EPA
United States
Environmental Protection
Agency

Cases in Water Conservation:

How Efficiency Programs Help Water Utilities Save Water and Avoid Costs

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A Message from the Administrator

Christine Todd Whitman

I believe water is the biggest environmental issue we face in the 21st Century in terms of both quality and quantity. In the 30 years since its passage, the Clean Water Act has dramatically increased the number of waterways that are once again safe for fishing and swimming. Despite this great progress in reducing water pollution, many of the nation's waters still do not meet water quality goals. I challenge you to join with me to finish the business of restoring and protecting our nation's waters for present and future generations.

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Introduction

Water utilities across the United States and elsewhere in North America are saving substantial amounts of water through strategic water-efficiency programs. These savings often translate into capital and operating savings, which allow systems to defer or avoid significant expenditures for water supply facilities and wastewater facilities.

These case studies feature the efforts and achievements of 17 water systems. These systems range in size from small to very large, and their efficiency programs incorporate a wide range of techniques for achieving various water management goals. In every case, the results are impressive. The following summary table provides an overview of the case studies, highlighting problems addressed, approaches taken, and results achieved. In general, water conservation programs also produce many environmental benefits, including reduced energy use, reduced wastewater discharges, and protection of aquatic habitats.

The incidence of water conservation and water reuse programs has increased dramatically in the last 10 years. Once associated only with the arid West, these programs have spread geographically to almost all parts of the United States. In many cities, the scope of water conservation programs has expanded to include not only residential customers, but commercial, institutional, and industrial customers, as well. These case studies illustrate some of the tangible results achieved by water conservation programs implemented at the local level. Many of these accomplishments have broader relevance to other communities facing similar water resource management and infrastructure investment issues.

EPA used secondary data sources to compile these case studies. These sources are cited in the "Resources" section at the end of each piece. In addition, contacts for each water system have reviewed and approved their case study. Because the case studies come from secondary sources, the type of information provided is not necessarily uniform or comparable, and is not intended to provide generalized results. The terms water conservation and water efficiency are used here in their broadest context, which includes water loss management, wastewater reclamation and reuse for non-potable purposes, adoption of conservation water rates, changes to more efficient water-using equipment, and behavioral changes that reduce water use.

Summary of Conservation Case Studies

City	Problem	Approach	Results
Albuquerque, New Mexico	A dry climate and increased population growth put a strain on Albuquerque's water supply.	Albuquerque's Long-Range Water Conservation Strategy Resolution consisted of new conservation-based water rates, a public education program, a high-efficiency plumbing program, landscaping programs, and large-use programs.	Albuquerque's conservation program has successfully slowed the groundwater drawdown so that the level of water demand should stay constant until 2005. Peak demand is down 14% from 1990.
Ashland, Oregon	Accelerated population growth in the 1980s and the expiration of a critical water right created a water supply problem.	Ashland's 1991 water efficiency program consisted of four major components: system leak detection and repair, conservation-based water rates, a showerhead replacement program, and toilet retrofits and replacement.	Ashland's conservation efforts have resulted in water savings of approximately 395,000 gallons per day (16% of winter usage) as well as a reduction in wastewater volume.
Cary, North Carolina	With the population more than doubling during the past 10 years and high water demand during dry, hot summers, the city's water resources were seriously strained.	Cary's water conservation program consists of eight elements: public education, landscape and irrigation codes, toilet flapper rebates, residential audits, conservation rate structure, new homes points program, landscape water budget, and a water reclamation facility.	Cary's water conservation program will reduce retail water production by an estimated 4.6 mgd by the end of 2028, a savings of approximately 16% in retail water production. These savings reduced operating costs and have already allowed Cary to delay two water plant expansions.
Gallitzin, Pennsylvania	By the mid-1990s, the town of Gallitzin was experiencing high water loss, recurring leaks, low pressure, high operational costs, and unstable water entering the system.	Gallitzin developed an accurate meter reading and system map, and a leak detection and repair program.	The results of the program were dramatic. Gallitzin realized an 87% drop in unaccounted-for water, a 59% drop in production, and considerable financial savings.
Gilbert, Arizona	Rapid population growth during the 1980s put a strain on the water supply of this Arizona town located in an arid climate.	Gilbert instituted a multi-faceted water conservation program that included building code requirements, an increasing-block water rate structure, a metering program, public education, and a low water-use landscaping program.	Gilbert has been particularly successful reusing reclaimed water. A new wastewater reclamation plant was built, as well as several recharge ponds that serve as a riparian habitat for a diverse number of species.

