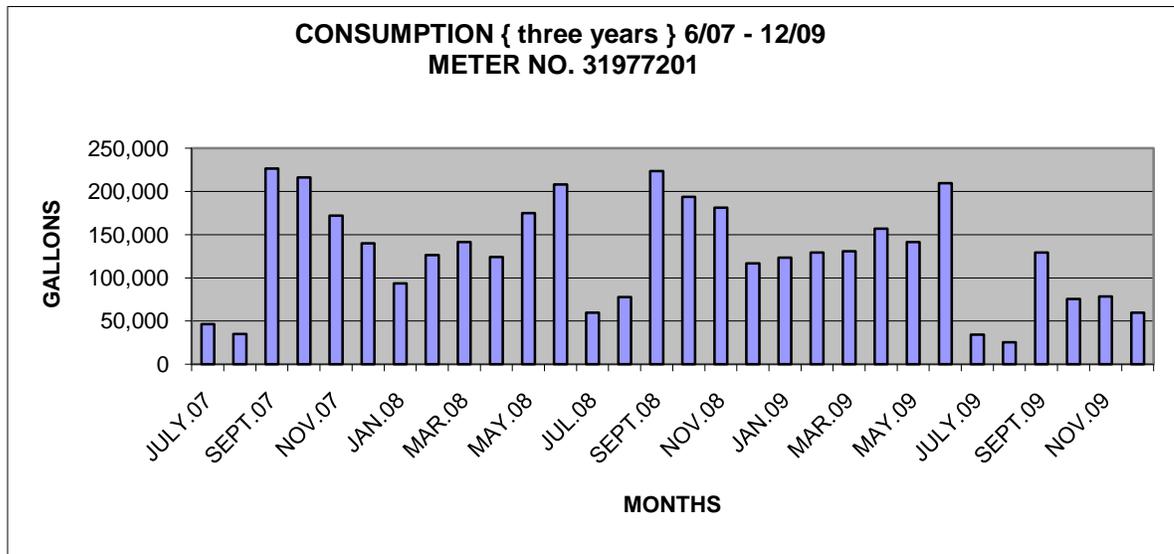
2.3 Personnel and Student Count

ABC Elementary employs a staff of 125 persons, including teachers, assistants, cafeteria personnel, and all other specialists. There are 813 students, distributed throughout kindergarten to fifth grade. The first grade consists of seven classes with an average 20 students each; the other grades have six separate classes each, with an average of 20-25 students per class. ABC Elementary also offers a Progressive Education Program (PEP) that provides services and training to students with moderate to severe mental and/or physical disabilities. There are four PEP classes with five to seven students each.

