Sustainable Urban Water Use

Engaging leaders in the Southeast to integrate water conservation into the utility business model
The RBC Blue Water Project is a wide-ranging, multi-year program to help foster a culture of water stewardship, so that people have clean fresh water today and tomorrow.
Dedicated to enhancing the ability of governments and organizations to provide environmental programs and services in fair, effective and financially sustainable ways

Serving EPA Region 4
Introduction: Why Conservation Planning?

- Name
- Title
- Status of water efficiency planning efforts
- Learning objectives
Terminology

• Water conservation: Any beneficial reduction in water use or in water losses
  – *Not necessarily curtailment*

• Water efficiency: Accomplishment of a function, task, process or result with the minimal amount of water feasible; tool of water conservation that reduced water demand without changing the quality of the use
Why water conservation planning?

• Maximize benefits
  – Diversify water resource portfolio
  – Cost-effectiveness
  – Customer service
  – Environmental benefits
  – Political benefits
• Meet regulatory requirements
• Eligibility for federal and state grants and funding
• It’s going to happen anyway
Diversify water resource portfolio (Drought time)

OWASA July 2006 through December 2008
From Water-using customer sales profile conducted by EFC
Does water conservation programming hurt future drought response?

Yes?

Short-term drought savings may be more difficult to achieve and the amount of water that can be saved by water rationing reduced, if water conservation reduces the “slack” in the system.

No?

If conservation ethic is a part of the community, in part due to conservation programs, customers seem to be more receptive to requests to reduce water use.
Diversify water resource portfolio (Average water use)

<table>
<thead>
<tr>
<th>Customer Subgroup Classification</th>
<th>Low Range</th>
<th>High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>percent</td>
<td>mgd</td>
</tr>
<tr>
<td>General residential†</td>
<td>10</td>
<td>6.5</td>
</tr>
<tr>
<td>Residential indoor‡ (pre-1995 housing)</td>
<td>20</td>
<td>2.6</td>
</tr>
<tr>
<td>Residential indoor§ (post-1995 housing)</td>
<td>31</td>
<td>1.7</td>
</tr>
<tr>
<td>Residential outdoor** (lawn watering)</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>Industrial</td>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>Commercial</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>Wholesale</td>
<td>10</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>18.5</td>
</tr>
</tbody>
</table>

*No significant conservation was included for fire protection, golf course, institutional and water utility classifications, which account for only 3.3 percent of total use; sources: references 6–9.
†Savings influenced by water rates and public education
‡Savings influenced by plumbing retrofits
§Savings influenced by Energy Policy Act, effective Jan. 1, 1994
**Savings influenced by watering restrictions
## Cost-effectiveness

### Assessing Southern California Water Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>2025 Regional Potential (TAF*)</th>
<th>Timeframe (years)</th>
<th>Drought-Proof (Reliability)</th>
<th>Risk (Project Aborted)</th>
<th>Enviro Opinion</th>
<th>GHG</th>
<th>Initial Cap. Cost ($millions)</th>
<th>Annual Oper. Cost ($millions)</th>
<th>30-yr cost treated ($/AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategies to Replace or Augment Imported Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Water Conservation</td>
<td>1,100+</td>
<td>0-2</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$0</td>
<td>$0.5</td>
<td>$210</td>
</tr>
<tr>
<td>Local Stormwater Capture</td>
<td>150+</td>
<td>3-5</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$40-$63</td>
<td>$1-$3.5</td>
<td>$350+</td>
</tr>
<tr>
<td>Recycling</td>
<td>450+</td>
<td>6-10</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$480</td>
<td>$30</td>
<td>$1,000</td>
</tr>
<tr>
<td>Ocean Desalination</td>
<td>150+</td>
<td>6-10</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$300</td>
<td>$37</td>
<td>$1,000+</td>
</tr>
<tr>
<td>Groundwater Desalination</td>
<td>TBD</td>
<td>6-10</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$24</td>
<td>$0.7</td>
<td>$750-$1,200</td>
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<tr>
<td><strong>Strategies to Increase Imported Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfers-Ag to Urban</td>
<td>200+</td>
<td>1-5</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>n/a</td>
<td>n/a</td>
<td>$700+</td>
</tr>
<tr>
<td><strong>Strategies to Increase Reliability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter-agency Cooperation</td>
<td>***</td>
<td>0-5</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>low</td>
<td>low</td>
<td>n/a</td>
</tr>
<tr>
<td>Groundwater Storage</td>
<td>1,500+</td>
<td>3-5</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$68-$135</td>
<td>$13</td>
<td>$580</td>
</tr>
<tr>
<td>Surface Storage</td>
<td>0</td>
<td>10+</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>$2,500+</td>
<td>$7.5-$15.5</td>
<td>$760-$1,400</td>
</tr>
</tbody>
</table>

*TAF-Thousand Acre-Feet
**Improves reliability and efficiency of existing supplies
Source: LAEDC

## Options in the lowest cost 2010 portfolio

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost Efficiency ($/MG)</th>
<th>Capital Cost ($M)</th>
<th>Yield (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water restrictions (no daytime watering)</td>
<td>10</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Rain sensors (retrofit 25% existing systems)</td>
<td>60</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Spray rinse valves (rebate program)</td>
<td>115</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Conservation pricing</td>
<td>125</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>GW for non-potable use</td>
<td>155</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Multi family sub-metering (retrofit 50% existing homes)</td>
<td>165</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Cooling towers (rebate program)</td>
<td>170</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Tussahaw Creek reservoir expansion</td>
<td>260</td>
<td>64</td>
<td>20</td>
</tr>
<tr>
<td>Lawrenceville GW system</td>
<td>300</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Dog river reservoir expansion</td>
<td>300</td>
<td>230</td>
<td>48</td>
</tr>
<tr>
<td>Showerheads and faucets (increased rebate program)</td>
<td>300</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 11 from Georgia Metro Atlanta Water Contingency Planning Task Force

Expected 2020 yield is shown for conservation options.
Customer Service

Conservation programming offers:

• An opportunity to interact positively with customers (rebates, give-aways)

• Handle high water bills with information and programming
Environmental Benefits

• Reduces:
  – sewage system failures
  – water contamination caused by polluted runoff from over-irrigating yards and agricultural lands
  – need to construct additional dams and reservoirs
  – need to construct additional water and wastewater treatment facilities
  – surface water withdrawals that degrade habitat both in streams and on land close to streams and lakes
  – Stormwater runoff

• Allows water to flow to healthier natural pollution filters
• Saves energy

WaterSense:
http://www.epa.gov/WaterSense/water_efficiency/environmental_benefits.html
Regulatory Requirements

• Federal
  • Environmental Impact Statements

• State
  – NC Drought Bill of 2008
  – GA Water Stewardship Act of 2010
  – SC Surface Water Permitting Bill of 2010
The “Drought Bill” (S.L. 2008-143) §143-355.4(b)(2)-(7)

Required Conservation Measures

1. Leak detection and repair program
2. Water Supply Plan/Water Shortage Response Plan
3. Meter all water use
4. No decreasing block rate structure for residential meters
5. Reclaimed water evaluation
6. Consumer education program

1 Required if applying for funds from any of the following programs (2) for the purpose of extending waterlines or expanding water treatment capacity
The “Drought Bill” (S.L. 2008-143) § 143-355.4(a)

“Local government water systems and large community water systems shall require separate meters for new in-ground irrigation systems that are connected to their systems.”
GA Water Stewardship Act of 2010

Legislative Intent: To create a Culture of Conservation

• Directs agencies to examine their practices to identify enhanced programming and incentives for voluntary water conservation and enhanced water supply by local water providers
  – Submit 1st report to Governor, Lt. Governor and Speaker by July 1, 2010
    • Annually through 2015
• Gives EPD authority to establish minimum standards and best practices for public water systems to address leakage, water loss audits and leak detection
  – Applies to water systems that serve more than 3,300 customers

Slide courtesy of the GA Department of Natural Resources
GA Water Stewardship Act of 2010

• Gives EPD authority to revoke, suspend or modify a local government authority’s water withdrawal or waste treatment permit for violations of outdoor water restriction guidelines
  – May irrigate outdoors daily between the hours of 4pm and 10am (Commercial agriculture, others excluded)
  – Right to hearing provided

• Farm use surface water/groundwater withdrawal permits
  – Active, inactive and unused

Slide courtesy of the GA Department of Natural Resources
GA Water Stewardship Act of 2010

- Watering restrictions for entire state (10am-4pm)
- Multi-tenant sub-metering beginning July 1, 2012
- High efficiency fixtures required in new construction beginning July 1, 2012
- High efficiency cooling devices in new industrial buildings beginning July 1, 2012

Slide courtesy of the GA Department of Natural Resources
Section 49-4-160 (A)
Each permittee must prepare and maintain on site, available for inspection, an operational and contingency plan to promote an adequate water supply from the surface water during times when the actual flow of the surface water is less than the minimum instream flow for that particular surface water segment. The plan must identify actions to be taken, as applicable, to address low flow conditions, including water conservation, supplemental water supplies, off-stream water storage, seasonal water flow fluctuation withdrawals, and hydroelectric operations in controlled surface waters.
How much is within your control?

- State and Federal water savings goals
- 3rd party certifications
- Neighboring utilities
State and Federal Water Savings Goals

• Federal Executive Order 13514: Federal Leadership in Environmental, Energy and Economic Performance
  • Requires agencies to reduce their potable water consumption intensity 2% per year, through fiscal year 2020, based on FY07 baseline

• NC Utility Savings Initiative

• SC Environmental Protection and Conservation—Title 48-52-820(8)
  – State buildings will... reduce the burden on municipal water supply and treatment by reducing potable water consumption
<table>
<thead>
<tr>
<th>Fixture</th>
<th>Maximum Water Use Allowed (effective January 1994)</th>
<th>Water Sense</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Toilets (water closets)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravity-tank</td>
<td>1.6 gallons per flush (gpf)</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td>Gravity-tank, white, two-piece, labeled “Commercial Use Only”</td>
<td>3.5 gpf</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td>Flushometer-tank</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td>Flushometer-valve (except blowout valve)</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td>Blowout-valve</td>
<td>3.5 gpf</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td>Electromechanical hydraulic</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
</tr>
<tr>
<td><strong>Urinals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any type</td>
<td>1.0 gpf</td>
<td>0.5 gpf</td>
</tr>
<tr>
<td><strong>Showerheads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any type (except those used for safety reasons)</td>
<td>2.5 gallons per minute (at 80 psi) or 2.2 gpm (at 60 psi)</td>
<td>2.0 gpm (at 20, 45 and 80 psi)</td>
</tr>
<tr>
<td><strong>Faucets and Replacement Aerators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lavatory faucets</td>
<td>2.5 gallons per minute (at 80 psi) or 2.2 gpm (at 60 psi)</td>
<td>1.5 gpm (at 60 psi)</td>
</tr>
<tr>
<td>Lavatory replacement aerators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen faucets</td>
<td>2.5 gallons per minute (at 80 psi) or 2.2 gpm (at 60 psi)</td>
<td></td>
</tr>
<tr>
<td>Kitchen replacement aerators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metering faucets</td>
<td>0.25 gallons per cycle</td>
<td></td>
</tr>
</tbody>
</table>
Household water use in North America

When controlling for weather and other variables.....

A household in the 2008 billing year used 11,678 gallons less annually than an identical household did in 1978.

Why?

