Smart Energy Design Assistance Center

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Primary focus is on energy efficiency and conservation
Perspectives on Water

The solution to our water problems is more rain.
   Attributed to Mark Twain

When the well's dry, we know the worth of water.
   Benjamin Franklin

Water and air, the two essential fluids on which all life depends, have become global garbage cans.
   Jacques Cousteau

Treat the earth well: it was not given to you by your parents, it was loaned to you by your children. We do not inherit the Earth from our Ancestors, we borrow it from our Children.
   Ancient Indian Proverb
The Jacuzzi Culture

- Domestic use nearly tripled from 1950 to 1995
  - Population growth
  - Higher per capita use
- People who have more money use more water

Per capita use of water

The adjacent chart derived from Aquastats data shows the wide variation in average per capita water withdrawals for domestic use from different nations. Humans need a minimum of two liters of drinking water per day to survive, which is less than one cubic meter per year.

Water footprint of individual consumers

The water footprint of an individual consumer refers to the sum of direct and indirect freshwater use by the consumer. The direct water use is the water used at home. The indirect water use relates to the total volume of freshwater that is used to produce the goods and services consumed by the consumer.

- The global average Water Footprint is 1240 m³ water/person/year.
- The Chinese average is 700 m³ water/person/year
- The United States average is 2480 m³ water/person/year
- The Finnish average is 1730 m³ water/person/year.
- The water footprint of the UK is 1695 m³ water/person/year.

http://en.wikipedia.org/wiki/Water_footprint
Water Concerns

- Seasonal water shortages
- Water use restrictions
- Aquifer drawdown
- Surface water pollution
- Contaminated groundwater
- Increasing population in arid areas
- Land Subsidence
Examined four facilities
- Chicago City Hall
- Chicago Cultural Center
- 11th District Police Station
- Garfield Community Center
Purpose of (limited) Study

- Identify cost effective water conservation opportunities
- Study Examined
  - Water closets
  - Urinals
  - Faucets
  - Showerheads
  - Once through cooling systems
  - Landscape irrigation
Energy Policy Act (EPAct)

- 1992 the National Energy Policy Act (H.R. 776) went into effect and mandated 1.6 GPF toilets for the entire U.S.
- Before the 1950s, toilets typically used 7 gallons or more for each flush. By the end of the 1960s, toilets were designed to flush with only 5.5 gallons, and in the 1980s the new toilets being installed were using only 3.5 gallons. Today, a new toilet uses no more than 1.6 gallons of water.
Current Plumbing Fixture Standards

- Toilets 1.6 gpf
- Urinals 1.0 gpf
- Showerheads 2.5 gpm @ 80psi
- Lavatory Faucets 2.5 gpm @ 80 psi
- Kitchen Faucets 2.5 gpm @ 80 psi
Going Beyond the Standard

- WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency,
- Manufacturers and independent testing agencies are other partners
- WaterSense labeled products will be about 20 percent more water efficient than their less efficient counterparts in the same category
- e.g.: high-efficiency toilets (HETs) use less than 1.3 gallons per flush

http://www.epa.gov/watersense/
www.epa.gov/watersense/docs/matrix508.pdf
Overview of recommended technologies

- High Efficiency Toilets (HET)
- Dual flush handles
- Pint flush urinals
- Waterless urinals
- Faucet aerators
- Low-flow showerheads
- Alternative mechanical systems
Wall Mounted w/Flush Valve

- 1.28 GPF High Efficiency Toilet (HET) for flush valves
- 20% water savings over standard 1.6 gpf system
- Manual or electronic flush valves
- Easy to incorporate into new construction, expensive to retrofit
Flush Valve Retrofits - Expensive

• Solar-powered, sensor-operated Flushometers

• Available in single-flush and dual-flush models. The dual-flush model has two flush cycles:
  1.6 gpf/6.0 Lpf flush for solid waste or
  1.1 gpf/4.2 Lpf for liquid waste.