Summary of Conservation Case Studies

City	Problem	Approach	Results
Goleta, California	A growing California town, Goleta was facing the possibility of future water shortages. Its primary water source, Lake Cachuma, was not sufficient to meet its needs.	Goleta established a water efficiency program that emphasized plumbing retrofits, including high-efficiency toilets, high-efficiency showerheads, and increased rates.	The program was highly successful, resulting in a 30% drop in district water use. Goleta was able to delay a wastewater treatment plant expansion.
Houston, Texas	Houston's groundwater sources have experienced increasing problems with land subsidence, saltwater intrusion, and flooding. These problems, along with a state regulation to reduce groundwater use, led Houston to explore methods for managing groundwater supplies.	Houston implemented a comprehensive conservation program that included an education program, plumbing retrofits, audits, leak detection and repair, an increasing-block rate structure, and conservation planning.	The dramatic success of pilot programs has led Houston to predict a 7.3% reduction in water demand by 2006 and savings of more than $260 million.
Irvine Ranch Water District, California	IRWD has experienced dramatic population growth, drought conditions in the late 80s and early 90s, and increasing wholesale water charges.	IRWD's primary conservation strategy was a new rate structure instituted in 1991. The five-tiered rate structure rewards water-efficiency and identifies when water is being wasted. The goal is to create a long-term water efficiency ethic, while maintaining stable utility revenues.	After the first year of the new rate structure, water use declined by 19%. Between 1991 and 1997, the district saved an estimated $33.2 million in avoided water purchases.
Massachusetts Water Resources Authority	MWRA is a wholesale water provider for 2.2 million people. From 1969 to 1988, MWRA withdrawals exceeded the safe level of 300 mgd by more than 10% annually.	MWRA began a water conservation program in 1986 that included leak detection and repair, plumbing retrofits, a water management program, an education program, and meter improvements.	Conservation efforts reduced average daily water demand from 336 mgd (1987) to 256 mgd (1997). This allowed MWRA to defer a water-supply expansion project and reduce the capacity of the treatment plant, resulting in total savings ranging from $1.39 million per mgd to $1.91 million per mgd.
Metropolitan Water District of Southern California	Metropolitan Water District is the largest supplier of water for municipal purposes in the United States. Metropolitan recognized the need for conservation, given increased economic and population growth, drought, government regulations, water quality concerns, and planned improvement programs.	Metropolitan's Conservation Credits Program provides funding for a large percentage of water conservation projects. Projects have included plumbing fixture replacement, water-efficiency surveys, irrigation improvements, training programs, and conservation-related research projects.	Conservation efforts have considerably reduced the cost estimate of Metropolitan's capital-improvement. Water savings have amounted to approximately 66,000 acre-feet per year, a savings of 59 mgd.

Summary of Conservation Case Studies

City	Problem	Approach	Results
New York City, New York	By the early 1990s, increased demand and periods of drought resulted in water-supply facilities repeatedly exceeding safe yields. Water rates more than doubled between 1985 and 1993.	New York's conservation initiatives included education, metering, leak detection, water use regulation, and a comprehensive toilet replacement program.	Leak detection and repair, metering, and toilet replacements were particularly successful programs. New York reduced its per-capita water use from 195 gallons per day in 1991 to 167 gallons per day in 1998, and produced savings of 20 to 40% on water and wastewater bills.
Phoenix, Arizona	Phoenix is one of the fastest growing communities in the United States and suffers from low rainfall amounts. The state legislature has required that, after 2025, Phoenix and suburban communities must not pump groundwater faster than it can be replenished.	Water conservation programs instituted in 1986 and 1998 focused on pricing reform, residential and industrial/ commercial conservation, landscaping, education, technical assistance, regulations, planning and research, and interagency coordination.	Phoenix's conservation program currently saves approximately 40 mgd. Phoenix estimates that the conservation rate structure alone saved 9 mgd.
Santa Monica, California	Santa Monica faced rapid population growth, which put a strain on its water supplies. Also, contamination was found in several wells in 1996, forcing the city to increase water purchases.	Santa Monica instituted a multifaceted water conservation program that includes water-use surveys, education, landscaping measures, toilet retrofits, and a loan program.	Santa Monica was able to reduce its water use by 14% and waste-water flow by 21%. The toilet retrofit program resulted in a reduction of 1.9 mgd and net savings of $9.5 million from 1990 to 1995.
Seattle, Washington	Steady population growth, dry summers, and lack of long-term storage capacity forced Seattle to choose between reducing use and developing new water sources.	Seattle's water conservation program has included a seasonal rate structure, plumbing fixture codes, leak reduction, incentives for water-saving products, and public education. Special emphasis has been placed on commercial water conservation.	Per-capita water consumption dropped by 20% in the 1990s. The seasonal rate structure, plumbing codes, and efficiency improvements are particularly credited with success. It is estimated that the commercial water conservation programs will save approximately 8 mgd.
Tampa, Florida	Rapid economic and residential population growth along with seasonal population growth has put a strain on Tampa's water supply.	Since 1989, Tampa's water conservation program has included high efficiency plumbing retrofits, an increasing-block rate structure, irrigation restrictions, landscaping measures, and public education. Particular emphasis has been put on efficient landscaping and irrigation.	Tampa's landscape evaluation program resulted in a 25% drop in water use. A pilot retrofit program achieved a 15% reduction in water use.