Breakdown of Louisville (KY) Water Company residential water decline between 1990 and 2007

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1990</th>
<th>2007</th>
<th>Allotment – gpd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household use – gpd</td>
<td>208</td>
<td>187</td>
<td>-21</td>
</tr>
<tr>
<td>PMDI</td>
<td>0.29</td>
<td>0.75</td>
<td>-2.6</td>
</tr>
<tr>
<td>People per household</td>
<td>2.52</td>
<td>2.38</td>
<td>-5</td>
</tr>
<tr>
<td>Educational index</td>
<td>2.45</td>
<td>2.81</td>
<td>+1.3</td>
</tr>
<tr>
<td>Average home value</td>
<td>$120,100</td>
<td>$144,600</td>
<td>+3.5</td>
</tr>
<tr>
<td>Home size</td>
<td>2,155 sq. ft.</td>
<td>2,281 sq. ft.</td>
<td>+0.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>=18.8</td>
</tr>
</tbody>
</table>

18.8 GPD attributed to increased installation of low-flow appliances

Neighboring Utilities - “Mediashed”
Trends for water use in NC

New Financial Realities

- Reclaimed Water Use Begins
- Drought 2001/02
- Drought 2007/08
cost recovery through rates and fees in FY 2007-08

- red: revenues did not cover costs of daily operations
- orange: revenues covered costs of daily operations, but not depreciation
- blue: revenues covered costs of daily operations and depreciation
- blue: sufficient revenue to set aside for capital improvements

Data from the Local Government Commission, NC Department of the State Treasurer
Minimum Requirements

- Revenues did not cover costs of daily operations (53 utilities/12% of utilities)
- Revenues covered costs of daily operations, but not depreciation (143 utilities/33% of utilities)
- Revenues covered costs of daily operations and depreciation (135 utilities/31% of utilities)
- Sufficient revenue to set aside for capital improvements (101 utilities/23% of utilities)
The conservation conundrum

• Water utilities face a dilemma in encouraging water conservation
  – By selling less water, utilities have to increase rates to cover their costs
  – Customers are essentially being asked to pay more for less water
CASE STUDY: SEATTLE PUBLIC UTILITIES
FIGURE 2  Demand forecasts with and without conservation

Source: Graphic courtesy of Bruce Flory, Seattle Public Utilities (2009)
Financial Results – Immediate Capital Budget Reductions

Seattle Public Utilities CIP Spending (2002-2007)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Millions of Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>$20.0</td>
</tr>
<tr>
<td>2003</td>
<td>$40.0</td>
</tr>
<tr>
<td>2004</td>
<td>$60.0</td>
</tr>
<tr>
<td>2005</td>
<td>$80.0</td>
</tr>
<tr>
<td>2006</td>
<td>$100.0</td>
</tr>
<tr>
<td>2007</td>
<td>$120.0</td>
</tr>
</tbody>
</table>

CIP Savings so far Due to Asset Management?
Water Conservation Planning and Tools and Models: Overview

(The following 31 slides were presented by Brian Skeens, P.E. of CH2M HILL at the GA Workshop)
Water Conservation Planning Resources

• Handbook of Water Conservation by Amy Vickers (WaterPlow Press, 2001)
10 Steps in Conservation Planning
(Vickers)

1. Identify conservation goals
2. Develop a water use profile and forecast
3. Evaluate planned facilities
4. Identify and evaluate conservation measures
5. Identify and assess conservation incentives
6. Analyze benefits and costs
7. Select conservation measures and incentives
8. Prepare and implement the conservation plan
9. Integrate conservation and supply plans, modify forecasts
10. Monitor, evaluate, and revise program as needed
10 Steps in Conservation Planning (AWWA)

1. Review detailed demand forecast
2. Review existing water system profile and descriptions of planned facilities
3. Evaluate the effectiveness of existing conservation measures
4. Define conservation potential
5. Identify conservation measures
6. Determine feasible measures
7. Perform benefit-cost evaluations
8. Select and package conservation measures
9. Combine overall estimated savings
10. Optimize demand forecasts
Water Conservation Plan

• A comprehensive plan can include the following:
  – Current Water Use Profile
  – Program Evaluation
    • Cost Effectiveness
    • Benefit/Cost Analysis
  – Effect on Demand Projections
  – Revenue Impacts
  – Demand Hardening
  – Implementation Planning
  – Tracking and Reporting
  – Update Schedule
Water Conservation Practices
Implementation Mechanisms

- Demand Side Conservation
- Behavior
- Technology
  - Education
  - Regulation
  - Economic Incentives
Before you can screen or evaluate conservation measures...

• You need to know:
  1. What are the current demographics of your service area?
  2. What or who makes up your target market?
  3. How much of that target market can you or do you want to reach?
  4. What is the level of consumption of the target market?
  5. What is your service area going to look like in the future?
Current Water Use Profile

• Allows for comparison (with others)
• Gives credit for past success
• Sets a starting point
• Indicators:
  – Per capita (residential and overall)
  – non-revenue water
• Identifies potential targets
Develop the Water Use Profile

- Understand your customer water use profile
- Gather historical billing data
- Billing system categories

![Pie chart showing water use profile]

- Residential: 44%
- Commercial: 18%
- Industrial: 30%
- Government: 8%
Understand Seasonal Variability

- Graph monthly usage by category
- Use multiple years (≥ 2 years)
Parcel-level Water Use Profile

• Billing Data Assessment - What to look for...
  – Consumption totals, by year and month
    • by Use Classification (C,SFR,MFR,IND,INS)
    • Service area/river basin/pressure zone
    • Monthly/Seasonal Variations
    • Irrigation and Reclaimed Water
    • Per Capita Use
    • Highest-use accounts, by Classification Category

• Parcel matching land-use type to historical use
Calculate Existing Per Capita

• Population Served
  – Jurisdictional boundaries
  – EPA SDWIS
  – Residential Accounts x household size (from census)

• Overall Per Capita Water Use
  – Influenced by non-residential users
  – not good for setting goals

• Residential Per Capita Water Use
  – Well defined
  – Known water “end-uses”
Select the Right Programs

• Based on Water Use Profile Analysis
  – residential vs. non-residential
  – indoor vs. outdoor
  – old vs. new

• Customer Acceptance

• Cost Effectiveness
Water Conservation Measure Screening

- Evaluate based on 4 different criteria (AWWA)
  - Technology/Market Maturity
  - Service Area Match
  - Customer Acceptance/Equity
  - Better Measure Available

<table>
<thead>
<tr>
<th>Measure</th>
<th>Criteria</th>
<th>Technology Market Maturity</th>
<th>Service Area Match</th>
<th>Customer Acceptance Equity</th>
<th>Better Measure Available</th>
<th>Score</th>
<th>Pass (&gt;16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Residential – Indoor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing Accounts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Require 1.6 gal/flush toilet to be installed at the time of sale</td>
<td>requirement at time of sale</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td></td>
<td>17</td>
<td>Y</td>
</tr>
<tr>
<td>Rebates for 6/3 dual flush or 4-liter toilets</td>
<td>rebate</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>12</td>
<td>N</td>
</tr>
<tr>
<td>Rebates for high efficiency clothes washers</td>
<td>rebate</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>17</td>
<td>Y</td>
</tr>
<tr>
<td>Low income home leak detection and repair</td>
<td>promote</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>N</td>
</tr>
<tr>
<td>Distribute retrofit kits w/low flow showerheads</td>
<td>requirement</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>17</td>
<td>Y</td>
</tr>
<tr>
<td>Increase school education programs</td>
<td>sponsor</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>16</td>
<td>Y</td>
</tr>
<tr>
<td>New Homes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Residential hot water recirculation incentives for new homes</td>
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Understand Interactions

• Weather
  – Drought can make peaks increase, but restrictions can make revenue decrease
  – Wet year can give false sense of conservation success

• Economic
  – High gas prices can make folks think twice about other expenses
  – Home building trends
  – Industrial fluctuations or efficiencies

• Others?
Program Evaluation

• Not all measures can be evaluated based on water savings (education, retrofit kits)

• Water savings take time to appear (multiple years)

• Progress can be measured by:
  – Implementation
    and/or
  – Water Savings
Tools Outline

• Need for conservation models
• History of conservation models
• Basic methodology
• List of different available models
• Comparison of features
• Evaluation of differences
• Conclusions
Need for Water Conservation Models

• Provides a way to compare effectiveness of water conservation practices
  – water savings
  – cost

• Municipal, Industrial, Urban Irrigation
History of Water Conservation Models

• 1968 – early developments of IWR-MAIN
• 1992 – CUWCC BMP models
• 1998 – US EPA Guidelines
• 1998 – Confluence
• 1999 – DSS model
• 1998 + Custom Utility/Consultant models
• 2006 – AWWA/CUWCC Avoided Costs Model
• 2006 – Conserve Florida GUIDE
• 2008 – Georgia Water Use and Conservation
• 2009 – AWE model

Source: Water Efficiency, September-October 2009
Basic Methodology

• Profile customer base, describe characteristics
• Using pre-determined assumptions, calculate water savings and costs
• Forecasts of growth and/or water savings
• Benefit/Cost Analysis OR Cost-Effectiveness
List of Available Models

- Georgia Water Use and Conservation Profiles (EPD website)
- AWE (free with membership)
- DSS (proprietary)
- AWWA Models (cost of WRF report)
- IWR-MAIN (proprietary)
- Conserve Florida GUIDE (free, Florida-specific)
- various consultant and utility spreadsheet models
- Voyage™ integrated conservation module
AWE Conservation Tracking Tool

- Meant for use by member utilities
- Data entry screens
- Growth by sector
- Conservation practice library (25 built-in)
- Revenue Impact module
- Multi-scenario capability
- Implementation tracking
- Further development is ongoing
DSS Model

- Used in Metro Atlanta and Bay Area planning
- End-use model
- Sophisticated forecasting model
- Detailed water billing data needed
- Top-down calculation and bottom-up verification
- Calculates practice interaction, to avoid overestimation
- Program customization by combining practices
- Not so user friendly, no built in practices
- No tracking capabilities
Spreadsheet Tools

- Customized to incorporate end-use modeling
- Can be expanded to add many practices
- Evaluates full implementation, can be adjusted
- Detailed water billing data needed
- Semi-complex, training needed
- No tracking capability
- Limited existing forecasting capability
Voyage™ Conservation Module

- Integrated into CH2M HILL’s Voyage™ Water Management Model
- Cary, NC IWRMP
- See impacts of demand management on other, related issues, such as IBT
Cost Effectiveness of Measures

• Use models to evaluate the cost effectiveness of each program ($/gal saved)
• Compare with cost of new or expanded supplies/production
• Consider long-term impacts on revenue
• Consider effect of demand hardening
Benefit/Cost Ratio of Measures

• Assess benefits of conservation measures
  – Avoided cost of water savings
    • Utility savings
    • Customer savings
  – Environmental benefits

• Evaluate full cost of water conservation measures
  – Set up, marketing, admin, unit costs
  – Revenue adjustments
Model Comparison

- Alliance for Water Efficiency Conservation Tracking Tool (AWE)
- Demand Side Management Least-Cost Planning Decision Support System (Maddaus Water Management)
- Georgia Water Use and Conservation Profiles (GA EPD and CH2M HILL)
- All Microsoft Excel models
## Comparison of Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>AWE</th>
<th>DSS</th>
<th>GA WUCP</th>
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<td>Customer profile</td>
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<td>Semi-automated</td>
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PV = Present Value
Summary

• AWE Tool is newest, and being developed actively
• DSS is proven, large scale tool
• GA WUCP is available, needs adaptation
• CONSERV Florida has support and is being developed, but mostly by researchers

• What is the goal?
Racking Up the Savings: Planning and Evaluating Cost-Beneficial Water Conservation Programs

Mary Ann Dickinson
President and CEO

Alliance for Water Efficiency
Constructing a Water Efficiency Plan

Data Collection
- Analyze Water Demand
- ID Conservation Measures
- Screen Measures

Formulate Draft Water Efficiency Programs
- Develop Evaluation Criteria
- Evaluate Efficiency Programs, Prioritize Options

Delivery Mechanisms
- Economic Analysis

Stakeholder Involvement

Draft Water Efficiency Implementation Plan

Source: A & N Technical Services, Inc.
AWWARF Project 2935: Water Efficiency Programs for Integrated Water Management
So Why Another Model?