3.0 Water Consumption

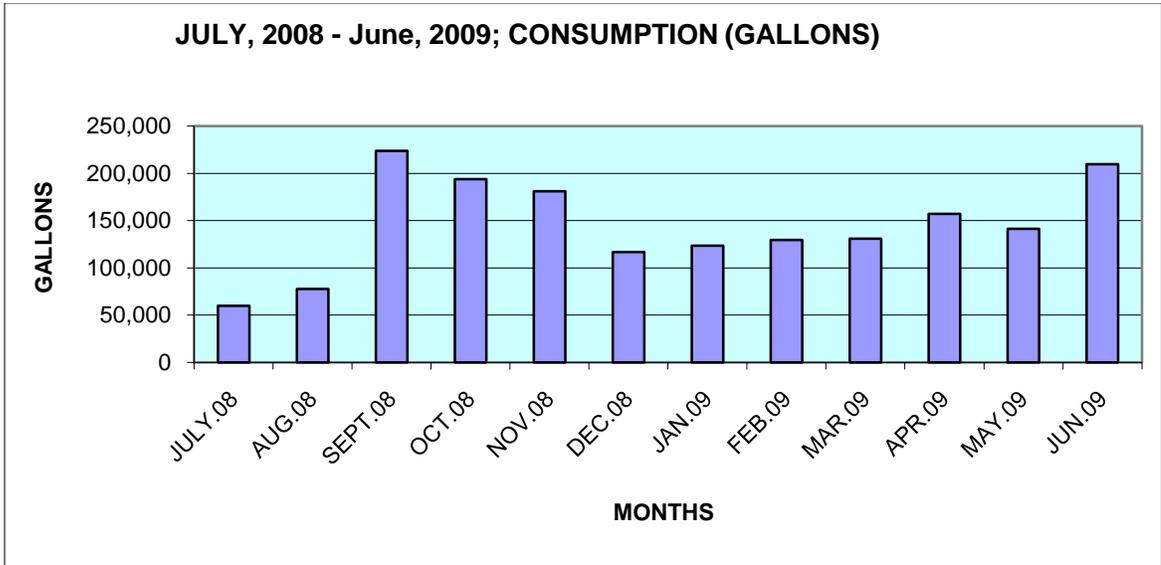
3.1 Historical Water Use

The graph below profiles the overall water usage at ABC Elementary School during the most recent three years on record.



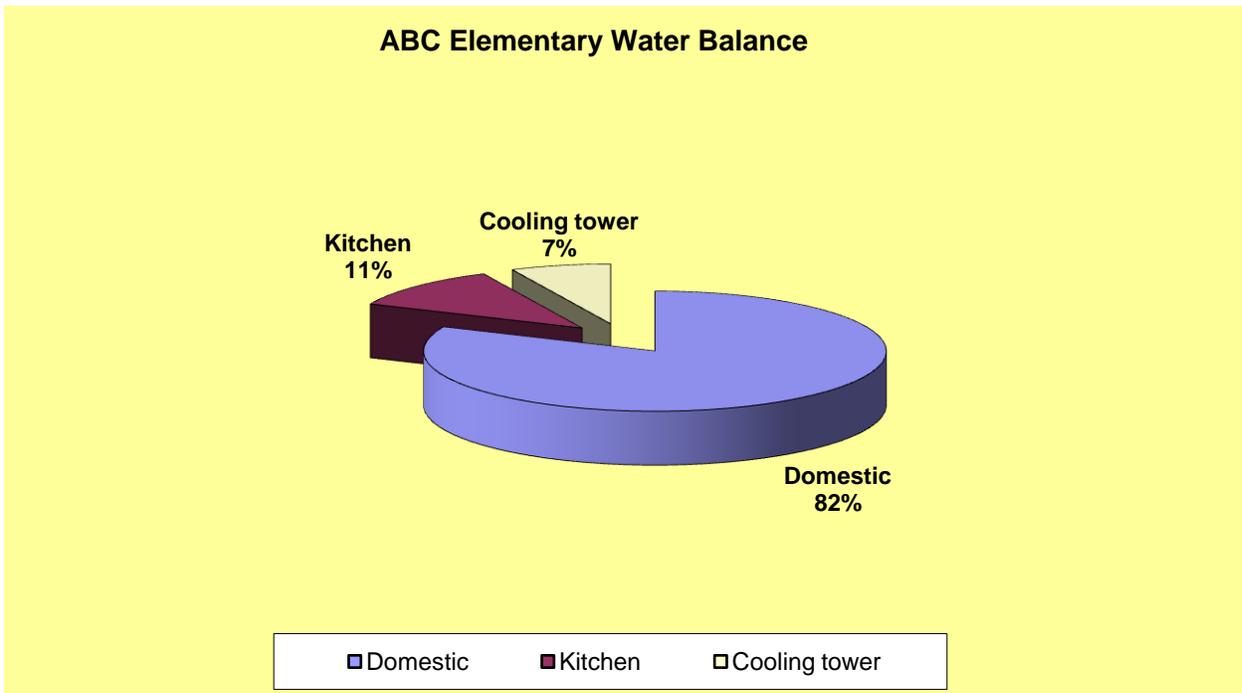
The display shows fairly consistent water usage over the full school years, July 2007 through June 2008 (1,704,692 gallons), and July 2008 through June 2009 (1,744,336 gallons). There is a decrease of approximately 50% in water consumption in the year, beginning in July 2009, and extending through the present time. The reasons for this large decline are not clear from the information provided with this assessment. There has been a 10-15% decrease in student enrollment during that period, but this alone could not account for such a substantial drop off in water usage.

The graph below is an expansion of the water consumption data for the school year, July 2008 through June 2009. The usage decline for the summer months is obvious.



The school year shown, July 2008 through June 2009, will be the focus of the calculations and water balance covered in this report.

3.2 Water Balance



4.0 Water-efficiency Measures and Options

4.1 Current Water-efficiency Measures

ABC Elementary is already equipped with a number of high-quality commercial units for water and energy conservation.