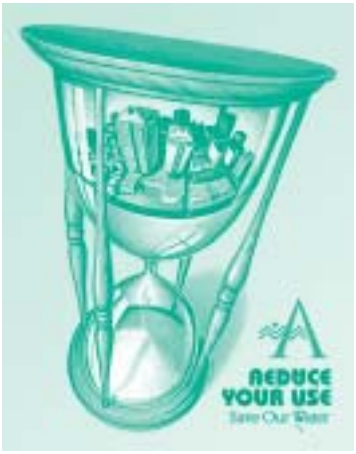
Summary of Conservation Case Studies

City	Problem	Approach	Results
Wichita, Kansas	Ten years ago, analysts determined that the city's available water resources would not meet its needs beyond the first decade of the 21st century. Alternative sources were not available at an affordable price.	Wichita utilized an integrated resource planning approach. This included implementing water conservation, evaluating existing water sources, evaluating nonconventional water resources, optimizing all available water resources, pursuing an application for a conjunctive water resource use permit, evaluating the effects of using different water resources, and communicating with key stakeholders.	Analysis of resource options for Wichita resulted in a matrix of 27 conventional and nonconventional resource options.
Barrie, Ontario	Rapid population growth put a strain on Barrie's water and wastewater infrastructure, forcing the city to consider expensive new supply options and infrastructure development.	Barrie's conservation plan focused on replacing inefficient showerheads and toilets.	Barrie was able to save an average of 55 liters (14.5 gallons) per person per day. The reduction in wastewater flows enabled Barrie to defer an expensive capital expansion project. Water conservation efforts saved an estimated $17.1 million (Canadian dollars) in net deferred capital expenditures.

mgd = million gallons per day

Albuquerque, New Mexico: Long-Range Planning to Address Demand Growth

Background



Albuquerque's water system produces approximately 37 billion gallons per year and serves a population of approximately 483,000. The city receives less than 9 inches of rain per year, and its water supply was strained severely when its population grew by 24 percent between 1980 and 1994.

In 1993, the United States Geological Survey reported that groundwater levels in Albuquerque were dropping significantly. The rate of groundwater withdrawals by the city was more than twice the amount that could be sustained over time. The city planned to use surface water diverted from the Colorado River Basin to the Rio Grande River Basin to recharge its falling groundwater supplies, but studies of the area showed that the plan was not feasible. In 1994, Albuquerque instead adopted a comprehensive Water Resources Management Strategy, which included plans to make more direct use of surface water supplies, reclaim wastewater and shallow groundwater for irrigation and other nonpotable uses, and implement an aggressive water conservation program.

Approach

Albuquerque adopted the Long-Range Water Conservation Strategy Resolution, which states that "conservation can extend the city's supply at a fraction of the cost of other alternatives." The resolution's goal is to reduce total water usage by 30 percent by 2004, a decrease of 75 gallons per capita per day over 9 years. The water conservation program includes five components:

- **Water Rates.** The city applies a summer surcharge of 21 cents per ccf (100 cubic feet) when customers' use exceeds 200 percent of their winter average. In 1995, the city increased the rate by 8.8 cents per ccf of water consumed to fund the water conservation program. More than half of the revenue from the surcharge is allocated to the conservation program, and a large portion is returned to customers through rebates and other incentives. On May 1, 2001, the commodity rate increased to $1.07 per ccf ($1.43 per 1,000 gallons) including an additional state surcharge of 2.44 cents per ccf.
- **Public Education.** Education programs consist of running public relations campaigns, including water usage information in water bills, and organizing cooperative programs

with schools and community organizations. The city works with citizens and affected customers whenever new legislation or measures are developed or proposed.

- **Residential Use.** Albuquerque amended its Uniform Plumbing Code to require high-efficiency toilets (1.6 gallons or less per flush) in all new residential construction. The city also established rebates for high-efficiency toilets (up to $100) and efficient clothes washers ($100). The city offers free water audits and installation of high-efficiency plumbing devices.
- **Landscaping/Outdoor Water Use.** In 1995, the city adopted the Water Conservation Landscaping and Water Waste Ordinance. The ordinance includes strict requirements for landscaping new developments, such as prohibiting the use of high-water-use grasses on more than 20 percent of the landscaped area. It also includes restrictions for landscaping on city properties, along with watering and irrigation regulations. Since 1996, the city has offered tools to assist property owners in converting to Xeriscape™ landscapes. In addition to how-to videos and guides, homeowners can choose from six professionally designed Xeriscape™ plans. The Xeriscape™ Incentive Program provides a rebate of 25 cents per square foot of converted landscape area up to $500 ($700 for commercial landscapes).
- **Institutional, Commercial, and Industrial Water Use.** The city requires all customers using more than 50,000 gallons per day to prepare and implement a water conservation plan. The city plans to adopt an ordinance to prohibit once-through cooling systems. The city currently runs a program to reduce water losses it can't account for and makes free water-use surveys available for non-residential customers.

Results

Albuquerque's water conservation program has successfully slowed the drawdown of the area's groundwater supply. Estimates indicate that the water conservation programs will decrease the level of water demand in Albuquerque until 2005. Water savings from conservation will help mitigate the rate of future demand growth.

Specific conservation programs have met with considerable success. By the end of April 2001, rebates had been provided for more than 39,000 high-efficiency toilets. At the close of the year, per capita water use had dropped to 205 gallons per day—a reduction of 45 gallons per day from 1995 levels. Albuquerque found that, by 2001, its landscaping program and rate structure had helped reduce peak water use by 14 percent from its high point in 1990.

Summary of Results for Albuquerque, NM

Number of high-efficiency toilets installed (by 2001)	39,303
Reduction in per-capita water use (from 1995 to 2001)	45 g/c/d
Reduction in peak demand (1990 – 2001)	14%

g/c/d = gallons per capita per day

Resources

City of Albuquerque, Water Conservation Programs 1998, <www.cabq.gov/waterconservation/index.html>

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), p. 39.