- Need for consistent and thorough analysis of cost-effective water conservation options
- Tools exist in various forms
- Most are proprietary
- AWE wanted robust but easy to use model with transparent code
- The Home Depot Foundation funded partial development
- “Tracking Tool” for savings as well as analytical tool for planning
Tracking Tool Inputs and Outputs

- System Avoided Cost Data
- Baseline Demand Data
- Conservation Measure Data

Model Outputs

- Savings Analysis
- Benefit-Cost Analysis
- Revenue/Rate Impacts
Getting Started:
1. The model uses a simple worksheet tab color code:
   - Blue Tabs: User Data Entry
   - Green Tabs: Model Outputs/Results
   - Gray Tabs: Data Storage and Library
2. First provide information about your system, customers, and water demands. This is done on data entry worksheets 1 thru 3.
3. Next define or import conservation activities and set their annual activity levels. This is done on data entry worksheets 4 and 5.
4. You can save conservation activity scenarios at any time. You access the scenario manager on the Common Assumptions worksheet.
5. You can navigate to model worksheets by clicking on the model schematic below or by clicking on the worksheet tabs at the bottom of the screen.
6. Data entry cells on input worksheets look like this: [Enter data in cells with this color coding].
Common Assumptions
Baseline Demands

- Two Data Entry Options
  - Enter or link to an existing demand forecast
  - Use model to grow current demand by population

- Plumbing/Energy Code Adjustment
  - Model can adjust for impact of existing plumbing/energy codes as necessary

- Demand Disaggregation
  - Peak/Off Peak Seasonal Demands
  - Customer Class Disaggregation
Avoided Costs

- Two Data Entry Options
  - Enter or link to an existing avoided cost forecast
  - Use model’s avoided cost calculator

- Model’s Avoided Cost Calculator
  - Short-run avoided O&M
    - Water Supply
    - Wastewater Treatment
  - Long-run avoided or deferred capacity
    - Calculates present value of delaying and/or downsizing peak season capacity expansion
## Capacity Deferral Analysis

### AWE Conservation Tracking Tool: Water Savings Summary Worksheet

<table>
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<tr>
<th>Year forecasted peak season demand equals existing peak season delivery capacity</th>
<th>Expansion (Years)</th>
<th>Deferred Capacity (MGD)</th>
<th>Benefit of Deferred Expansion ($)</th>
<th>Avoided Capacity (MGD)</th>
<th>Benefit of Avoided Expansion ($)</th>
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### Select Chart to View

- Peak Season Capacity

### Peak Season System Capacity

- Current System Capacity
- Planned System Capacity
- Gross Peak Season Demand
- Less Passive Savings
- Less Active Savings
Setting Up Conservation Measures

- Two Specification Options
  - Build from scratch
  - Import pre-defined measures from library
  - Pre-defined measures can be customized

- Library currently includes 25 measures
  - 13 residential measures
  - 8 ClI measures
  - 4 large landscape measures
Defining a New Conservation Measure

AWE CONSERVATION TRACKING TOOL: DEFINE CONSERVATION ACTIVITIES WORKSHEET

Define Conservation Program Activities

<table>
<thead>
<tr>
<th>Activity ID</th>
<th>Activity Name</th>
<th>Class</th>
<th>Savings, Per Unit (gpg)</th>
<th>Savings, Annual Rate of Decay (%)</th>
<th>Savings, Peak Period (% of Annual Savings)</th>
<th>Savings, Useful Life (yrs)</th>
<th>Savings, Participant Free Riders (% of Participants)</th>
<th>Utility Costs, Year Denominated</th>
<th>Utility Costs, Initial Fixed ($)</th>
<th>Utility Costs, Initial Variable ($/unit)</th>
<th>Utility Costs, Years of Follow-up (yrs)</th>
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</table>

Define Conservation Activities

Activity Name: Residential Surveys, SF
Affected Customer Class: Single Family

Unit Water Savings | Utility Costs | Participant Costs | Participant Non Water Benefits | Plumbing Code |

Unit Water Savings (gallons/year): 12,373.0
Annual Rate of Savings Decay (%/Year): 20.00%
Peak Period Savings (% of Annual): 65.00%
Peak days = 42% of days in a year.
Useful Life (years): 5
Participant Freeriders (% of Participants): 0.00%
Importing a Library Measure

Define Conservation Activities

Activity Name: Residential Surveys, SF
Affected Customer Class: Single Family

Unit Water Savings: 
Utility Costs: 
Participant Costs: 
Participant Non-Water Benefits: 
Plumbing Code: 

Import from Library

Residential Surveys, SF
Residential Surveys, MF
Residential ULF Toilets, SF
Residential ULF Toilets, MF
Residential HE Toilets, SF
Residential HE Toilets, MF

Unit Water Savings (Gal/Yr): 
Annual Rate of Savings Decline: 
Peak Period Savings (% of Annual Savings): 
Useful Life (Years): 5
Participant Freeriders (% of Participants): 0.00%

Import an Activity from the Library

Close Form
Previous Record
Next Record
New Record
Delete Record

1 of 5
### Entering Annual Activity Levels

**AWE CONSERVATION TRACKING TOOL: ENTER ANNUAL CONSERVATION ACTIVITY WORKSHEET**

#### Enter Annual Conservation Activity

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#### Effective Conservation Activity

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#### Gross Water Savings (AF)

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<th>2011</th>
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<td>171.0</td>
<td>199.5</td>
<td>228.6</td>
</tr>
<tr>
<td>Total</td>
<td>Gross Water Savings</td>
<td>305.7</td>
<td>603.7</td>
<td>790.1</td>
<td>971.7</td>
<td>1,149.3</td>
<td>1,264.8</td>
<td>1,387.8</td>
<td>1,651.0</td>
<td>1,857.5</td>
<td>1,933.8</td>
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</tbody>
</table>

#### Peak Gross Water Savings (AF)

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity Name</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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<tbody>
<tr>
<td>SF</td>
<td>Residential Surveys, SF</td>
<td>24.7</td>
<td>44.4</td>
<td>60.2</td>
<td>72.9</td>
<td>83.0</td>
<td>58.3</td>
<td>38.5</td>
<td>22.7</td>
<td>10.1</td>
<td>0</td>
</tr>
<tr>
<td>SF</td>
<td>Residential HE Toilets, SF</td>
<td>11.7</td>
<td>23.5</td>
<td>35.2</td>
<td>47.0</td>
<td>56.7</td>
<td>70.5</td>
<td>82.2</td>
<td>94.0</td>
<td>105.7</td>
<td>117.5</td>
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<tr>
<td>CII</td>
<td>CII HE Toilet</td>
<td>15.9</td>
<td>32.8</td>
<td>45.0</td>
<td>58.9</td>
<td>74.9</td>
<td>89.3</td>
<td>104.9</td>
<td>126.2</td>
<td>149.3</td>
<td>149.3</td>
</tr>
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</table>
### Water Demand Summary

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Demands</td>
<td>AF</td>
<td>67.822</td>
<td>68.112</td>
<td>68.404</td>
<td>68.633</td>
<td>68.863</td>
<td>69.093</td>
<td>69.325</td>
<td>69.557</td>
<td>69.790</td>
<td>70.023</td>
</tr>
</tbody>
</table>

### Per Capita Demands

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Baseline Demands</td>
<td>GPD</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
<td>173.0</td>
</tr>
<tr>
<td>Baseline - Code Savings</td>
<td>GPD</td>
<td>173.0</td>
<td>172.4</td>
<td>171.8</td>
<td>171.3</td>
<td>170.6</td>
<td>170.0</td>
<td>169.4</td>
<td>168.9</td>
<td>168.4</td>
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<tr>
<td>Baseline - Code Savings - Program Savings</td>
<td>GPD</td>
<td>172.2</td>
<td>170.9</td>
<td>169.8</td>
<td>168.9</td>
<td>167.8</td>
<td>166.9</td>
<td>166.1</td>
<td>165.0</td>
<td>164.0</td>
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</table>

### Service Area Water Savings

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Water Savings</td>
<td>AF</td>
<td>0.0</td>
<td>236.9</td>
<td>461.7</td>
<td>677.6</td>
<td>942.1</td>
<td>1,191.7</td>
<td>1,427.5</td>
<td>1,650.4</td>
<td>1,862.2</td>
</tr>
<tr>
<td>Program Water Savings</td>
<td>AF</td>
<td>305.7</td>
<td>600.8</td>
<td>781.5</td>
<td>954.8</td>
<td>1,121.7</td>
<td>1,224.1</td>
<td>1,332.7</td>
<td>1,580.3</td>
<td>1,769.8</td>
</tr>
<tr>
<td>Total Water Savings</td>
<td>AF</td>
<td>305.7</td>
<td>837.7</td>
<td>1,243.2</td>
<td>1,632.4</td>
<td>2,063.7</td>
<td>2,415.8</td>
<td>2,760.2</td>
<td>3,230.7</td>
<td>3,632.0</td>
</tr>
<tr>
<td>% of Baseline Demands</td>
<td>%</td>
<td>0.5%</td>
<td>1.2%</td>
<td>1.8%</td>
<td>2.4%</td>
<td>3.0%</td>
<td>3.5%</td>
<td>4.0%</td>
<td>4.6%</td>
<td>5.2%</td>
</tr>
</tbody>
</table>

### Class Water Savings

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>AF</td>
<td>127.4</td>
<td>405.0</td>
<td>667.3</td>
<td>917.8</td>
<td>1,205.6</td>
<td>1,428.1</td>
<td>1,647.4</td>
<td>1,862.6</td>
<td>2,012.3</td>
</tr>
<tr>
<td>Multi Family</td>
<td>AF</td>
<td>-</td>
<td>54.4</td>
<td>106.0</td>
<td>155.7</td>
<td>212.9</td>
<td>267.1</td>
<td>318.3</td>
<td>366.9</td>
<td>413.1</td>
</tr>
<tr>
<td>CII</td>
<td>AF</td>
<td>44.2</td>
<td>110.2</td>
<td>201.8</td>
<td>290.7</td>
<td>377.1</td>
<td>452.4</td>
<td>526.4</td>
<td>598.9</td>
<td>670.2</td>
</tr>
<tr>
<td>Irrigation</td>
<td>AF</td>
<td>134.1</td>
<td>268.2</td>
<td>268.2</td>
<td>268.2</td>
<td>268.2</td>
<td>268.2</td>
<td>402.3</td>
<td>536.4</td>
<td>536.4</td>
</tr>
<tr>
<td>Water Losses</td>
<td>AF</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>AF</td>
<td>305.7</td>
<td>837.7</td>
<td>1,243.2</td>
<td>1,632.4</td>
<td>2,063.7</td>
<td>2,415.8</td>
<td>2,760.2</td>
<td>3,230.7</td>
<td>3,632.0</td>
</tr>
</tbody>
</table>