Boiler Room

The Safgard, Model 750 hot water boiler lists the following protective features:

- Automatic burner shutoff – prevents boiler damage in low water conditions.
- Manual reset – will not lock out in power failures.
- Low maintenance design – has no moving parts to wear, stick, or hang up, such as those found in float devices.

A Bradford White 200R5-STA energy-saver hot water storage tank is lined with a porcelain-like ceramic interior to prevent corrosive effects of hot water.

Hot water tank

All hot water lines from these pieces of equipment and for general hot water transport are well insulated to prevent heat loss.

Cooling Tower

The Evapco UT induced draft, counterflow design cooling tower is a modern, efficient unit for evaporative cooling. Regular chemical treatment, with a concentration ratio maintained at a value of 7.5 – 8, is carried out by Andy Jenkins of Charlotte Chemical. This range of a concentration ratio is considered to be at a water conserving. Makeup water for the cooling tower is metered, and Andy's carefully managed records show that 122,112 gallons were used in school year 2008 – 2009 for cooling tower makeup water. This is a modest 7% of total annual water consumption.



Evapco cooling tower

Kitchen and Cafeteria



Hobart 66" single rack dishwasher

Kitchen water usage is significant, since ABC Elementary serves full hot lunches and has Title 1 designation, with 32% of the student body eligible for free lunches and 7% eligible for reduced-cost lunches.

The Hobart (Model CRS-66) 66-inch single rack commercial dishwasher transports 122 trays per hour and uses approximately 130 gallons of water per hour. Minimum wash temperature is 160 deg. F, and minimum

rinse temperature is 180 deg. F. Estimated usage is six hours per day, five days per week.



Scotsman ice chest

The pre-rinse sprayer delivers an efficient 1.6 gallons per minute of pressurized spray.

The Scotsman B330P Energy Star, air-cooled icemaker produces cube slices for the use of about 150 lb. of ice per day.

Stainless steel faucets and tubs are used for pot scrubbing and some thawing of frozen vegetables. Kitchen

staff members try to anticipate needs and pre-thaw vegetables as much as possible to conserve water.

Domestic Water Usage

Domestic water consumption in bathrooms and communal lavatory areas dominates the ABC Elementary water balance. Most fixtures are from the original construction of the building and are old model higher-flow toilets and faucets. There are 60 toilets @ 3.5 gallons per flush (gpf); 3 urinals @ 3.5gpf; 18 urinals @ 1.6gpf; 42 faucets @ 1.5 gallons per minute (gpm) average; 30 faucets @ 1.7gpm; 2 faucets @ 3.5gpm; 1 faucet @ 5gpm. At least 10 faucets are missing aerators. The best water-saving and cost-saving opportunities will be in replacement of toilets and faucets with high-efficiency units. Domestic water consumption at ABC for school year 08/09 is 1,423,684 gallons.



PEP laundry appliances

In the PEP section of the school there is a small kitchen area with two stainless steel sinks and a household-sized clothes washer and dryer. The kitchen area is used by the PEP teachers and staff, and the laundry appliances are used for towels and other flat goods from the PEP kitchen and classrooms. Water usage in this area is probably not more than 30 gallons per week and is not considered a significant factor in these estimates.

4.2 Recommendations for Cost-saving Upgrades

- Replace 60 Sloan, Zurn, or Delaney 3.5gpf flush valve toilets with 1.28gpf (or less) high efficiency toilets.
- Replace three Delaney 3.5gpf urinals with 0.13gpf high efficiency urinals.
- Replace 18 Delaney 1.6gpf urinals with 0.13gpf high efficiency urinals.
- Replace 75 faucets @ 1.7gpm (average flow rate) with metered 0.5gpm high efficiency faucets.

Large volume purchase cost for fixtures*: toilets, \$200; urinals, \$250; faucets, \$50.

*(Estimated fixture pricing is based on the cost of water saving fixtures in similar school systems. Smith County Schools will need to adjust payback periods according to pricing structures established with corresponding vendor choices.)