Contact

Jean Witherspoon
Albuquerque Public Works Department
Phone: 505 768-3633
Fax: 505 768-3629
E-mail: jasw@cabq.gov

Ashland, Oregon: Small Town, Big Savings

Background

Ashland, Oregon, is a small city of approximately 20,000 people. The Water Division treats and transports an average of 6.5 million gallons daily in the summer and 2.5 million gallons daily in the winter. Annual usage is approximately 150 gallons per capita per day. Ashland experienced an accelerated population growth rate in the late 1980s. At the same time, it faced the imminent expiration of a critical water right. Initially, the city had two options available to increase water supplies. The first was to create a reservoir by damming Ashland Creek at a cost of approximately $11 million. The second was to lay 13 miles of pipeline to the Rogue River at a cost of approximately $7.7 million. The city decided, however, that neither option was fiscally or politically feasible. Furthermore, the proposed dam site disturbed habitat for the endangered spotted owl. Ashland therefore decided to implement a four-point water efficiency program to address its water supply problem.

Approach

Ashland's water conservation program became a natural addition to the city's existing resource conservation strategy, which addresses energy efficiency, regional air quality, recycling, composting, and land use. In 1991, the city council adopted a water efficiency program with four major components: system leak detection and repair, conservation-based water rates, a high-efficiency showerhead replacement program, and toilet retrofits and replacement. The city estimated that these programs would save 500,000 gallons of water per day at a cost of $825,875—approximately one-twelfth the cost of the proposed dam—and would delay the need for additional water-supply sources until 2021.

Implementation of the program began with a series of customer water audits, which in turn led to high-efficiency showerhead and toilet replacements and a $75 rebate program (later reduced to $60). Ashland also instituted an inverted block rate structure to encourage water conservation. Recently, Ashland began offering rebates for efficient clothes washers and dishwashers (including an energy rebate for customers with electric water heaters). The town provides a free review of irrigation and landscaping, as well.

Results

Implementation of Ashland's Water Conservation Program began in July 1992. By 2001, almost 1,900 residences had received a water audit. Almost 85 percent of the audited homes

participated in the showerhead and/or toilet replacement programs. Ashland has been able to reduce its water demand by 395,000 gallons per day (16 percent of winter use) and its wastewater flow by 159,000 gallons per day. An additional benefit of the program has been an estimated annual savings of 514,000 kilowatt-hours of electricity, primarily due to the use of efficient showerheads.

Summary of Results for Ashland, OR

Water Savings	
Water Savings per day (by 2001)	395,000 gal.
Reduction in winter usage	16%
Wastewater reduction per year (by 2001)	58 million gal.
Cost Savings	
Estimated cost of proposed reservoir program	$11,000,000
Estimated cost of proposed pipeline program	$7,700,000
Cost of water conservation program	$825,875
Total estimated avoided costs	$6,874,125 – $10,174,125

Resources

"A Negadam Runs Through It," *Rocky Mountain Institute Newsletter.* Vol. XI, No. 1 (Spring 1995), p. 8.

"The City of Ashland Municipal Utility Comprehensive Conservation Programs," The Results Center. Profile #115 <www.crest.org >.

The City of Ashland, Oregon, Conservation Department, <www.ashland.or.us/SectionIndex.asp?SectionID=432>.

Contact

Dick Wanderscheid
Ashland Conservation Division
Phone: 541 552-2061
Fax: 541 552-2062
E-mail: dick@ashland.or.us

Cary, North Carolina: Cost-Effective Conservation

Background

The population of Cary, North Carolina—an affluent suburb just west of Raleigh—has more than doubled during the past 10 years, putting a strain on the city's water resources. In 1995, Cary officials began planning to expand the city's water plant to meet increased demand. Two additional expansions were scheduled to occur within a 30-year time period. Cary's water supplies are particularly strained during its dry, hot summers, mostly because of irrigation and lawn watering. Most water use in Cary (approximately 75 percent) can be attributed to residential customers, and commercial customers account for almost 21 percent of total usage. Analysts predict that the average daily retail water demand in Cary will grow from 8.6 million gallons per day (mgd) in 1998 to 26.7 mgd in 2028.

Approach

Recognizing the need to incorporate conservation into its integrated resource management, the Cary town council adopted a water conservation program in 1996 with the following goals:

- Reduce the town's average per capita water use by 20 percent by 2014 (later revised to 2020).
- Support the high quality of life in Cary by providing safe, reliable water service, while reducing per capita use of water.
- Conserve a limited natural resource.
- Reduce costs of infrastructure expansion.

In 1999, Cary decided to have its conservation programs place a greater emphasis on measures that could reduce peak-day demand during the high-volume summer months. The resulting 10-year Water Conservation and Peak Demand Management Plan is based on a careful benefit/cost analysis of numerous potential conservation programs. According to the plan, any conservation measures undertaken by the city must meet certain criteria:

- A benefit/cost ratio greater than 1.0
- Reasonable cost
- Significant water savings
- Nonquantifiable but positive effects (community acceptance)

Cary's water conservation program consists of eight elements:

Public Education. Cary runs several public education programs. The "Beat the Peak" campaign is aimed at the high-demand summer months. Through this program, residents are encouraged to gauge their sprinkler use. Another program, called "Block Leader," is a grassroots effort to involve residents in water conservation. Cary also runs an elementary school program to distribute educational materials in schools, offers workshops to teach water-efficient landscaping and gardening, and distributes printed material on water conservation to the general public.