• If the user does not press a button, the Flushometer’s Dual-Flush Smart Sense Technology™ takes over and automatically initiates a flush cycle, based on how long the user remains in the sensor range. Users who stay within the sensor range less than a minute activate the reduced flush; users who stay longer activate the full flush.
Flush Valve Retrofits - Inexpensive

- Dual Flush handle retrofit for existing flush valves
- Up for liquid waste 1.1 GPF
- Down for solid waste 1.6 GPF
- Good for engaging the user in thinking about water conservation
- ~$50 (or more) for handle
Floor Mounted

- Different types
  - High-Performance Gravity feed
  - Pressure assisted
- Dual flush (0.8 to 1.6 GPF)
- WaterSense HET 1.1 to 1.28 GPG
Interesting Urinal facts

• There are an estimated 12 million urinals currently in use in the United States, and an additional 300,000 new urinals are sold for installation in new buildings or replacement of aging fixtures each year.

• Of the 12 million existing urinals, up to 80 percent (9.6 million) are inefficient units with flush volumes exceeding the current maximum flush volume allowed by federal standards—some by as much as 4 gallons per flush.

• According to data from the U.S. Department of Labor Statistics and Amy Vickers, *Handbook of Water Use and Conservation*, Water Plow Press, 2001, *it is estimated that the average urinal is flushed 18 times per day*. Savings are based on the assumption that urinals are typically used 260 days per year.

• Since the federal standards were enacted, manufacturers have developed urinals that use significantly less water than the standard 1.0 gpf fixtures. These high-efficiency fixtures can save at least 0.5 gallons of water per flush compared to standard 1.0 gpf fixtures, resulting in a savings of more than 2,300 gallons per urinal per year. Replacing older, inefficient urinals with these new high-efficiency fixtures can save even more water.
Urinal Standards & Future Goals

• Current Federal Standards are 1.0 GPF

• EPA Water Sense Program has developed a draft specification for high-efficiency flushing urinals to promote and enhance the market for water-efficient flushing urinals.

• The water-efficiency component of the draft specification establishes a maximum average flush volume of 0.5 gpf (1.9 Lpf)

• This value represents a 50 percent reduction from the current 1.0 gpf standard and is consistent with WaterSense’s stated goal of increasing product water efficiency by at least 20 percent.
Urinal Options

Low-flow
- 0.5 gpf [2.0 Lpf]
- 50% water savings over standard 1.0 gpf [4.0 Lpf] system

Ultra low-flow
- 1/8 gpf [0.5 Lpf]
- Over 85% water savings over standard 1.0 gpf [4.0 Lpf] system

Waterless
- Uses no water
- Trap needs occasional maintenance
- Mixed results
- May have code and union issues
Low-flow Showerheads ~ 1.5 GPM

• Approximately 73% of the water used in a typical shower is hot water.

• Low flow showerheads save water and energy because the water heater doesn’t have to heat as much water.

• Inexpensive and simple-to-install, low-flow shower heads and faucet aerators can reduce home water consumption and water heating costs by as much as 50%*

• Non-conserving showerheads use 5 to 8 gpm

* - http://www.fypower.org/res/tools/products_results.html?id=100160
Ultra Low-Flow Showerhead

- 0.5 GPM
- Adjustable width of spray
- Made in the USA
- $37.99

http://www.showerheadstore.com/0-5gpm-showerhead.html
Faucet Aerators

- Faucet aerators mix air with water to reduce the water a fixture puts out without reducing water pressure.
- Many different flow rates available: .5, 1.0, 1.5, 2.0 GPM.
- Inexpensive & easy to install.
- Saves hot water.
Single Pass Cooling Systems

- Single-pass or once through cooling systems provide an opportunity for significant water savings.

- In these systems, water is circulated once through a piece of equipment and then is disposed down the drain.

- To maximize water savings, replace single-pass cooling equipment with direct expansion or a chilled water system.
Example of a building with once-through water cooling systems
Other high-use water areas

- Cooling towers
- Commercial laundries
- Commercial kitchens
Cooling tower evaporation

- Water evaporation ~3 GPM/100 tons
- Many factors affect water use
Commercial laundry systems

Several options
- Ozone laundry systems
- Tunnel washing systems
- AquaRecycle
- Aqutex 360

Facilities that generate large amounts of laundry
- Hotels/Motels
- Hospitals
- Nursing Homes
- Prisons/Jails
- Universities

http://www.allianceforwaterefficiency.org/commercial_laundry.aspx
Commercial kitchens

- Steamers
- Dish cleaning
- Dishwashing
- Ice Machines
- Kitchen Practices
Kitchen pre-rinse spray valve

- Self-closing 1.24 GPM @ 60 psi (4.7 l/min @ 400 kPa) pre-rinse valve

- Studies done by the California Urban Water Conservation Council show that average savings in a restaurant are 137 gpd and 0.93 therms for gas hot-water heating per day.