### Year forecasted peak season demand equals existing peak season delivery capacity

<table>
<thead>
<tr>
<th></th>
<th>Deferred Expansion (Years)</th>
<th>Deferred Capacity (MGD)</th>
<th>Benefit of Deferred Expansion ($)</th>
<th>Avoided Capacity (MGD)</th>
<th>Benefit of Avoided Expansion ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Demands</td>
<td>2020</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline - Code Savings</td>
<td>2031</td>
<td>11</td>
<td>6.4</td>
<td>9,144,908</td>
<td>0.0</td>
</tr>
<tr>
<td>Baseline - Code Savings - Program Savings</td>
<td>2039</td>
<td>19</td>
<td>6.4</td>
<td>14,198,213</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### Select Chart to View

- Per Capita Demands

---

*Note: The image also includes a chart for Per Capita Demands.*
## AWE Conservation Tracking Tool: Utility Costs & Benefits Worksheet

### Conservation Program Cost Analysis (2010 Dollars)

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity Name</th>
<th>Unit Cost ($/AF)</th>
<th>PV Cost</th>
<th>Amortized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>Residential Surveys, SF</td>
<td>$832</td>
<td>$1,469,277</td>
<td>$97,962</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential HE Toilets, SF</td>
<td>$403</td>
<td>$1,694,499</td>
<td>$112,979</td>
</tr>
<tr>
<td>CII</td>
<td>CII HE Toilet</td>
<td>$787</td>
<td>$4,220,334</td>
<td>$281,386</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential Irrigation Controller, SF</td>
<td>$783</td>
<td>$7,687,606</td>
<td>$512,563</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Large Land. Irrigation Controller</td>
<td>$193</td>
<td>$2,520,977</td>
<td>$168,083</td>
</tr>
<tr>
<td>CII</td>
<td>CII Spray Rinse Valve</td>
<td>$324</td>
<td>$318,207</td>
<td>$21,216</td>
</tr>
<tr>
<td>CII</td>
<td>CII Cooling Tower</td>
<td>$201</td>
<td>$1,055,409</td>
<td>$70,368</td>
</tr>
<tr>
<td><strong>Subtotal Conservation Activities</strong></td>
<td></td>
<td><strong>$469</strong></td>
<td><strong>$18,966,309</strong></td>
<td><strong>$1,264,557</strong></td>
</tr>
<tr>
<td><strong>Total With Overhead &amp; Public Information</strong></td>
<td></td>
<td><strong>$469</strong></td>
<td><strong>$18,966,309</strong></td>
<td><strong>$1,264,557</strong></td>
</tr>
</tbody>
</table>

### Conservation Benefit Analysis (2010 Dollars)

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity Name</th>
<th>Unit Benefit ($/AF)</th>
<th>PV Benefit</th>
<th>Avoided Supply</th>
<th>Avoided Wastewater</th>
<th>Capacity Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>Residential Surveys, SF</td>
<td>$662</td>
<td>$1,167,828</td>
<td>$898,505</td>
<td>$40,596</td>
<td>$228,728</td>
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<tr>
<td>Single Family</td>
<td>Residential HE Toilets, SF</td>
<td>$676</td>
<td>$2,841,271</td>
<td>$2,280,326</td>
<td>$240,463</td>
<td>$320,482</td>
</tr>
<tr>
<td>CII</td>
<td>CII HE Toilet</td>
<td>$675</td>
<td>$3,624,397</td>
<td>$2,908,842</td>
<td>$306,741</td>
<td>$408,815</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential Irrigation Controller, SF</td>
<td>$620</td>
<td>$6,089,920</td>
<td>$4,773,421</td>
<td>-</td>
<td>$1,316,499</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Large Land. Irrigation Controller</td>
<td>$634</td>
<td>$8,295,971</td>
<td>$6,369,481</td>
<td>$506,741</td>
<td>$1,926,490</td>
</tr>
<tr>
<td>CII</td>
<td>CII Spray Rinse Valve</td>
<td>$695</td>
<td>$683,579</td>
<td>$536,074</td>
<td>$57,006</td>
<td>$90,499</td>
</tr>
<tr>
<td>CII</td>
<td>CII Cooling Tower</td>
<td>$748</td>
<td>$3,927,857</td>
<td>$2,862,134</td>
<td>$303,931</td>
<td>$791,792</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$658</strong></td>
<td><strong>$26,630,822</strong></td>
<td><strong>$20,628,782</strong></td>
<td><strong>$948,736</strong></td>
<td><strong>$5,053,304</strong></td>
</tr>
</tbody>
</table>

### Utility Conservation Program NPV and B/C Ratio (2010 Dollars)

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity Name</th>
<th>NPV ($)</th>
<th>B/C Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>Residential Surveys, SF</td>
<td>$(301,449)</td>
<td>0.79</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential HE Toilets, SF</td>
<td>$1,146,772</td>
<td>1.68</td>
</tr>
<tr>
<td>CII</td>
<td>CII HE Toilet</td>
<td>$(595,937)</td>
<td>0.86</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential Irrigation Controller, SF</td>
<td>$(1,597,688)</td>
<td>0.79</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Large Land. Irrigation Controller</td>
<td>$5,774,994</td>
<td>3.29</td>
</tr>
<tr>
<td>CII</td>
<td>CII Spray Rinse Valve</td>
<td>$365,371</td>
<td>2.15</td>
</tr>
<tr>
<td>CII</td>
<td>CII Cooling Tower</td>
<td>$2,872,448</td>
<td>3.72</td>
</tr>
<tr>
<td><strong>Subtotal Conservation Activities</strong></td>
<td></td>
<td><strong>$7,664,513</strong></td>
<td><strong>1.40</strong></td>
</tr>
<tr>
<td><strong>Total With Overhead &amp; Public Information</strong></td>
<td></td>
<td><strong>$7,664,513</strong></td>
<td><strong>1.40</strong></td>
</tr>
</tbody>
</table>
Assessing Water Loss Control

- Important to include water loss control methods in model analysis
- Detailed modeling necessary to incorporate individual water loss control strategies for a specific utility
- Insufficient funding available for first version of model to do this
- Wanted to benchmark water loss control strategies against demand side management strategies
Model Assumptions

- Default assumption that 65% of total water losses are real losses and 35% are apparent losses. This default assumption can be modified by the user.
- Default assumption that an aggressive water loss reduction program would, for a typical utility, reduce real losses by 20 - 40%.
- Model compares this savings potential to program water savings from demand side conservation activities defined in the model.
## Benchmark Examples (in AF)

<table>
<thead>
<tr>
<th>Company</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco PUC</td>
<td>$439</td>
</tr>
<tr>
<td>Nashville Water Works</td>
<td>$318</td>
</tr>
<tr>
<td>Los Angeles Dept. of Water and Power</td>
<td>$347</td>
</tr>
<tr>
<td>California Grant Program</td>
<td>$658</td>
</tr>
<tr>
<td>Las Vegas WD</td>
<td>$464</td>
</tr>
<tr>
<td>Large Western US Utility</td>
<td>$318</td>
</tr>
<tr>
<td>Orange County Utilities, FL</td>
<td>$463</td>
</tr>
</tbody>
</table>

**Average** $430  
**Maximum** $658  
**Minimum** $318

Source: Julian Thornton and Reinhard Sturm
Conservation Activities Sorted by Utility Unit Cost

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity Name</th>
<th>NPV ($  )</th>
<th>B/C Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>Residential Surveys, SF</td>
<td>$(301,449)</td>
<td>0.79</td>
</tr>
<tr>
<td>Single Family</td>
<td>Residential HE Toilets, SF</td>
<td>$1,146,772</td>
<td>1.68</td>
</tr>
<tr>
<td>CII</td>
<td>CII HE Toilet</td>
<td>$(595,937)</td>
<td>0.86</td>
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<td>Single Family</td>
<td>Residential Irrigation Controller, SF</td>
<td>$(1,597,886)</td>
<td>0.79</td>
</tr>
<tr>
<td>Irrigation</td>
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<td>3.29</td>
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<td>CII Cooling Tower</td>
<td>$2,872,448</td>
<td>3.72</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal Conservation Activities</strong></td>
<td>$7,664,513</td>
<td>1.40</td>
</tr>
<tr>
<td></td>
<td><strong>Total With Overhead &amp; Public Information</strong></td>
<td>$7,664,513</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Conservation Activities Sorted by Utility Unit Cost

*Low and high unit cost represent the 90% confidence interval for average unit cost of 7 U.S. water loss control programs, as reported in Thornton and Sturm (2007).*
**Utility Revenue Requirement and Rate Impacts**

<table>
<thead>
<tr>
<th>Program Impact on...</th>
<th>Baseline</th>
<th>With Conserv.</th>
<th>Change to Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Utility Annual Sales Revenue Requirement</td>
<td>49,750,031</td>
<td>$49,378,362</td>
<td>($371,668)</td>
</tr>
<tr>
<td>% change from baseline</td>
<td>-0.75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. Water Rate ($/Thou Gal)</td>
<td>$2.17</td>
<td>$2.31</td>
<td>$0.14</td>
</tr>
<tr>
<td>% change from baseline</td>
<td>6.60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annualized Bill Impact ($/M.)</td>
<td>46.91</td>
<td>$46.58</td>
<td>($0.32)</td>
</tr>
<tr>
<td>% change from baseline</td>
<td>-0.69%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Impact to Utility Sales Revenue Requirement**

The chart shows the annualized change in utility sales revenue requirement from 2008 to 2037. The impact is measured in millions of dollars, with a range from ($1.5) to $1.5. The chart includes a horizontal line indicating the annualized change, which is close to zero, suggesting a minimal overall impact over the period.
Beta Testing the Model

- Four US utilities tested the model: Seattle, San Antonio, Tampa Bay, Marin Municipal Water District
- Model now finalized with results from beta testing
- Version 1.2 now available in Excel
- Future versions will add to library of conservation measures
- Detailed water loss evaluation component will be added
Availability of Model

- Available free to members
- AWE agrees to provide free all future updates and one free hour of technical assistance
- Version 1.2 released last month with new features and corrections
- International applications (Jordan, Australia, Italy)
- Collecting case studies of user experiences
Observations Since Model Release

- Data inputs must be correct on avoided costs and system expansion needs
- Utility conservation costs must be correctly estimated
- Utility overhead not double-counted
- Savings of 15-30% reasonably likely depending upon avoided costs
- Users are able to create and customize
- California highest activity to date (due to state planning requirements)
Examples of Water Utility Planning

- CA: CA Water Service Co. (26 systems)
- CA: Ontario region
- CA: City of Oxnard
- CA: San Jose Region
- CA: West Basin Region
- CA: Apple Valley
- CO: Westminster
- GA: Statewide estimates underway
- TX: SAWS, Austin, Montgomery County
- Australia: Melbourne and Perth Region
- Jordan: Countrywide with all 3 utilities
Alliance for Water Efficiency

A Voice and a Platform
Promoting the efficient and sustainable use of water

www.a4we.org
(773) 360-5100
CHICAGO
Choosing the Right Programs for Your Utility
Conservation Programs: What are your options?