Landscape and Irrigation Codes. The city implements water-use-restriction ordinances limiting outdoor watering during summer peak months. The Controlling Wasteful Uses of Water Ordinance allows the city to regulate and control irrigation and reduce hardscape watering and runoff. Commercial landscaping regulations require drought-tolerant plants and other water-efficient landscaping methods.

Toilet Flapper Rebates. Customers receive rebates to replace existing flappers with early closure flappers that can save up to 1.3 gallons per flush.

Residential Audits. Residential customers are offered a 1-hour audit to assess water use, detect leaks, and provide supplies such as low-flow plumbing devices.

Conservation Rate Structure. Cary has established an increasing-block rate structure to encourage water conservation. The rate structure consists of three tiers—a low-use, average-use, and high-use.

New Homes Points Program. The city approves development projects based on a point scale, giving extra points for subdivisions that use selected water-efficient measures.

Landscape Water Budget. Large public and private irrigation users are provided monthly water budgets that identify the appropriate watering needs for their situation.

Water Reclamation Facility. The city is building a water reclamation facility that will produce up to 1.58 million gallons of reclaimed water per day. The water will be used for irrigation and other nonpotable uses. Reclaimed water will be offered free of charge to bulk-purchase customers.

Results

According to estimates, water conservation in Cary will reduce retail water production by 4.6 mgd (16 percent) by the end of 2028. Water conservation efforts will also help Cary reduce operating costs and defer considerable capital expenditures. The city has delayed the two water plant expansions, projecting that the 10-year savings from water conservation will be 1 mgd and 2 mgd by 2019.

Cary's water reclamation facility is expected to cut peak demand in the city by 8 percent. City ordinances restricting water use considerably decreased usage during peak demand months. In addition, 80 percent of residential customers and 99.9 percent of commercial customers comply with the rain sensor ordinance. City residents have redeemed approximately 500 rebates and have purchased more than 1,000 flappers. The city also distributed 25,000

packets to residents to gauge amounts of irrigation, reached 19 percent of the city's customers through Block Leaders, and mailed water conservation brochures to all customers.

Summary of Results for Cary, NC

Program Element	Water savings projected in 2009 (mgd)	Water savings projected in 2019 (mgd)	Unit cost of water saved ($/mgd)	First 5 years of costs ($)	Benefit/cost ratio
Residential water audits	0.053	0.077	546.85	71,335	1.13
Public education	0.3	0.41	400.59	314,280	1.53
Toilet flapper rebate	0.005	0	828.04	11,762	1.03
Water reclamation facility	0.27	0.3	NA	NA	NA
Landscape water budgets	0.013	0.023	754.33	64,175	0.88
New home points program	0.5	0.77	38.18	100,000	16.20
Landscape/irrigation codes	0.02	0.04	276.07	128,350	2.60
Inverted-block rate structure	0.14	0.42	49.40	54,000	14.26
Combined results	1.17	2.0	137.50	655,552	4.44

Source: Raftelis Environmental Consulting as reported in Jennifer L. Platt and Marie Cefalo Delforge, "The Cost-Effectiveness of Water Conservation," *American Water Works Association Journal.* Vol. 93, No. 3 (March 2001), p. 78.

Note: Water savings estimated for the water conservation plan do not equal the total water savings associated with the sum of each plan element because of the "shared water savings" produced by conservation measures that focus on similar end uses. The decision to construct a water reclamation facility was made independent of this study.

Resources

"Cary's Bulk Reclaimed Water Project," Town of Cary <www.townofcary.org/depts/pio/bwindex.htm>.

Platt, Jennifer L. and Delforge, Marie Cefalo. "The Cost-Effectiveness of Water Conservation," *American Water Works Association Journal.* Vol. 93, No. 3 (March 2001), pp. 73-83.

"Town of Cary Water Conservation," Town of Cary Public Works and Utilities <www.townofcary.org/depts/pwdept/water/waterconservation/overview.htm>.

Contact

Jennifer L. Platt
Cary Department of Public Works and Utilities
Phone: 919 462-3872
Fax: 919 388-1131
E-mail: jplatt@ci.cary.nc.us

Gallitzin, Pennsylvania: Leak Management by a Small System

Background

Gallitzin is a small town in western Pennsylvania with a population of approximately 2,000. The Gallitzin Water Authority services approximately 1,000 connections. In the mid-1990s, the system was experiencing water losses exceeding 70 percent. In November 1994, the system was using an average of 309,929 gallons per day. Gallitzin experienced a peak usage in February 1995 of 500,000 gallons per day. The water authority identified five major problems in the system:

- High water loss
- Recurring leaks
- High overall operational costs
- Low pressure complaints
- Unstable water entering the distribution system

Based on these issues, the authority decided it needed a comprehensive program for water leak detection and corrosion control.

Approach

Gallitzin first developed accurate water production and distribution records using 7-day meter readings at the plant and pump station. It then created a system map to locate leakage. Through the use of a leak detector, the authority found approximately 95 percent of its leaks. Outside contractors identified the remaining 5 percent. The city initiated a leak repair program and a corrosion control program at the Water Treatment Plant. Gallitzin was one of the first systems to receive technical assistance from the Pennsylvania Department of Environmental Protection Small Water Systems Outreach Program. The training helped the authority repair distribution system leaks, replace meters, and improve customer billing. Gallitzin is also working to improve the capacity of surface-water sources and develop a supplemental groundwater source.