- Quick paybacks
Purpose of water audit

- Determine cost-effective conservation options
- Prioritize retrofits
- Save water, sewer and costs
- Save pumping (electricity) costs
- Reduced chemical usage
Water Audits

- Where is water being used?
- How much is being used?
- How much does the water & sewage cost?
- What are the water savings/cost potential?
- Will there be additional savings?
  - Less heated water?
  - Less pumping?
  - etc.
Audit Data Collection

- Obtain two years of water and wastewater usage records
- List all water using equipment
  - Obtain water use characteristics of fixtures
  - Estimate frequency of use
- Determine irrigation use and schedule
Identify Fixture Characteristics

- Toilets - GPF
- Showerheads - GPM
- Lavatories - GPM
- Washing machines – Gallons per cycle
- Dishwashers – Gallons per cycle
- Kitchen facilities – spray nozzles/other
- Irrigation – GPM & cycles
- Misc. – ice maker, steamers,
Information necessary for study

• Annual water consumption
• Utility & sewer rates
• Floor plans to identify # of fixtures
• Walk through audit – identify fixture characteristics (GPF)
• Occupancy rates / visitors
• Hours of use of equipment
Water use for a typical office building is as follows:

- Sanitary = 40 percent
- Cooling Tower Make-up water = 26 percent
- Irrigation = 22 percent
- Miscellaneous = 9 percent
- Single-Pass Cooling = 1 percent
- Kitchen = 1 percent

http://www.epa.gov/oaintrnt/water/background.htm
Disaggregating Water Bill

- Reconcile water use estimates with actual water billing records to within 10%
- Focus on equipment or fixtures that have a high volume of use or present the best prospects for savings
- Toilets, urinals and faucets are associated with 40% or more of water consumed in most buildings
Determining where and in what quantity water is used

**Water Balance Summary**

<table>
<thead>
<tr>
<th>Sources of Water Use</th>
<th>Gallons per year</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling: tower make-up and boiler make-up</td>
<td>7,966,000</td>
<td>38.3</td>
</tr>
<tr>
<td>Process use: parts and mixing vat cleaning</td>
<td>3,848,000</td>
<td>18.5</td>
</tr>
<tr>
<td>Domestic: faucets, toilets, and showers</td>
<td>3,536,000</td>
<td>17</td>
</tr>
<tr>
<td>Once-through cooling: air compressors, and pumps</td>
<td>2,388,000</td>
<td>11</td>
</tr>
<tr>
<td>Landscaping</td>
<td>832,000</td>
<td>4</td>
</tr>
<tr>
<td>General washing, sanitation, and maintenance</td>
<td>561,600</td>
<td>2.7</td>
</tr>
<tr>
<td>Leaks (detected)</td>
<td>416,000</td>
<td>2</td>
</tr>
<tr>
<td>Food preparation: dishwasher</td>
<td>312,000</td>
<td>1.5</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td>19,859,000</td>
<td>95.5</td>
</tr>
<tr>
<td>TOTAL WATER PURCHASE</td>
<td>20,800,000</td>
<td>100.0</td>
</tr>
<tr>
<td>UNACCOUNTED FOR</td>
<td>941,000</td>
<td>4.5</td>
</tr>
</tbody>
</table>

http://www.p2pays.org/ref/01/00692.pdf
## Chicago water & sewer rates

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>% Increase</th>
<th>Water per 1,000 Gallons</th>
<th>Sewer as a % of Water Bill</th>
<th>Sewer per 1,000 Gallons</th>
<th>Water &amp; Sewer per 1,000 Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/08</td>
<td>15%</td>
<td>$1.53</td>
<td>84%</td>
<td>$1.29</td>
<td>$2.82</td>
</tr>
<tr>
<td>1/1/09</td>
<td>15%</td>
<td>$1.76</td>
<td>85%</td>
<td>$1.50</td>
<td>$3.26</td>
</tr>
<tr>
<td>1/1/10</td>
<td>14%</td>
<td>$2.01</td>
<td>86%</td>
<td>$1.73</td>
<td>$3.74</td>
</tr>
</tbody>
</table>
## Water rates around the US