- Alliance for Water Efficiency Resource Library
- AWWA’s Water Efficiency Clearinghouse
- EPA’s Water Conservation Plan Guidelines (WaterSense)
- California Urban Water Conservation Council Best Management Practices
- Amy Vickers’ Handbook of Water Use and Conservation
Components of a Program

Conservation program = conservation measure(s) + delivery mechanism(s)

• Conservation measures
  • Technologies, plumbing fixtures, management, practices

• Delivery mechanism
  • Education, rebates, incentives, direct install, ordinances

Delivery mechanisms

Education, Public Awareness  Program Marketing, Rebates & Incentives  Legislation, Ordinances, Regulation

Information  Incentives and Active Programs  Requirement

Town of Cary, NC’s Water Conservation Program Stool
Choosing the Right Program for Your Utility

• Considerations
  – Legal requirements
  – Customer demographics and characteristics
  – Demand forecast
  – Utility challenges
    • Infrastructure
    • Financial
    • Growth
  – Cost-benefit comparison
Customer Demographics

Fayetteville, NC Demographics

Household Income Distribution (Nominal Dollars)

Census Bureau, 2008 American Community Survey and 2000 Decennial Census.

Age of Housing Stock, 2008
Customer Usage Characteristics

• Irrigators?
• Peakers?
• Significant contributors to the bottom line?
• Responsive to drought restrictions and conditions?
High peaking
(Avg. high use/Avg. low use: Above 2.0)

Low users, High peakers
22,536  Households in FY08
21,651  Households in FY07

Low volume user
Average up to 5,000 GPM

High users, High peakers
21,636  Households in FY08
18,983  Households in FY07

High volume user
Average above 5,000 GPM

Low users, Low peakers
16,088  Households in FY08
16,515  Households in FY07

Low peaking
Avg. high use/Avg. low use: Below 2.0

High users, Low peakers
8,660  Households in FY08
9,801  Households in FY07
Choosing the Right Measures for Your Utility

Matching utility and customer characteristics to conservation measures and programs

<table>
<thead>
<tr>
<th>Utility Issue</th>
<th>Conservation Measure Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large rental community</td>
<td>Sub-metering</td>
</tr>
<tr>
<td>Affordability concerns/Customer service</td>
<td>Residential water audits</td>
</tr>
<tr>
<td>Seasonal population</td>
<td>Seasonal rates</td>
</tr>
<tr>
<td>High summer peak</td>
<td>Reuse program, irrigation policies</td>
</tr>
</tbody>
</table>
SELECTING WATER CONSERVATION MEASURES

If your customer base is primarily

- Residential
  - Without or in addition to Irrigation Systems
    - Homes older than 1994
      - HET Rebate Program
    - Homes newer than 1994
      - Faucet Aerator Distribution
        - Showerhead Exchange
        - High Eff Washer (Information only)
  - High Irrigation Use
    - Xeriscape Education
    - Watering Day Enforcement
    - Irrigation Audits
    - Irrigation/Landscape Rebates (Pilot scale)

- Commercial, Institutional
  - Without or in addition to Irrigation Systems
  - Target Specific Business Types
    - Restaurants
      - Pre-Rinse
      - Spray Valve Distribution
      - Laundromats
        - Commercial Clothes Washer
        - (Information only)
    - High use (Theaters, Malls, Stadiums)
      - High Efficiency Urinal Rebates
      - Faucet Aerator Distribution

- Industrial
  - Water Audits
  - Cooling Tower Workshops
  - Target Specific Business Types
    - Cooling Tower Workshops
    - Information on WASCOS for Audits and Retrofits

Figure 6-1. Overview of water conservation measure selection based on customer base. Measures outlined are those appropriate for small and medium-sized utilities with limited budgets. (Graphic: Water Media Services and Liz Block)
Introduction of Case Studies

Peak Beach

Budville

LaLaLand

Urtown?
Peak Beach

- Winter population: 62,000  Median income: $40k
- Summer population: 94,000  Median income: $70k
- Account profile: 90% residential/10% CII
- Peaking factor: 2.5 in the summer (from influx of people and irrigation)
- Residential rate structure: Increasing block (4, 8, >8)
- Commercial rate structure: Uniform
- Bi-monthly billing
Budville

• Population: 10,000
• Close proximity to economically thriving area
• Account profile: 95% residential/5% CII
• Operating ratio: 1.14
• Water treatment capacity:
  • Average demand day: 75%
  • Peak demand day: 87%
• Small increases in demand over last 20 years
• Reliance on State SRF funds for capital projects

• Goal: Economic growth
LaLaLand

• 150,000 accounts in multiple municipalities
• Median household income: $55k, but 20% live below poverty level
• Account profile: Residential, 60%
• Average residential water use: 6,000 GPM, but declining
• Peaking factor: 1.25
• Crumbling infrastructure (20% water loss during distribution)
• $20 million revenue gap
• Issue: Delinquent or non-payments
Urtown

• Describe Service Area (population, growth, account profile, average usage, peak usage)
• Identify Water Conservation Opportunities
  – Top Users
  – Age of residential construction
  – Irrigation water use (location, amount)
• CIll Accounts
• Issues (infrastructure, financial, capacity)
Funding ICI Programs
(The following 18 slides were presented by Kathy Nguyen of Cobb County, GA at the Georgia Workshop)
What is ICI?

• These are the customers in your system classified as:
  – Industrial: heavy manufacturing, chicken plants, bottling factories, paper companies, etc.
  – Commercial: Retail, builders, landscapers, building management, restaurants, etc.
  – Institutional: Schools, Government, Prisons
What Programs Can we Develop?

• Alternate source projects – rainwater capture, cooling tower water, gray water.
• Large retrofit programs
• Comprehensive process changes
• Large outdoor efficiency programs
• Education programs
• Public awareness programs
Are they Different than Residential?

- Require more oversight
- Require more technical evaluation for water savings
- Inherently need more flexibility
- Need a way to estimate the savings and the value
- Have to look at your entire system – many issues with wastewater in some commercial programs
- It has to have reasonable ROI
How Can You Fund?

• Surcharge or assessment on meter base charge
  – Dedicated amount that gets set aside for commercial programs.
  – The money is sent to designated fund.
  – All commercial customers pay so all commercial customers can take advantage
• Allocate a portion of the budget to programs
• Dedicate a portion of the highest tier to be dedicated to conservation
• Require that a fee be paid by new development that goes into a fund for conservation program to save water needed for the new development
Cobb’s Customers

Percentage of Customer Base

- Residential: 94.8%
- Commercial: 4.5%
- Government: 0.1%
- HOA: 0.2%
- Multi-Unit: 0.3%
- Industrial: 0.0%
- School: 0.1%
- Commercial: 4.5%
- Government: 0.1%
- HOA: 0.2%
- Multi-Unit: 0.3%
- Industrial: 0.0%
- School: 0.1%
Top 10 Industries in Cobb

- Administrative and Support services
- Professionals/Scientific/ Tech Services
- Food Service
- Ambulatory Health Care
- Wholesalers of durable goods
- Specialty Trade Contractors
- Management Companies
- General Merchandise Stores
- Transportation Equipment
- Hospitals
Determining Your Targets

• Started Residential
• Looked at commercial sectors
  – By consumption
  – Interest level
• Services we could offer
• How to design a usable program for them
• What could we do for “free”
Much More Work Building the Ethic

• Businesses seeing this as someone else’s problem.
• Slow to take hold of Conservation
  – Difficulty with Commercial Audits
  – Commercial programs potentially higher cost
• Need the industry buy-in
• Payback is extended due to cheap water
Clean Your Own House First

• Cobb County Government retrofitted County buildings
• Adopted a LEED Construction Policy for new construction
• Adopted Water Efficient Landscape Practices
• Adopted a WaterSense Purchasing Requirement
Get Their Attention!
It’s Who you Know

• Built Relationships
  – Schools
  – Plumbers
  – BOMA
  – Leadership Cobb

• Offered Technical Expertise
  – Speaking engagements
  – Panel and Board Members
  – Hosted Training
Start Affordable

• Industry Training
  – Green Plumbers
  – Green Industry Professionals

• Incentive Programs
  – Pilot Tests
  – Learn as much from failure as success

• Ordinances and requirements
  – Submetering
  – Pool Cover Requirement
  – Carwash Recycling

• Public Awareness
  – Serving water in restaurants
  – Green Hotel
Preach About the Choir!

- School Projects
- Green Builders
- Landscape Professionals
- Business Leaders
- Golf Course industry
Show Me the Money!

• Cobb’s Budget for Water Efficiency
  – $250,000 – Programs (has been expanded each year due to popularity of programs)
  – $150,000 – Staff / Benefits / Retirement

• We have budget autonomy on what programs to fund
  – Have chosen the pilot approach for commercial incentives
  – Largest investment in commercial is staff time.
Where is Cobb Going?

• Multi-family Toilet Rebate Program
• Development Standards
• Looking at a fee to be assessed to fund commercial incentives addition to base charge
• Looking to form a conservation committee
• Creating a potentially more flexible incentive program
Questions?

Kathy Nguyen
Senior Project Manager
Cobb County Water System
770-419-6244
Driving Efficiency Through Price
Is there a relationship between water rates and usage?
In theory

Utilities set rates based on projected use to recover costs

As rates go up, water use goes down
Does it happen in practice?

Yes!
In North Carolina, utilities with higher rates generally have lower residential use.
What about one utility that raises its rates from one year to the next?

Study of >250 NC utilities, tracking their rates and usage over two years.

Utilities that raised their rates saw a decline in their average residential water use.

http://efc.unc.edu/projects/NC_ratesetting.htm
Is this unique to North Carolina?

Studies and studies and studies showing the same result all over the country

Studies of the studies
“Price Elasticity of Demand”

\[ \text{Elasticity} = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} \]
Before we continue – why should you care?

If you ignore it, danger of overestimating potential revenues when you propose to raise rates (especially if there is a substantial rate increase)

Driving efficiency through price (long term)
QUIZ!!
Elasticity = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}}

Which is greater? % Change in Demand % Change in Price

What is the sign of Elasticity? Positive Negative
What do you think?

\[ Elasticity = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} \]

If a utility raises price (rates) by 100%, how much will average demand (water use) decline?
Example

$$Elasticity = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}}$$

Utility A:

– Combined W & WW price increases 10%
– Demand decreases 2%

What is the elasticity?

Elasticity = -2% / 10% = -0.2
Example in rate setting

\[ Elasticity = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} \]

Avg. use before price change = 5,000 gallons/month
Proposing raising combined W & WW rates 15%
Elasticity is -0.2
Therefore, change in demand after rate increase
= \(-0.2 \times 15\%\) = \(-3\%\)
New avg. use = 5,000 \(-3\% \text{ of 5,000} \)
= 4,850 gallons/month

Use 4,850 instead of 5,000 gal/mon to estimate revenues
What elasticity number should you use?