Results

By November 1998, 4 years after implementation of the program, the system delivered an average of 127,893 gallons per day to the town—down from 309,929 gallons per day in November 1994. Unaccounted-for water dropped to only 9 percent. The financial savings from the program have been highly beneficial. The city saved $5,000 on total annual chemical costs and $20,000 on total annual power costs from 1994 to 1998. The significant savings help the authority keep water rates down.

Other beneficial impacts reported by the Gallitzin Water Authority include:

- Extended life expectancy of equipment
- Savings in purchased water costs during drought conditions
- Reduction in overtime costs
- Improvement in customer satisfaction
- Enhanced time utilization

Summary of Results for Gallitzin, PA

	Unit	1994	1998	Percentage change
Customers	Connections (approximate)	1,000	1,000	0%
Water	Production gallons per day	309,929	127,893	-59%
	Annual production gallons	113,124,085	46,680,945	-59%
	Water pumped from low to high tank	99,549,195 (88%)	35,010,708 (75%)	-65%
	Total plant production hours	5,387	2,223	-59%
	Filter backwash water (gallons)	1,316,788	543,376	-59%
	Unaccounted-for water	70%	9%	-87%
Power	Kilowatt-hours	142,807	50,221	-65%
	Total power cost @ $.081/kwh	$31,671	12,367	-61%
Chemicals	Cost per million gallons ($) *	$90.98	$116.86	28%
	Total chemical cost ($)	$10,292	$5,455	-47%

Source: John Brutz, "Leak Detection Helps District Cut Losses," A presentation at the Energy Efficiency Forum in San Diego, California (August 1999).

* Added sodium bicarbonate treatment; other unit chemical costs remained constant or declined.

Resources

John Brutz, "Leak Detection Helps District Cut Losses," A presentation at the Energy Efficiency Forum in San Diego, California (August 1999).

"First Small Water System Outreach Effort A Success," July 12, 1996. Pennsylvania Department of Environmental Protection press release, <www.dep.state.pa.us/dep/counties/common/outreach.htm>.

Contact

John Brutz
Operations Supervisor
Gallitzin Water Authority
Phone: 814 886-5362
Fax: 814 886-6811
E-mail: galitznh20@aol.com

Gilbert, Arizona: Preserving Riparian Habitat

Background

The town of Gilbert, Arizona, has experienced rapid population growth, increasing from 5,717 residents in 1980 to 29,188 residents in 1990, with an estimated 2001 population of 115,000. This rapid growth has strained water resources, particularly because Gilbert is located in a very arid region, receiving an annual average rainfall of 7.66 inches and losing substantial amounts of water annually to evaporation. Prior to March 1997, Gilbert was entirely dependent upon groundwater. The town now relies on a combination of water supplies, with a capacity of 27 million gallons per day (mgd) from groundwater and 15 mgd from surface water. Surface water capacities will be expanded to 40 mgd by the summer of 2002 following the addition of a new water treatment plant. Gilbert's average water demand is 28.5 mgd, with a peak demand of 41.5 mgd. Gilbert opted to implement a comprehensive water efficiency program to help meet increased water demand, and is recognized as the first community in Arizona to design and implement a 100-year water plan. A key component of the plan is wastewater reclamation and recharge of groundwater. The reuse project has created wildlife habitat and the recharge areas are used for recreation, education, and research.

Approach

Gilbert has implemented a multifaceted approach to water conservation. First, building code requirements exist for all new construction and include requirements for efficient plumbing devices and the use of recycled water. Next, an increasing-block water rate structure was instituted, consisting of the following:

Monthly Consumption (Gallons)	Cost per 1,000 gallons
0 to 20,000	$0.85
20,000 to 30,000	1.10
30,000+	1.25

All water use in Gilbert—residential, commercial, and industrial—is metered, and Gilbert set a goal of 100 percent reuse of reclaimed water. The town also sponsors several public-education programs and requires using pre-approved low water-use plant materials for all landscaping in street right-of-way. Gilbert also is developing additional conservation measures, such as water-use audits, free conservation kits, Xeriscape™ brochures and other outdoor water saving information; a homeowners water conservation education program; and a new school education program.

Results

Gilbert's conservation efforts are considered a success, particularly its efforts to reuse and recharge all its reclaimed water. Gilbert receives credits from the state where the effects of recharge are measurable. Water reclamation has helped the city meet groundwater management goals and has provided an additional resource for meeting water demand. In 1986, Gilbert built a 5.5 mgd wastewater reclamation plant, allowing the city to store recharge water for future use. In 1989, the town developed a 40-acre recharge site with six recharge ponds. In 1993, it expanded the site to 75 acres and 12 recharge ponds.

By 2001, the system served 20 customers via 25 miles of reclaimed water distribution pipeline and recharged more than 5 billion gallons of water. As an incentive, the cost of the reclaimed water is $0.03 per 1,000 gallons. An added benefit of the reuse project has been the development of a shoreline habitat for diverse plant species and a variety of birds, mammals, fish, amphibians, and insects that provides educational and recreational opportunities for local residents. In October 1999, Gilbert completed a 130-acre project with 7 percolation basins averaging 9 acres each that recharge up to 4 mgd of tertiary-treated effluent from the wastewater reclamation plant, as well as surface water from the Colorado River and from Salt River Project's system.

Summary of Results for Gilbert, AZ

Amount of water recharged	5 billion gallons
Number of recharge ponds	12
Number of reclaimed water customers	20

Resources

"Gilbert, Arizona," Center for Renewable Energy and Sustainable Technology, <www.crest.org>.