**Cost per 1,000 gallons**

<table>
<thead>
<tr>
<th>Cities</th>
<th>Water:</th>
<th>Sewer:</th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairbanks</td>
<td>$ 7.43</td>
<td>$ 9.86</td>
<td>$ 17.29</td>
</tr>
<tr>
<td>Atlanta</td>
<td>$ 4.14</td>
<td>$ 10.55</td>
<td>$ 14.69</td>
</tr>
<tr>
<td>Seattle</td>
<td>$ 4.47</td>
<td>$ 9.95</td>
<td>$ 14.42</td>
</tr>
<tr>
<td>Boston</td>
<td>$ 5.33</td>
<td>$ 6.62</td>
<td>$ 11.95</td>
</tr>
<tr>
<td>Birmingham</td>
<td>$ 3.05</td>
<td>$ 7.96</td>
<td>$ 11.01</td>
</tr>
<tr>
<td>Portland</td>
<td>$ 2.41</td>
<td>$ 8.51</td>
<td>$ 10.92</td>
</tr>
<tr>
<td>San Francisco</td>
<td>$ 1.97</td>
<td>$ 8.31</td>
<td>$ 10.28</td>
</tr>
<tr>
<td>Portland</td>
<td>$ 2.37</td>
<td>$ 7.66</td>
<td>$ 10.03</td>
</tr>
<tr>
<td>Austin</td>
<td>$ 3.84</td>
<td>$ 6.05</td>
<td>$ 9.89</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>$ 7.19</td>
<td>$ 2.27</td>
<td>$ 9.46</td>
</tr>
<tr>
<td>Aurora</td>
<td>$ 4.81</td>
<td>$ 2.22</td>
<td>$ 7.03</td>
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</tbody>
</table>
Analysis

Conducted with different spreadsheets

• LEED spreadsheet – Leadership in Energy & Environmental Design
• Spreadsheets developed by SEDAC personnel
• Watergy3-1 – can be downloaded from web
Assumptions

• Usage rates - # of times a fixture is used/day
• Evaporation rate from cooling tower
• Blowdown rates & quantities
• Maintenance/cleaning
• Pounds of laundry & type of laundry system
• Pool evaporation rates
### Calculation of water usage - CCC

<table>
<thead>
<tr>
<th>Public Restrooms</th>
<th>W/C</th>
<th>Urinals</th>
<th>Lav</th>
<th>Patrons</th>
<th>Uses</th>
<th>GPF</th>
<th>Gallons</th>
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</thead>
<tbody>
<tr>
<td>Mens WC</td>
<td>8</td>
<td></td>
<td></td>
<td>419,500</td>
<td>1</td>
<td>1.6</td>
<td>671,200</td>
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<tr>
<td>Mens Urinals</td>
<td>8</td>
<td></td>
<td></td>
<td>419,500</td>
<td>2</td>
<td>1</td>
<td>839,000</td>
</tr>
<tr>
<td>Mens Lav</td>
<td>12</td>
<td></td>
<td></td>
<td>419,500</td>
<td>3</td>
<td>0.25</td>
<td>314,625</td>
</tr>
<tr>
<td>Womens WC</td>
<td>12</td>
<td></td>
<td></td>
<td>419,500</td>
<td>3</td>
<td>1.6</td>
<td>2,013,600</td>
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<tr>
<td>Womens Lav</td>
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<td></td>
<td>419,500</td>
<td>3</td>
<td>0.25</td>
<td>314,625</td>
</tr>
</tbody>
</table>

**Before Retrofit**

| Public water consumption | 4,153,050 |

<table>
<thead>
<tr>
<th>Public Restrooms</th>
<th>W/C</th>
<th>Urinals</th>
<th>Lav</th>
<th>Patrons</th>
<th>Uses</th>
<th>GPF</th>
<th>Gallons</th>
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<tbody>
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<td>Mens WC</td>
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<td></td>
<td>419,500</td>
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<td>1.12</td>
<td>469,840</td>
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<td>1</td>
<td>839,000</td>
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<tr>
<td>Mens Lav</td>
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<td></td>
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<td>Womens WC</td>
<td>12</td>
<td></td>
<td></td>
<td>419,500</td>
<td>3</td>
<td>1.12</td>
<td>1,409,520</td>
</tr>
<tr>
<td>Womens Lav</td>
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<td></td>
<td>419,500</td>
<td>3</td>
<td>0.25</td>
<td>314,625</td>
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</tbody>
</table>