<table>
<thead>
<tr>
<th>Price specification</th>
<th>Study</th>
<th>Price elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norden specification</td>
<td>Agthe and Billings (1980)</td>
<td>-0.179 to -0.705</td>
</tr>
<tr>
<td>(marginal price and difference)</td>
<td>Billings and Agthe (1980)</td>
<td>-0.267 to -0.49</td>
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<td></td>
<td>Billings (1982)</td>
<td>-0.56 to -0.66</td>
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<td></td>
<td>Howe (1982)</td>
<td>-0.05 to -0.57</td>
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<tr>
<td></td>
<td>Agthe et al. (1986)</td>
<td>-0.26 to -0.62</td>
</tr>
<tr>
<td></td>
<td>Deller et al. (1986)</td>
<td>-0.36 to -1.12</td>
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<tr>
<td></td>
<td>Billings (1987)</td>
<td>-0.05 to -0.5</td>
</tr>
<tr>
<td></td>
<td>Billings and Day (1989)</td>
<td>-0.52</td>
</tr>
<tr>
<td></td>
<td>Nevesavando and Molina (1989)</td>
<td>-0.09 to -0.86</td>
</tr>
<tr>
<td></td>
<td>Hewitt and Haukomm (1995)</td>
<td>-1.57 to -1.63</td>
</tr>
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<td></td>
<td>Barkatullah (1996)</td>
<td>-0.23 to -0.28</td>
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<tr>
<td></td>
<td>Agthe and Billings (1997)</td>
<td>-0.29 to -0.57</td>
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<td></td>
<td>Dandy et al. (1997)</td>
<td>-0.12 to -0.86</td>
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<td></td>
<td>Conrad et al. (1998)</td>
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<td>Remmick and Archbold (1998)</td>
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<tr>
<td></td>
<td>Remmick and Green (2000)</td>
<td>-0.16</td>
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<tr>
<td></td>
<td>Martinez-Espiniera (2002b)</td>
<td>-0.12 to -0.28</td>
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<tr>
<td>Marginal price</td>
<td>Howe and Linsaweaver (1967)</td>
<td>-0.21 to -1.57</td>
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<td></td>
<td>Gibbs (1978)</td>
<td>-0.51</td>
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<tr>
<td></td>
<td>Carver and Boland (1980)</td>
<td>-0.02 to -0.70</td>
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<tr>
<td></td>
<td>Jones and Morris (1984)</td>
<td>-0.07 to -0.21</td>
</tr>
<tr>
<td></td>
<td>Martin et al. (1984)</td>
<td>-0.25</td>
</tr>
<tr>
<td></td>
<td>Williams (1985)</td>
<td>-0.263 to -0.539</td>
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<tr>
<td></td>
<td>Martin and Thomas (1986)</td>
<td>-0.50</td>
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<tr>
<td></td>
<td>Williams and Suh (1986)</td>
<td>-0.25</td>
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<tr>
<td></td>
<td>Monte (1987)</td>
<td>-0.03 to -0.08</td>
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<td>Schneider and Whirlatch (1991)</td>
<td>-0.11 to -0.262</td>
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<td></td>
<td>Lyman (1992)</td>
<td>-0.30 to -3.33</td>
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<tr>
<td></td>
<td>Martin and Wilder (1992)</td>
<td>-0.32 to -0.00</td>
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<tr>
<td></td>
<td>Nevesavando (1992)</td>
<td>-0.02 to -0.17</td>
</tr>
<tr>
<td></td>
<td>Nevesavando and Cobb (1993)</td>
<td>-0.17 to -0.29</td>
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<tr>
<td></td>
<td>Hanes (1996)</td>
<td>-0.003 to -0.1</td>
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<td></td>
<td>Kishimshira (1996)</td>
<td>-0.23 to -0.78</td>
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<td></td>
<td>Hogland (1999)</td>
<td>-0.10</td>
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<td></td>
<td>Peir (1999)</td>
<td>-0.04 to -1.24</td>
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<td>Average price</td>
<td>Savall and Rousseau (1974)</td>
<td>-0.057 to -0.568</td>
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<tr>
<td></td>
<td>Gibbs (1978)</td>
<td>-0.62</td>
</tr>
<tr>
<td></td>
<td>Foster and Bentitt (1979)</td>
<td>-0.27 to -0.76</td>
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<td></td>
<td>Hulse and de Mare (1982)</td>
<td>-0.15</td>
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<tr>
<td></td>
<td>Jones and Morris (1984)</td>
<td>-0.18 to -0.34</td>
</tr>
<tr>
<td></td>
<td>Williams (1985)</td>
<td>-0.619 to +0.332</td>
</tr>
</tbody>
</table>

Residential customers: In the neighborhood of -0.2 to -0.8

From Arbues, Garcia-Valinas & Martinez Espiniera, 2003
What elasticity number should you use?

Average residential elasticity across the state of NC (for W & WW combined) is between -0.3 and -0.4

30 - 40%

http://efc.unc.edu/projects/NC_ratesetting.htm
Is that the elasticity for *your* utility?

Maybe, maybe not.

Elasticity is unique for each utility & customer based on:

- Season, customers’ final uses of water, lot size, income, education, household size, urban vs. rural, current price and rate structure, age of customers, age of homes and plumbing, etc.

Other things will also affect water use:

- **Weather**, growth, billing period, policies, etc.
Elasticity numbers to use

30-40%: good starting point for the southeast

40-60%: if higher than average discretionary use in community

10-20%: if low discretionary use or suspect low price responsiveness in community
So, you can account for reduced use with price increases.

Now what?
What else can you do?
This document provides guidance on rate structure design and billing practices to water utilities that are attempting to decrease water usage among, primarily, their residential customers. There may be additional rate structure design and billing practices that the utilities can implement to encourage water conservation among non-residential customers which are not addressed in this document.

While all utilities are encouraged to promote efficient use of water resources, there are varying degrees to which utilities in North Carolina need to actively promote conservation in order to ensure adequate supply to meet their demands. One rate structure does not fit all utilities in North Carolina. Hence, these guidelines are not mandatory for water utilities. While these guidelines represent good practice in many circumstances, they are not necessarily all suitable for all water utilities in North Carolina or even the same water utility at different points in time. There is one mandatory legal requirement pertaining to water rate structures for water systems expanding service using state funds, further cited in Option #2 on the following page.

These guidelines have been prepared in accordance with S.L. 2006-143, Section 17, by the North Carolina State Water Infrastructure Commission (SWIC) through consultation with the Environmental Finance Center at the University of North Carolina’s School of Government (EFC).

**NC SESSION LAW 2006-143, SECTION 17.**

The State Water Infrastructure Commission, in consultation with the Department of Environment and Natural Resources, the School of Government at the University of North Carolina at Chapel Hill, the North Carolina Utilities Commission, the Public Staff of the North Carolina Utilities Commission, and the Local Government Commission, shall develop guidelines for water rate structures that are adequate to pay the cost of maintaining, repairing and operating the system, including payment of principal and interest on indebtedness incurred for maintenance or improvement of the water system. The guidelines shall also consider the effect of water rates on water conservation and recommend rate structures that support water conservation. Copies of the guidelines shall be made available to the Department of Environment and Natural Resources, the North Carolina Utilities Commission, and to all local government water systems and large community water systems, as defined in G.S. 143-350. The Commission shall report to the Environmental Review Commission its progress in developing the guidelines no later than January 1, 2009.

1 The 2005 General Assembly created the State Water Infrastructure Commission in GS 159G-65 (S.L. 2005-464). Representatives of the Department of Commerce, Department of Environment & Natural Resources, Rural Economic Development Center, Clean Water Management Trust Fund, Local Government Commission, NC League of Municipalities, NC Association of County Commissioners, NC State University, American Council of Engineering Companies, Water Resources Research Institute, Governor, Senate, and House of Representatives serve on the SWIC.
Section 17 [SWIC] ... shall **develop guidelines** for water rate structures that are adequate to pay the cost of maintaining, repairing, and operating the system, including payment of principal and interest on indebtedness incurred for maintenance or improvement of the water system. The guidelines shall also **consider the effect of water rates on water conservation** and recommend rate structures that support water conservation.
# The guidance document

<table>
<thead>
<tr>
<th>What it <em>is</em></th>
<th>What it is <em>not</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidance</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Menu of rate structure and billing options</td>
<td>Requirement for funding</td>
</tr>
<tr>
<td>Acknowledgement that each utility is unique</td>
<td>Encouraging conservation over cost recovery</td>
</tr>
<tr>
<td>Recognition that there may be tradeoffs with other utility policies</td>
<td>The only alternatives at your disposal</td>
</tr>
</tbody>
</table>
Rank Your Utility Rate Setting Objectives

1. __________
2. __________
3. __________
4. __________

Refer to this list and focus on the highest ranked objectives when following the guidelines for selecting the appropriate rate structure design.
With rate structures: cost recovery first – *then* efficiency

“Once the utility has determined the baseline cost to deliver services, utilities attempting to encourage conservation may consider implementing as many of the following options as desired.”

“Utilities should only embark on implementing conservation-oriented rate structures if they are judged to also be financially and economically sound.”
Rate structure and billing option 1

Set prices that encourage water conservation at the average as well as high levels of residential customer consumption
Rate structure and billing option 2

Do not charge residential customers (or usage below 20,000 gallons/month) using a decreasing block rate structure
Design a rate structure that significantly reduces total bills for customers that reduce water consumption
Rate structure and billing option 4

Use an increasing block rate structure with 3 or 4 blocks within the first 20,000 gallons/month

Utilities with residential increasing block rate structures that use substantial rate differentials between blocks should realize a conservation response
Rate structure and billing option 5

As an alternative to an increasing block rate structure, use a uniform rate structure with a higher volumetric price or a seasonal rate structure that permanently charges higher rates in the summertime than in the wintertime.
Rate structure and billing option 6

Charge higher impact fees (system development charges) for irrigation water meters than for standard household water meters and/or create a residential irrigation meter rate structure and charge a higher volumetric price for irrigation water than for standard household water.
Rate structure and billing option 7

Use a monthly billing period
Rate structure and billing option 8

Provide price and use information on customers’ bills
Encourage sub-metering in apartment complexes and other master-metered multi-family residential housing areas
Rate structure and billing option 10

Review rates each year and adjust rates as needed to meet both operating and long-term costs
In concert with the Water Shortage Responses Plans, consider a role for temporary rate adjustments (e.g.: “drought surcharges”) that are tied to drought conditions and water storage levels
Resource

Designing Rate Structures that Support Your Objectives: Guidelines for NC Water Systems

Questions

Shadi Eskaf

eskaf@sog.unc.edu

Acknowledgement: the NC Department of Environment and Natural Resources, the U.S. Environmental Protection Agency, the NC State Water Infrastructure Commission.
Combining Price and Non-Price Programs: A New Business Model for the Water Utility
Combining Price and Non-Price Programs

Utility-specific blend

Applicability

Acceptability

Feasibility

Effectiveness
## Price vs. Non-price Conservation Programs

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Non-price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economically cost – effective(^1)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Monitoring and enforcement(^1)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Predictability(^1)</td>
<td></td>
<td>No advantage</td>
</tr>
<tr>
<td>Equity(^1)</td>
<td></td>
<td>No advantage</td>
</tr>
<tr>
<td>Political ease(^2)</td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>


## Choosing the Right Plan for Your Utility

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Landscape Audits</th>
<th>Conservation Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>Concentrated</td>
<td>Dispersed</td>
</tr>
<tr>
<td>Costs</td>
<td>Dispersed</td>
<td>Concentrated</td>
</tr>
</tbody>
</table>
# Choosing the Right Plan for Your Utility

<table>
<thead>
<tr>
<th>Utility</th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlotte-Mecklenburg Utilities</td>
<td>6,109 GPM</td>
<td>4,488 GPM</td>
</tr>
<tr>
<td>Fayetteville Public Works Commission</td>
<td>5,401 GPM</td>
<td>4,000 GPM</td>
</tr>
<tr>
<td>Greenville Utilities Commission</td>
<td>4,788 GPM</td>
<td>3,740 GPM</td>
</tr>
<tr>
<td>City of Hendersonville</td>
<td>4,170 GPM</td>
<td>3,200 GPM</td>
</tr>
<tr>
<td>City of High Point</td>
<td>4,226 GPM</td>
<td>3,740 GPM</td>
</tr>
<tr>
<td>OWASA</td>
<td>4,501 GPM</td>
<td>3,000 GPM</td>
</tr>
</tbody>
</table>
How high would your rates be to get him to conserve?
The conservation conundrum

• Water utilities face a dilemma in encouraging water conservation
  – By selling less water, utilities have to increase rates to cover their costs
  – Customers are essentially being asked to pay more for less water
Utility Business Model

Public information campaigns → Customer Consumption
Technology → Customer Consumption
Restrictions → Customer Consumption
Weather → Customer Consumption

← Utility Rates
Utility Business Model

- Utility Revenues
- Customer Consumption
- Utility Rates
when you conserve water... we have a deficit... so I have to raise your rates!