Gilbert, Arizona, Home Page, <www.ci.gilbert.az.us/water/index.htm>.

Contact

Kathy Rall
Gilbert Water Conservation
Phone: 480 503-6892
Fax: 480 503-6892
E-mail: kathyr@ci.gilbert.az.us

Goleta, California: Avoiding Shortages and Plant Expansion

Background

The Goleta, California, Water District serves approximately 75,000 customers spanning an area of about 29,000 acres. Goleta's water supply comes primarily from Lake Cachuma (9,300 acre-feet per year) and the state Water Project (4,500 acre-feet per year). The district can also produce approximately 2,000 acre-feet per year from groundwater wells. In 1972, analysts predicted future water shortages in Goleta, so the district began seeking additional water sources and established a water efficiency program.

Approach

Goleta's water efficiency program cost approximately $1.5 million and emphasized plumbing retrofits, including the installation of high-efficiency toilets (1.6 gallons per flush) and showerheads. The program also included free onsite water surveys, public education, and changes in metering and rate structure. A mandatory rationing plan was imposed on May 1, 1989 to reduce use by 15 percent.

Results

Between 1987 and 1991, Goleta issued 15,000 rebates for high-efficiency toilets and installed 35,000 low-flow showerheads. Between 1983 and 1991, 2,000 new high-efficiency toilets were installed in new construction and remodels. Onsite surveys and public education efforts helped consumers improve outdoor water efficiency, and increased water rates provided extra incentive for consumers to reduce water use. The conservation and rationing programs, as well as the rate increases, contributed to a 50-percent drop in per capita residential water use in 1 year—between May 1989 and April 1990. Total district water use fell from 125 to 90 gallons per capita per day—twice the original target of 15 percent. The water-efficiency program also reduced sewage flow from 6.7 million gallons per day (mgd) to 4 mgd. As a result, Goleta Sanitary was able to delay a multimillion-dollar treatment plant expansion.

Summary of Results for Goleta, CA

Number of toilet rebates (1987–1991)	15,000
Number of toilets installed in new construction and remodels (1983–1991)	2,000
Number of showerheads installed	35,000
Reduction in per-capita residential water use	50%
Reduction in total district water use	30%
Reduction in wastewater flow	2.7 mgd (40%)

mgd= million gallons day

Resources

Goleta Water District, Home Page, <www.goletawater.com/html/framework/splash.html>.

"Residential Indoor Water Efficiency: Goleta, CA," Center for Renewable Energy and Sustainable Technology, <www.crest.org>.

Contact

Marlee Franzen
Goleta Water District
Phone: 805 964-6761
Fax: 805 964-4042
Email: mfranzen@goletawater.com

Houston, Texas: Reducing Capital Costs and Achieving Benefits

Background

The Houston Department of Public Works and Engineering serves a population of 1.7 million and provides water service to more than 553,000 retail connections. The city also sells wholesale water to 16 other communities. Houston receives an average of 50 inches of rain per year and has sufficient water supplies to meet demand through 2030, but 43 percent of Houston's water comes from groundwater sources that are threatened by increasing instances of land subsidence, saltwater intrusion, and flooding. In some areas, the land has actually subsided, or sunk, 10 feet. Conversion to surface sources or expanded use of surface water will require costly construction of water treatment plants and transmission mains. In addition, Houston is required by state regulations to reduce groundwater use 20 percent by 2030. These factors have led Houston to explore methods for managing its groundwater supplies.

Approach

Houston implemented water conservation programs to help reduce city expenditures and capital investments. In 1993, the Texas Natural Resource Conservation Commission also required Houston to implement a conservation plan to meet state requirements. The conservation program has four elements:

- Education program
- In-house program
- Contract customers program
- Conservation planning program

The education program consists primarily of outreach initiatives, as well as efficiency retrofits for older structures. The in-house program includes city irrigation audits, leak detection and repair for city pools and fountains, and analysis of city departments' water use. The contract customers program eliminated unnecessary requirements, required billing based on actual water use, and added penalties for excessive water usage during peak-demand periods.

The conservation planning program began in 1994 when Houston was awarded a grant from the Texas Water Development Board that financed a conservation planning study. The study examined the costs and benefits of more than 200 con-

servation measures. The conservation plan adopted by the city council in 1998 expanded existing educational and other programs to include residential water audits, appliance labeling, commercial indoor audits, cooling tower audits, public indoor and exterior audits, pool and fountain audits and standards, an unaccounted-for water program, increased public education, and a "water-wise and energy-efficiency program."

Houston also uses an increasing-block rate structure with two tiers for single-family residents. A minimum charge covers a base amount of water. Consumption between 5,000 and 12,000 gallons per month is billed an additional $2.36 per 1,000 gallons and consumption greater than 12,000 gallons per month is billed an additional $4.30 per 1,000 gallons.

Results

Since the program's inception, Houston has distributed 10,000 "WaterWise and Energy Efficient" conservation kits with high-efficiency showerheads and faucet aerators to area fifth-graders as part of a comprehensive education program, the majority of which were installed in homes. In addition, a pilot program at a 60-unit low-income housing development in Houston replaced 5 gallons-per-flush toilets with 1.6 gallons-per-flush toilets, fixed leaks, and installed aerators. At a total cost of $22,000, shared between the utility and the housing authority, the program reduced water consumption by 72 percent, or 1 million gallons per month. Water and wastewater bills dropped from $8,644 to $1,810 per month. These dramatic results have led the Houston Housing Authority to develop plans to retrofit more than 3,000 additional housing units.