Opportunity Area	Recommended Action	Savings (Gallons per year- (gpy))	Savings (\$/yr)	Investment (\$)	Simple Payback (Yr)
All student and staff bathrooms	Replace 60 old-style 3.5 gpf toilets with 1.28gpf high efficiency toilets.	693,163	6,152	12,000	2.0
All men's and boys' bathrooms in all locations.	Replace 21 old-style 3.5gpf or 1.6gpf urinals with 0.13gpf ultra high efficiency urinals.	190,717	1,692	5,250	3.1
All bathrooms	Replace all faucets with metered 0.5gpm high efficiency faucets.	84,225	748	3,750	5.0
Total		*968,105	8,592	21,000	2.4

Gpf = gallons per flush; gpm = gallons per minute
 * 55.5% improvement in overall consumption

4.3 Normalized Data

Based on occupancy of 813 students and 125 staff members (938 individuals), the domestic water usage for school year, July 2008 to June 2009, is 1,423,684 gallons. This represents 81.6% of the total water consumption of 1,744,336.

Daily water consumption per student (2008-2009)*: 5.9gpd
 Annual water consumption per student (2008-2009)*: 2,146gpy

* Based on 365 days per year

Benchmark for daily water consumption per student: 4.7 – 7.4gpd/student¹
 Benchmark for annual water consumption per student: 1,700 – 2,700gpy/student¹

(1) Source: Benchmarking Task Force Collaboration for Industrial, Commercial and Institutional Water Conservation, Colorado Waterwise Council, June 2007.

5.0 Other Waste Streams

Opportunities for recycling of mixed paper, cans, and plastic bottles were initiated in the Smith County Schools in 2004. ABC Elementary was provided with classroom bins, rolling carts, and information sheets for recycle implementation. These efforts should be reviewed and reinforced for a robust and successful recycling effort.

ATTACHMENTS

Calculations for ABC Elementary School

I. Kitchen Water Consumption

DISHWASHER

- Hobart Model CRS-66; 66" single rack commercial dishwasher. Water consumption: approximately 130 gallons/hour.
- Assume dishwasher is used 6 hours per day, each day school is in session. (Kitchen staff uses dishwasher from 7 a.m. to 2 p.m. with one-hour break for lunch.)
- Water use estimate: 130 gallons per hour x 6 hours per day x 180 days = 140,400 gallons per school year.

FAUCET USE IN STATIONARY STAINLESS STEEL SINKS

- Kitchen equipped with two s/s double sinks, dimensions 24"x24"x12".
- Assume two basins filled to 6" depth. Combined volume $2(24" \times 24" \times 6") = 6912$ cu. in. = 4.0 cu. ft. of water.
- Assume basins are filled 6 times per day. 4.0 cu. ft. x 6 = 24 cu. ft. of water per day.
- 24 cu. ft. x 7.48 gallons/cu. ft. = 180 gallons per day to fill s/s basins.
- Water use estimate: 180 gallons per day x 180 days = 32,400 gallons per school year.

PRE-RINSE SPRAYER

- Flow rate of 1.6 gallons per minute. Estimate 4 sec. (0.067 hr.) per rack x 122 racks/hr. = 8.1 min. pre-rinse/ hr. of dishwashing.
- 8.1 min./hr. x 6 hrs./day = 49 min. per day.
- 1.6 gal. per min. x 49 min. per day = 78 gal. per day.
- 78 gal. per day x 180 days = 14,040 gallons per school year.

ICE MACHINE (Scotsman Energy Star, air cooled)

- Estimate 3 oz. (0.19 lb.) ice per student/day x 800 students = 152 lb./day. This amount of ice requires 45 gallons of water/day.
- 45 gallons per day x 180 days per year = 8,100 gallons per school year.

FLOOR SCRUBBING

- Estimate 20 gallons per day x 180 days per year = 3,600 gallons per school year.

TOTAL KITCHEN WATER USAGE: 140,400 + 32,400 + 14,040 + 8,100 + 3,600 = 198,540 gallons per year.

198,540 gallons per year/1,744,336 gallons total consumption = 11.4% of total.

II. Evapco Cooling Tower Water Makeup

- Metered measurement for 2008 – 2009 school year cooling tower makeup = 122,112 gal.
- 122,112 gallons/1,744,336 gallons total consumption = 7.0% of total.

III. Domestic Water Usage

- 1,744,336 gal. total – 198,540 gal. kitchen usage – 122,122 gal. cooling tower usage = 1,423,684 gallons domestic usage (by difference).
- 1,423,684 gallons for year/1,744,336 total gallons for 2008-2009 = 81.6% domestic.