Source: Fayetteville Observer 2/6/04
Utilities’ costs are mostly fixed, not dependent on the amount of water sold/used by the customers. But the majority of revenues come from the amount of water sold. If customers conserve, revenues drop significantly but not costs.

Source: CMU Director Doug Bean’s presentation to the Charlotte City Council on December 1, 2008.
Water Use and Revenue

“Water demand is recalibrating according to new economic realities and public policy directives. Ignoring declining demand does make it go away – or rather, come back. The intractable manager will remain cash-flow frustrated. The enlightened manager will be better positioned for cost recovery in accordance with a fluid equilibrium.”

Strategies for financial security and conservation

- Reduction of non-revenue water losses
- Conservative finance models
- Multi-year finance plan
- Annual rate adjustments
- Customer analysis
- Affordability strategies
- Well designed increasing block structure and water budget based rates
- Rethinking minimum charges
- Rethinking utility business model
<table>
<thead>
<tr>
<th>System Input Volume (corrected for known errors)</th>
<th>Authorized Consumption</th>
<th>Billed Authorized Consumption</th>
<th>Billed Metered Consumption (including water exported)</th>
<th>Revenue Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unbilled Authorized Consumption</td>
<td>Unbilled Metered Consumption</td>
<td>Unbilled Unmetered Consumption</td>
<td>Non-Revenue Water (NRW)</td>
</tr>
<tr>
<td>Water Losses</td>
<td>Apparent Losses</td>
<td>Unauthorized Consumption</td>
<td>Customer Metering Inaccuracies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real Losses</td>
<td>Systematic Data Handling Errors</td>
<td>Leakage on Transmission and Distribution Mains</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leakage and Overflows at Utility’s Storage Tanks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leakage on Service Connections up to point of Customer metering</td>
<td></td>
</tr>
</tbody>
</table>
Global problem

32,000,000,000 m³

or

8,448,000,000,000 gallons

Lost to leaks in the world each year
Reasons for Loss

• Leakage
• Pressure Management
• Rehabilitation and Replacement
• Leak Repair Time
• Meter Accuracy
What allowable?

**Unavoidable Annual Real Losses (UARL)**

UARL (gallons/day) = (5.41Lm + 0.15Nc + 7.5Lp) x P

where

- Lm = length of water mains, miles
- Nc = number of service connections
- Lp = total length of private pipe, miles = Nc x average distance from curbstop to customer meter
- P = average pressure in the system, ps
What is allowable?

Elimination of unaccounted-for water is a goal of all utilities, but it is impossible for utilities to reach this goal. A commonly accepted rule-of-thumb for acceptable levels of unaccounted-for water is **15 percent**, although this value is highly site specific.

The real rule for deciding whether unaccounted-for water exists at an acceptable level is an economic one; the economic savings in water production at least offsets the cost of reducing unaccounted-for water. *For example, on a present-worth basis, the cost of a leak detection and repair program should be less than the value of water no longer leaked plus any damages associated with leaking water.*

In an area with costly treatment requirements and limited source capacity, it may be worthwhile to reduce unaccounted-for water to less than 10 percent. In a utility with excess capacity, little growth, and inexpensive treatment and pumping, unaccounted-for water exceeding 20 percent may be acceptable.

From Water Distribution Handbook, 2000
In 2006, the North Carolina Rural Center carried out a comprehensive utility water and sewer survey that included questions on water usage. The survey asked utilities to quantify their “Annual Usage” over the last 12 calendar months and to estimate their monthly “Unaccounted for Water” usage.

466 water utilities provided information on their unaccounted for water as part of this survey. Based on this data, the average amount of unaccounted for water as a percent of water usage was 12%.

§ 143-355.4. Water system efficiency.
http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_143/GS_143-355.4.html

(a) Local government water systems and large community water systems shall require separate meters for new in-ground irrigation systems that are connected to their systems.

(b) To be eligible for State water infrastructure funds from the Drinking Water Revolving Fund or the Drinking Water Reserve Fund or any other grant or loan of funds allocated by the General Assembly whether the allocation of funds is to a State agency or to a nonprofit organization for the purpose of extending waterlines or expanding water treatment capacity, a local government or large community water system must demonstrate that the system:

(1) Has established a water rate structure that is adequate to pay the cost of maintaining, repairing, and operating the system, including reserves for payment of principal and interest on indebtedness incurred for maintenance or improvement of the water system during periods of normal use and periods of reduced water use due to implementation of water conservation measures. The funding agency shall apply guidelines developed by the State Water Infrastructure Commission in determining the adequacy of the water rate structure to support operation and maintenance of the system.

(2) Has implemented a leak detection and repair program.

…

(2008-143, s. 9.)
Case Study: Gwinnett County Survey

- A 12-month process discovered more than 500 leaks
- 1.8 MGD in savings ($400,000/yr)
- 87% leaks attributable to fire hydrants, service lines and meter
- 49% of water loss attributed to 42 water main leaks

Case Study: Clayton County Water Authority

March 2000
Non-revenue water loss was *nearing* 20%
Leak Detection program Initiated
Meter Testing Program expanded and placed under direction of the Maintenance and Construction Department

October 2004
Non-revenue water loss *is at* 11%

<table>
<thead>
<tr>
<th>Year</th>
<th># Leaks Discovered</th>
<th>Gallons Recovered</th>
<th>Production Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>47</td>
<td>735,445,800</td>
<td>$1,220,840.03</td>
</tr>
<tr>
<td>2001</td>
<td>48</td>
<td>506,941,200</td>
<td>$927,702.40</td>
</tr>
<tr>
<td>2002</td>
<td>16</td>
<td>134,810,700</td>
<td>$338,374.86</td>
</tr>
<tr>
<td>2003</td>
<td>48</td>
<td>462,468,000</td>
<td>$1,114,547.88</td>
</tr>
<tr>
<td>2004</td>
<td>26</td>
<td>237,308,400</td>
<td>$688,194.36</td>
</tr>
</tbody>
</table>


Georgia Water Stewardship Act of 2010

- By January 1, 2011, Board of Natural Resources must adopt measures for monitoring and improving the efficiency and effectiveness of water use
- Initiate a phased-in approach requiring public water systems implement water-loss detection programs
- By January 1, 2012, systems serving 10,000 individuals must conduct a water-loss audit
- By January 1, 2013, all other systems must conduct audit
Unaccounted for No More
Water Audit Software Assesses Water Loss
by George Kunkel

Water utilities now have a standardized tool to determine water supply efficiency: a spreadsheet software package for compiling a basic audit of water supply operations, developed by AWWA’s Water Loss Control Committee. The software, which exists in Microsoft Excel, is available to anyone for free download from the Water Loss Control pages on WaterWiser, the water efficiency clearinghouse, accessible from the AWWA website. It is also accessible from the AWWA...
Unlock the Secrets of Water Loss Control with AWWA’s M36 Water Audits and Loss Control Programs, Third Edition

• Clear steps to compile the water audit according to the new standard method co-developed by the International Water Association (IWA) and the American Water Works Association (AWWA)

• Rational terms, definitions and performance indicators that give water utilities objective ways to assess their water loss standing and reliably plan loss control activities

• Worksheets, sample calculations and references to AWWA’s Free Water Audit Software

• Techniques to capture more revenue by controlling apparent losses in customer metering and billing operations, as well as unauthorized consumption

• Innovative technologies to move from reactive, “break and fix” leakage response to proactive leakage management featuring component analysis, pressure management, leak noise logging and other advanced technologies: successful approaches to minimize unnecessary source water withdrawals and excessive water production costs
Other case studies:

**Tampa Water Department**

**Miami-Dade County**
Examples of commercial water audit programs include:

- City of Austin, Texas
  http://www.ci.austin.tx.us/watercon/systemaudits.htm#

- City of Portland

- City of Albuquerque
  http://abcwua.org/waterconservation/auditformici.html

- Tampa
  http://www.tampagov.net/dept_water/conservation_education/Program/ici.asp

- Santa Rosa

- Cochise County, Arizona
  http://ag.arizona.edu/cochise/wwes/wateraudits.htm

- City of Seattle
  http://www.seattle.gov/util/Services/Water/For_Commercial_Customers/WATERCONS_200311261707523.asp

From: http://www.northgeorgiawater.com/files/Example_ICI_Audit_Programs.pdf
Conservative, multi-year finance plan

Contra Costa Water District 2011-2020 CIP

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>NA (2)</td>
<td>90.5</td>
<td>96.2</td>
<td>105.5</td>
<td>110.5</td>
<td>111.2</td>
<td>111.9</td>
<td>112.6</td>
<td>113.3</td>
<td>113.9</td>
<td>114.6</td>
</tr>
<tr>
<td>2010</td>
<td>87.7</td>
<td>92.0</td>
<td>96.6</td>
<td>105.6</td>
<td>110.5</td>
<td>111.2</td>
<td>111.9</td>
<td>112.6</td>
<td>113.3</td>
<td>113.9</td>
<td>NA</td>
</tr>
</tbody>
</table>

Difference

(1) Does not include City of Brentwood consumption, estimated at 8,325 acre feet in 2010
(2) Current estimate for 2010 is 87,744 acre feet
Annual rate adjustments

Figure 15: Percent of Rate Structures that Increased Residential Rates in the Last Year

- Water: 48%
- Wastewater: 51%

Data collected in EFC and NCLM 2010 Annual Rate Survey
Annual rate adjustments

Figure 17: Percent Increase in Residential Monthly Bills Since Last Year for 5,000 GPM Among 237 Water and 205 Wastewater Rate Structures that Raised Rates

Data collected in EFC and NCLM 2010 Annual Rate Survey
Basic customer analysis

Percentage of households bills throughout the year where volume was X gallons of water, or less

Cumulative % of Household Bills

Usage Volume on the Bill (up to and including) (1,000 gallons/month)
Basic customer analysis

Usage and billed amounts of households using high volumes on average (avg. 11-20k GPM)

- % of Households
- % of Total Volume
- % of Total Billed Amounts

Average Monthly Consumption of High Volume Households:

<table>
<thead>
<tr>
<th>Year</th>
<th>% Households</th>
<th>% Total Volume</th>
<th>% Billed Amounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY07</td>
<td>8%</td>
<td>21%</td>
<td>18%</td>
</tr>
<tr>
<td>FY08</td>
<td>9%</td>
<td>23%</td>
<td>20%</td>
</tr>
</tbody>
</table>
Advanced customer analysis

Changes in water use by households with varying levels of usage in FY07

Percent change in water use:
- Increased more than 50%
- Increased between 25% and 50%
- Increased between 5% and 25%
- Maintained within 5%
- Decreased between 5% and 25%
- Decreased between 25% and 50%
- Decreased more than 50%

Household types based on their average water use in FY07:
- Low users: up to 5 kGPM (n=36599)
- Medium users: 6-10 kGPM (n=21707)
- High users: 11-20 kGPM (n=5662)
- Super high users: >20 kGPM (n=701)
OCIM, Hillsborough begin water assistance program

By Emily Coakley - The Herald-Sun

Greensboro Urban Ministry
305 West Lee Street
Greensboro, NC 27408
330.271.5859

Upcoming Events
16th Annual Feast of Caring - November 15, First Baptist Church

Emergency Assistance Program
General Guidelines
Hours of Operation:
- Financial Interests:
- Assistance is available:
1. Past due rent
2. Past due mortgage

COUNCIL APPROVES EMERGENCY ASSISTANCE PROGRAM
"People have had few places to turn for help to pay for the most basic requirement of life"

Emergency Utility Assistance Program
This program assists homeless shelter providers with utility expenses in emergency situations. It pays for current utility bills and is limited to four time per year.