**After Retrofit**

| Public water consumption | 3,347,610 |
## Staff Restroom Calculations

<table>
<thead>
<tr>
<th>Staff Restrooms</th>
<th>W/C</th>
<th>Urinals</th>
<th>Lav</th>
<th>Showers</th>
<th>Empl.</th>
<th>Uses</th>
<th>GPF</th>
<th>Days</th>
<th>Days Factor</th>
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<tbody>
<tr>
<td>Basement Mens WC</td>
<td>2</td>
<td></td>
<td>2</td>
<td>80</td>
<td>0.5</td>
<td>5</td>
<td></td>
<td>343</td>
<td>68,600</td>
</tr>
<tr>
<td>Mens Urinals</td>
<td>3</td>
<td>0.5 gpm</td>
<td></td>
<td>60 min/hr</td>
<td>24 hrs/day</td>
<td>365 days/yr</td>
<td>3</td>
<td>788,400</td>
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<tr>
<td>Mens Lav</td>
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<td></td>
<td>80</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>343</td>
<td>27,440</td>
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</tr>
<tr>
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<td>0</td>
<td>1</td>
<td>125</td>
<td>1</td>
<td>5</td>
<td>343</td>
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<td></td>
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<tr>
<td>Womens Lav</td>
<td>3</td>
<td>125</td>
<td></td>
<td>1</td>
<td>1</td>
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<td>5</td>
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<td>3</td>
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<td>1</td>
<td></td>
<td>343</td>
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<tr>
<td>2nd floor Staff Lounge Mens Lav</td>
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<td></td>
<td></td>
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<tr>
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<td>2</td>
<td>5</td>
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<td></td>
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<td>4</td>
<td>2</td>
<td>kitchen sinks</td>
<td>125</td>
<td>2</td>
<td>1</td>
<td>343</td>
<td>85,750</td>
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</table>

**Staff water consumption**: 1,958,030
# Results for City Hall

<table>
<thead>
<tr>
<th>Water Cost Reduction Measure (WCRM) or Package of WCRMs</th>
<th>ID</th>
<th># of fixtures</th>
<th>Material cost ($)</th>
<th>Labor Cost ($)</th>
<th>Material + Labor cost/unit ($)</th>
<th>Project Cost ($)</th>
<th>Water Savings (gallons)</th>
<th>Annual water &amp; sewer cost savings ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install 1/8 GPF urinals</td>
<td>WCRM1</td>
<td>50</td>
<td>600</td>
<td>334</td>
<td>$934</td>
<td>$46,700</td>
<td>350,000</td>
<td>$985</td>
</tr>
<tr>
<td>Install dual flush handles on toilets</td>
<td>WCRM2</td>
<td>36</td>
<td>45</td>
<td>63</td>
<td>$108</td>
<td>$3,888</td>
<td>911,520</td>
<td>$2,566</td>
</tr>
<tr>
<td>Install Faucet aerators</td>
<td>WCRM3</td>
<td>36</td>
<td>3</td>
<td>10</td>
<td>$13</td>
<td>$468</td>
<td>306,000</td>
<td>$861</td>
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<tr>
<td>PKG1 – WCRMs 1, 2, 3</td>
<td>PKG1</td>
<td></td>
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<td></td>
<td>$51,056</td>
<td>1,567,520</td>
<td>$4,413</td>
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</tbody>
</table>
Before & After
CCC