IV. Domestic Water Consumption Savings

- Assumptions: All toilets and urinals are used equally. Allow one flush per fixture.
-

- (There are 81 (total) toilets + urinals.]
- One hand wash occurs for every toilet or urinal usage.
- All eight pods have fixtures identical to those in Buena Vista Pod.
(Buena Vista Pod was inspected in detail with flow measurements.)

Faucet count: 42 faucets @ 1.5gpm = 63gpm
 30 faucets @ 1.7gpm = 51gpm
 2 faucets @ 3.5gpm = 7gpm
1 faucet @ 5 gpm = 5gpm
 Totals 75 faucets 126gpm

Average flow rate per faucet = 1.7gpm

For the following tabulated results, one hand wash takes place for every use of toilets and urinal fixtures. There is a total of 81 toilets and urinals.

FIXTURES	NUMBER/gpf	TOTAL GALLONS (with current fixtures)	TOTAL GALLONS (after high efficiency fixture replacement)
Toilets	60 / 3.5	210	76.8 (after 1.28gpf replacement)
Urinals	3 / 3.5	10.5	0.39 (0.13 gpm replacement)
	18 / 1.6	28.8	2.34
Faucets*	75 / 1.7 (avg)	22.7	6.5 (after 0.5gpm replacement)
Overall totals		272	86.03 (after all replacements)

❖ 81 uses @ 0.28 gallons (10 sec. per hand wash @ 1.7gpm avg.) = 22.7 gallons

❖ 81 uses @ 0.08 gallons (10 sec. per hand wash @ 0.5gpm) = 6.5 gallons

Total gallons saved = **186 gallons**; (186/272 = **68.4% of domestic total**).

Cost savings for domestic water fixture replacement recommendations:

- 1,423,684 gallons per year (gpy) domestic x 0.68.4 = 968,105gpy saved.
- 968,105 gallons/748 gallons per 100 cu. ft. (ccf) = 1,294ccf.
- Cost of water: Consumption is \$3.00/ccf; sewer is \$3.64/ccf. Total is \$6.64/ccf.

1,294ccf x \$6.64/ccf = **\$8,592 per year savings.**

V. Domestic Cost Savings and Payback Period

- Replace 60 Sloan, Zurn, or Delaney 3.5gpf flush valve toilets with 1.28gpf (or less) high efficiency toilets.

$$3.5 - 1.28 = 2.22\text{gpf saved}$$

For equal use of all toilets: $60 \times 2.22 = \underline{133.2}$ gallons saved for 1 use each.

- Replace 3 Delaney 3.5gpf urinals with 0.13gpf high efficiency urinals.

$$3.5 - 0.13 = 3.37\text{gpf saved}$$

For equal use of all urinals: $3 \times 3.37 = \underline{10.1}$ gallons saved for 1 use each.

- Replace 18 Delaney 1.6gpf urinals with 0.13gpf high efficiency urinals.

$$1.6 - 0.13 = 1.47\text{gpf saved}$$

For equal use of all urinals: $18 \times 1.47 = \underline{26.5}$ gallons saved for 1 use each.

Equal use of all toilets and urinals = 81 flushes total

- Replace 75 faucets with 1.7gpm (average flow rate) with metered 0.5gpm high efficiency faucets.

$$1.7 - 0.5 = 1.2\text{gpm saved}$$

For equal use of all faucets with 81 flushes: $81 \times 1.2 \times 10/60 = \underline{16.2}$ gallons saved for 1 use each.

- Gallons saved for 1 use each with equal number of flushes and hand washes =

$$133.2 + 10.1 + 26.5 + 16.2 = \underline{186 \text{ gallons.}}$$

- 186 gallons saved/272 total gallons used with current fixtures = **68.4% of domestic total.**

- Large volume purchase cost for fixtures*: toilets, \$200; urinals, \$250; faucets, \$50.

*Estimated fixture pricing is based on the cost of water-saving fixtures in similar school systems.

Toilets 60 x \$200 = \$12,000

Urinals 21 x \$250 = \$5,250

Faucets 75 x \$50 = \$3,750

Total investment \$21,000

Total water cost savings \$8,592 per year.

Payback on investment $\$21,000/\$8,592 \text{ yr.}^{-1} = 2.4 \text{ years.}$