The Herald-Sun

Taste of Hope

Greensboro Urban Ministry
AN AVERAGE DAY AT GREENSBORO URBAN MINISTRY
Receive Assistance | Donate /Volunteer | Annual Events / Fundraisers | About Greensboro Urban Ministry

Emergency Assistance Program

Council approved Council Bill 115636 which will provide assistance for water utilities. The city is participating in a program to a

City of Fayetteville
North Carolina
COMMUNITY DEVELOPMENT

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City of Fayetteville
North Carolina
COMMUNITY DEVELOPMENT
Rate structures matter

Monthly Consumption (in 1,000 gallons)

Monthly Equivalent Water Billing

Median of 358 Water Systems, FY04-05

Utility A

Utility B

Utility C

Rate structures matter
Your City Utility Bill Explained

The folks at the City’s Revenue Collection division get asked questions. Here’s some answers to some of the most frequently asked questions about the City’s Utility Bill.

What is included in the “Sewer” charge that appears on my bill?

The sewer charge consists of two separate charges—the sewer expansion fee and sewer volume charge. The sewer expansion fee is a flat monthly fee based on the meter size at your location. The sewer expansion fee was established in 2004 to pay for the expansion of our Land Application Wastewater Treatment Facility to meet future demand due to growth.

What is the “Inflow/Infiltration Fee” that appears on my bill?

This fee was established to help fund the cost of a new State requirement to reduce/eliminate rain and groundwater from entering our Sewer Collection and Treatment System. Examples of things that cause this to happen are illegal roof drains and sump pump connections to the sewer system from homes and businesses; the removal of manhole covers and “clean-out” caps to drain city streets and property during heavy rains; broken or missing “clean-out” caps; and cracks in manholes and sewer lines.

This additional rainwater is pumped and then treated at the City’s Land Treatment Facility and uses up capacity. The State mandated that the City
# WATER AND SEWER RATE SCHEDULE

**SCHEDULE “A”**  
EFFECTIVE 07/01/2007

<table>
<thead>
<tr>
<th>RATE SCHEDULE DESCRIPTION</th>
<th>WATER PLANT</th>
<th>WATER</th>
<th>SEWER DEBT CAPACITY</th>
<th>I&amp;I</th>
<th>SEWER EXP.</th>
<th>WATER &amp; SEWER TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Capacity Charge Per Month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 5/8&quot; meter</td>
<td>8.25</td>
<td>3.65</td>
<td>15.79</td>
<td>2.00</td>
<td>7.30</td>
<td>36.99</td>
</tr>
<tr>
<td>b. Multi-units (per unit)</td>
<td>8.25</td>
<td>3.65</td>
<td>15.79</td>
<td>2.00</td>
<td>7.30</td>
<td>36.99</td>
</tr>
<tr>
<td>c. 3/4&quot; meter</td>
<td>12.38</td>
<td>5.48</td>
<td>23.69</td>
<td>3.00</td>
<td>10.95</td>
<td>55.50</td>
</tr>
<tr>
<td>d. 3/4&quot; SP meter (Sprinkler)</td>
<td>8.25</td>
<td>3.65</td>
<td>15.79</td>
<td>2.00</td>
<td>7.30</td>
<td>36.99</td>
</tr>
<tr>
<td>e. 1&quot; meter</td>
<td>20.63</td>
<td>9.13</td>
<td>39.48</td>
<td>5.00</td>
<td>18.25</td>
<td>92.49</td>
</tr>
<tr>
<td>f. 1-1/2&quot; meter</td>
<td>41.25</td>
<td>18.25</td>
<td>78.95</td>
<td>10.00</td>
<td>36.50</td>
<td>184.95</td>
</tr>
<tr>
<td>g. 2&quot; meter</td>
<td>66.00</td>
<td>29.20</td>
<td>126.32</td>
<td>16.00</td>
<td>58.40</td>
<td>295.92</td>
</tr>
<tr>
<td>h. 3&quot; meter</td>
<td>132.00</td>
<td>58.40</td>
<td>252.64</td>
<td>32.00</td>
<td>116.80</td>
<td>591.84</td>
</tr>
<tr>
<td>i. 4&quot; meter</td>
<td>206.25</td>
<td>91.25</td>
<td>394.75</td>
<td>50.00</td>
<td>182.50</td>
<td>924.75</td>
</tr>
<tr>
<td>j. 6&quot; meter</td>
<td>412.50</td>
<td>182.50</td>
<td>789.50</td>
<td>100.00</td>
<td>365.00</td>
<td>1849.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Volume Charges per 100 Gallons</th>
<th>Capacity</th>
<th>Capacity</th>
<th>Capacity</th>
<th>Capacity</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 2,000 gallons</td>
<td>See #1</td>
<td>See #1</td>
<td>See #1</td>
<td>See #1</td>
<td>See #1</td>
</tr>
<tr>
<td>2,001 – 9,999 gallons</td>
<td>.0840</td>
<td>.1320</td>
<td>.1597</td>
<td>.1273</td>
<td>.5030</td>
</tr>
<tr>
<td>10,000 – 29,999 gallons</td>
<td>.1284</td>
<td>.1520</td>
<td>.1797</td>
<td>.1673</td>
<td>.6274</td>
</tr>
<tr>
<td>30,000 – 69,999 gallons</td>
<td>.1484</td>
<td>.1620</td>
<td>.1897</td>
<td>.1773</td>
<td>.8774</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount</th>
<th>Interest</th>
<th>Debt Type</th>
<th>Final Payment Due</th>
<th>Payment Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$15.0 million</td>
<td>3.57%</td>
<td>Revolving Loan Fund</td>
<td>May 2016</td>
<td>June 2016</td>
</tr>
<tr>
<td>5.0 million</td>
<td>4.4563%</td>
<td>Revolving Loan Fund</td>
<td>May 2016</td>
<td>June 2016</td>
</tr>
<tr>
<td>2.8 million</td>
<td>3.035%</td>
<td>Revolving Loan Fund</td>
<td>May 2017</td>
<td>June 2017</td>
</tr>
<tr>
<td>3.0 million</td>
<td>3.035%</td>
<td>Revolving Loan Fund</td>
<td>May 2017</td>
<td>June 2017</td>
</tr>
<tr>
<td>8.0 million</td>
<td>4.5%</td>
<td>Installment Purchase</td>
<td>May 2011</td>
<td>June 2011</td>
</tr>
</tbody>
</table>
The Utility Business Model Continuum

Complete decoupling

Revenue completely based on usage

Customer has little to no incentive to conserve

Customer Conservation Incentive

Customer has a strong incentive to conserve

A

B

C

D

E
Where is your utility?

Customer Conservation Incentive

Decoupling of Revenues and Usage

Customer has little to no incentive to conserve

Customer has a strong incentive to conserve

A

B

C

D

E

Complete decoupling

Revenue completely based on usage
Revenues less reliant on actual usage:
The bills being sent to customers usually consist of two elements: a base charge for zero usage plus a volumetric charge based on how much water was used. The proportion of base charges to the total charges (base+volumetric) charged to customers in one year indicates the total revenue that the utility collects that is not dependent on actual usage.

Encouraging conservation:
residential customers would use less water per month on average
Where Does the City of High Point Lie on the Continuum?

EFC analysis using the City of High Point, NC's bills to all single dwelling unit residential households between July 2007 and June 2008 (FY 2008).
EFC analysis using the City of High Point, NC's bills to all single dwelling unit residential households between July 2007 and June 2008 (FY 2008).
A new business model?

- Energy – demand charges
- Airlines – surcharge model
- Phone/cable – bundled services for predetermined fixed fees
- REI – estimate prices based on revenue forecasts and return excess funds to customers/owners as available
- IBM - Rebranding
A variable base rate

2009 Peak @ 16,500 gal
2010 Peak @ 15,200 gal
Using drought surcharges to weather the storm

- What is a drought surcharge? A temporary increase of water rates during drought conditions

Example - OWASA’s drought surcharge

<table>
<thead>
<tr>
<th>Block</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use level:</td>
<td>0-2,999</td>
<td>3,000-5,999</td>
<td>6,000-10,999</td>
<td>11,000-15,999</td>
<td>&gt;16,000</td>
</tr>
<tr>
<td>Stage 1</td>
<td>No surcharge</td>
<td>No surcharge</td>
<td>No surcharge</td>
<td>1.5x normal block 4 rate</td>
<td>2x normal block 5 rate</td>
</tr>
<tr>
<td>Stage 2</td>
<td>No surcharge</td>
<td>No surcharge</td>
<td>1.5x normal block 3 rate</td>
<td>2x normal block 4 rate</td>
<td>3x normal block 5 rate</td>
</tr>
<tr>
<td>Stage 3</td>
<td>No surcharge</td>
<td>1.25x normal block 2 rate</td>
<td>2x normal block 3 rate</td>
<td>3x normal block 4 rate</td>
<td>4x normal block 5 rate</td>
</tr>
</tbody>
</table>
Limitations of drought surcharge

<table>
<thead>
<tr>
<th>Evaluation of Options</th>
<th>Increase Fixed</th>
<th>Capacity</th>
<th>Drought Surcharge</th>
<th>Rate Equalization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impacts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drought</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rain</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Economy</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Capital Markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Disasters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Considerations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low conservation impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impacts low consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Already changes w/ formula</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly volatile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong conservation message</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needed for AAA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds need to be replenished</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most flexible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: CMU Presentation on Revenue Stability
Water budget-based rates

A water budget-based rate is an increasing block rate structure in which the block definition is different for each customer based on an efficient level of water use by that customer.

Graphics: Raftelis
Budget Basis

Indoor

• Average water use for customer class
• Average water use for household
• # of residents, size of yard and month (Irvine Ranch WD)
• # of residents and large animals (Monterey District Tariff Area)

Outdoor

• Tiered for lot size (City of Boulder)
• Irrigatable area, ET rate, crop coefficient and effective rainfall (Capistrano Valley WD)
Tiger Household – Hypothetical Budget in IRWD

Outdoor

Indoor
Tiger Household – Hypothetical Budget in IRWD

- Wasteful Rate ($9.48/ccf)
- Excessive Rate ($4.32/ccf)
- Inefficient Rate ($2.50/ccf)
- Base Rate ($1.21/ccf)
- Low Volume Rate ($0.91/ccf)
Water budget-based rates

**Pros**
- Effective at promoting water efficiency
- Equitable/Perceived fairness
- Affordable for essential uses
- Better drought response
- Promotes communication between utility and customers

**Cons**
- Data and software requirements
- High administrative cost – many questions
- Harder to communicate
- Promotes communication between utility and customers
A water co-op?
Rebranding: What are you buying?

OR
Continuing the dialogue...