2,228,733 Annual Gallon Savings
28% Reduction in Water Usage

Before Retrofit

After retrofit

Estimate of Water Consumption by Sector
7,883,830 Gallons Total

Other Water Consuming Fixtures
1,872,750
23%

Public Restrooms
4,153,050
52%

Staff Restrooms
1,958,030
25%

Estimate of Water Consumption by Sector
5,755,097 Gallons Total

Other Water Consuming Fixtures
1,872,750
33%

Public Restrooms
3,347,610
58%

Staff Restrooms
534,737
9%
### Results for Chicago Cultural Center

<table>
<thead>
<tr>
<th>Water Cost Reduction Measure (WCRM) or Package of WCRMs</th>
<th>ID</th>
<th>Project Cost</th>
<th>Annual Savings</th>
<th>Monthly Savings</th>
<th>Internal Rate of Return (IRR)</th>
<th>Net Present Value (NPV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install valves on staff urinals</td>
<td>WCRM1</td>
<td>$1,500</td>
<td>$2,140</td>
<td>$178</td>
<td>143%</td>
<td>$15,314</td>
</tr>
<tr>
<td>Install water shut-off valve on 2nd floor A/C unit</td>
<td>WCRM2</td>
<td>$1,500</td>
<td>$1,187</td>
<td>$99</td>
<td>79%</td>
<td>$7,826</td>
</tr>
<tr>
<td>Install waterless urinals in public restrooms</td>
<td>WCRM3</td>
<td>$6,400</td>
<td>$2,362</td>
<td>$197</td>
<td>36%</td>
<td>$12,157</td>
</tr>
<tr>
<td>Install 1/8 GPF urinals in public restrooms</td>
<td>WCRM4</td>
<td>$8,800</td>
<td>$2,067</td>
<td>$172</td>
<td>20%</td>
<td>$7,440</td>
</tr>
<tr>
<td>Install dual flush valves on public toilets</td>
<td>WCRM5</td>
<td>$14,700</td>
<td>$2,267</td>
<td>$189</td>
<td>15%</td>
<td>$13,926</td>
</tr>
<tr>
<td>Install dual flush handles on staff toilets</td>
<td>WCRM6</td>
<td>$3,250</td>
<td>$562</td>
<td>$47</td>
<td>12%</td>
<td>$1,166</td>
</tr>
<tr>
<td>Install rain sensor for green roof</td>
<td>WCRM7</td>
<td>$450</td>
<td>$1,153</td>
<td>$96</td>
<td>256%</td>
<td>$8,609</td>
</tr>
<tr>
<td>PKG1 – WCRMs 1, 2, 4, 5, 6, 7</td>
<td>PKG1</td>
<td>$30,200</td>
<td>$9,376</td>
<td>$781</td>
<td>29%</td>
<td>$43,456</td>
</tr>
</tbody>
</table>
Calculations of CO$_2$ production from water heating

Elec consumption for water treatment
1,407 kWh/MM gal

Elec consumption for sewage treatment
1,188 kWh/MM gal

CO2 Production:
1.344 lb/kWh
11.709 lb/Therm
## Savings Results

<table>
<thead>
<tr>
<th>Summary</th>
<th>Water Savings (gallons)</th>
<th>Therm savings</th>
<th>kWh for supply</th>
<th>kWh for waste</th>
<th>lb of CO2 reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Hall</td>
<td>1,019,520</td>
<td>836</td>
<td>1,434</td>
<td>1,211</td>
<td>13,344</td>
</tr>
<tr>
<td>11th District Police Station</td>
<td>458,075</td>
<td>2,430</td>
<td>645</td>
<td>544</td>
<td>30,050</td>
</tr>
<tr>
<td>Garfield Community Center</td>
<td>176,188</td>
<td>1,362</td>
<td>248</td>
<td>209</td>
<td>16,562</td>
</tr>
<tr>
<td>Totals</td>
<td>1,653,783</td>
<td>4,628</td>
<td>2,327</td>
<td>1,965</td>
<td>59,957</td>
</tr>
</tbody>
</table>
Audit Conclusions

• Some retrofits are very cost effective, others not
• Influencing factors
  • Existing GPM or GPF
  • Usage Rate
  • Water and sewer rates

• Cost effective retrofits
  • Dual flush handles
  • Low-flow Showerheads
  • Faucet Aerators
### Example: Efficiency Benefits

A commercial facility that replaces a typical existing 3.5-gpf toilet with a standard new 1.6-gpf unit could cut its annual water use by more than half and save hundreds of dollars in water costs, assuming 30 flushes per day for 260 days (see chart below). (Savings vary with water cost, flow rates, electricity or gas costs and expected usage.)

<table>
<thead>
<tr>
<th>Performance</th>
<th>Typical Existing Unit</th>
<th>New Standard Unit</th>
<th>Best Available Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons per flush (gpf)</td>
<td>3.5 gpf</td>
<td>1.6 gpf</td>
<td>1.0 gpf</td>
</tr>
<tr>
<td>Annual Water Use</td>
<td>27,300</td>
<td>12,500</td>
<td>7,800</td>
</tr>
<tr>
<td>Annual Water Cost</td>
<td>$110</td>
<td>$50</td>
<td>$30</td>
</tr>
<tr>
<td>Lifetime Water Cost</td>
<td>$880</td>
<td>$400</td>
<td>$250</td>
</tr>
<tr>
<td>Lifetime Water Cost Savings (for replacing existing unit 10 years early)</td>
<td>-</td>
<td>$480</td>
<td>$630</td>
</tr>
</tbody>
</table>

Metric Conversion: 1 gallon = 3.8 liters

Cost Effectiveness Assumptions: Savings estimates are based on an existing flush rate of 3.5 gpf. Usage assumption: 30 flushes per day, and 260 days per year. Assumed combined water and wastewater price: $4.00/1000 gallons.

Source: DOE, FEMP, FYP

http://www.fypower.org/com/tools/products_results.html?id=100139
Water conservation planning

Steps for a successful water efficiency program

Step 1 - Establish commitment and goals
Step 2 - Line up support and resources
Step 3 - Conduct a water audit
Step 4 - Identify water management options
Step 5 - Prepare a plan and implementation schedule
Step 6 - Track results and publicize success

http://www.p2pays.org/ref/01/00692.pdf
WaterSmart Guidebook for Businesses

- Free guidebook with very good information
- Available at website below

http://www.allianceforwaterefficiency.org/WaterSmart_Guidebook_for_Businesses.aspx
Restaurant equipment information

http://www.fishnick.com/
Different Approaches – Same result

http://www.flickr.com/photos/26903716@N03/323780257/in/pool-wto
http://www.flickr.com/photos/rastrus/2593433428/in/pool-wto/
A quick look at Residential water usage
## Typical Residential Water Use

<table>
<thead>
<tr>
<th>Use</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showers and Baths</td>
<td>(20%)</td>
</tr>
<tr>
<td>Potable Uses</td>
<td>(9%)</td>
</tr>
<tr>
<td>Clothes and dishwashing</td>
<td>(16%)</td>
</tr>
<tr>
<td>Toilets</td>
<td>(19%)</td>
</tr>
<tr>
<td>Lawns and gardens</td>
<td>(36%)</td>
</tr>
</tbody>
</table>
## Average Indoor Water Usage

Average Daily Water Use (gallons per person, per day)

<table>
<thead>
<tr>
<th></th>
<th>Average Home</th>
<th>Efficient Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>Leaks</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Shower/Bath</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Faucet/Other</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>
It’s estimated that each American uses about 69.3 gallons of water a day in the typical single-family home. By installing water-efficient fixtures and checking for leaks, individual use can be reduced by about 39 percent. Here’s how it breaks down:

<table>
<thead>
<tr>
<th></th>
<th>Typical Household</th>
<th>Water-Efficient Home</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gallons</td>
<td>Percent</td>
</tr>
<tr>
<td>Showers</td>
<td>11.6</td>
<td>16.7</td>
</tr>
<tr>
<td>Clothes washing</td>
<td>15</td>
<td>21.6</td>
</tr>
<tr>
<td>Dishwashers</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Toilets</td>
<td>18.5</td>
<td>26.7</td>
</tr>
<tr>
<td>Faucets</td>
<td>10.9</td>
<td>15.7</td>
</tr>
<tr>
<td>Other</td>
<td>12.3</td>
<td>17.7</td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**TOTALS**: 69.3 100 42.3 100

Source: Handbook of Water Use and Conservation by Amy Vickers

JUDSON DRENNAN / The News & Observer

http://media.newsobserver.com/content/news/story_graphics/20071023_wateruse.jpg
Indoor residential opportunities

• High efficiency toilets
• Horizontal axis washing machines
  • Standard – 32 to 50 gallons per load
  • Horizontal axis – 24 gallons per load, ~40% savings
• Low-flow showerheads
• Faucet aerators
• Eliminate leaks
Other Water Conservation Techniques

- Consumer Education
  - Personal use habits
- Low flow fixtures
- Graywater recycling
- Xeriscaping
- Rainwater harvesting
The End

http://www.flickr.com/photos/35163871@N02/3335263854/sizes/o/in/pool-726473@N20/