The Houston City Council approved a new conservation plan on September 2, 1998 that includes a forecast of the savings from implementing the recommended water conservation measures. The plan predicts that implementation will reduce water demand by 7.3 percent by 2006. Including savings from continued use of efficient plumbing products in new construction and renovation, the overall demand forecast for 2006 will be cut by 17.2 percent.

Summary of Results for Houston, TX

Pilot Retrofit Program at 60-Unit Housing Development	
Fixture costs paid by water utility	$5,000
Fixture costs paid by housing authority	$6,000
Labor costs paid by housing authority	$11,000
Total cost of program	$22,000
Savings in water and wastewater bills from low-income pilot program	$6,834 per month
Activities and Water Savings	
Conservation kits distributed	10,000
Conservation kits installed	8,000
Average water savings from conservation kits	18% per household
Water savings from low-income pilot program (above)	72% (1 million gallons per month)
Predicted cut in water demand from conservation plan	7.3% (year 2006)
Total predicted cut in water demand	17.2% (year 2006)
Cost Savings	
Predicted benefit cost ratio of conservation plan	3.7 to 1
Predicted savings from conservation plan	$262 million

Resources

Daniel B. Bishop and Jack A. Weber, *Impacts of Demand Reduction on Water Utilities* (Denver: American Water Works Association, 1996), pp. 48-49.

City of Houston Water Conservation Branch Web page, <www.ci.houston.tx.us/pwe/utilities/conservation/>.

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), pp. 31-32.

Contact

Pat Truesdale
Houston Department of Public Works and Engineering
Phone: 713 837-0423
Fax: 713 837-0425
E-mail: ptruesda@pwe.ci.houston.tx.us

Irvine Ranch Water District, California: Reducing Purchased Water Costs Through Rates

Background

Irvine Ranch Water District (IRWD) in California provides water service, sewage collection, and water reclamation for the city of Irvine and portions of surrounding communities. The district serves a population of approximately 150,000 in a 77,950-acre service area containing 59,646 domestic and reclaimed water connections. IRWD delivered a total of 22.8 billion gallons of water between 1996 and 1997. The area has experienced considerable growth and development during recent decades. The district's service population grew by more than 75 percent in the 1980s and is projected to grow by 20 percent every 10 years. Population growth, drought conditions in the late 1980s and early 1990s, and increasing wholesale water charges led IRWD to choose conservation as one approach to meet the growing demand for water. The district is now a recognized leader in water reclamation and conservation programs.

Approach

IRWD adopted a five-tiered rate structure to reward water efficiency and identify areas where water is being wasted. The rate structure aims to create a long-term water efficiency ethic while maintaining stable utility revenues. IRWD individualizes rates for each account based on landscape square footage, number of residents, any additional needs of individual customers (such as for medical uses), and daily evapotranspiration rates (the amount of water lost through evaporation and transpiration of turfgrass).

Based on daily fluctuations in precipitation, each customer's rates are adjusted on each water bill to reflect estimated needs. When customers use more water than needed, they are given progressively expensive penalties. This individualized feedback alerts customers to excess use or leakage. Customers that correct a problem can request the removal of the penalties. Because IRWD does not depend on penalty revenues, such requests can be quickly and readily granted, leading to very high customer satisfaction ratings.

The five-tiered rate structure consists of the following:

Rate Tier	Amount and Basis
Low-volume discount	$0.48 per 100 cubic feet (ccf) for use of 0-40 percent of allocation ($0.64 per 1,000 gallons)
Conservation base rate	$0.64 per ccf for use of 41-100 percent of allocation ($0.85 per 1,000 gallons)
Inefficient	$1.28 per ccf for use of 101-150 percent of allocation ($1.71 per 1,000 gallons)
Excessive	$2.56 per ccf for use of 151-200 percent of allocation ($3.42 per 1,000 gallons)
Wasteful	$5.12 per ccf for use of 201 or greater percent of allocation ($6.85 per 1,000 gallons)

In addition to the consumption charges, all customers are billed a fixed water-service fee based on meter size, which ensures that utility revenues are permanently stable, regardless of the level of water sales. Residential customers with usage levels approximately 10 ccf/month are charged a flat sewer fee of $6.60 per month. Sewer fees are $0.74 per ccf ($0.99 per 1,000 gallons) for non-residential customers using more than 10 ccf per month. IRWD also imposes a pumping surcharge that varies from $0.11 to $0.56 per ccf ($0.15 to $0.75 per 1,000 gallons) for customers residing in high elevations. The average total residential water bill is approximately $20 per month.

Results

IRWD implemented the new rate structure in June 1991 and its impact was immediately evident. Water use in 1991/1992 declined by 19 percent, as compared to 1990/1991. Surveys show that customer satisfaction with the rate structure is highly favorable, reflecting 85 to 95 percent approval.

IRWD believes that the implementation of incentive pricing, especially the individualized customer water budget, made their other conservation programs more effective. Over the 6-year period between 1991 and 1997, IRWD spent approximately $5 million on other conservation programs such as irrigation workshops, water audits, and fixture rebates. During that time period, the estimated savings in avoided water purchases has been $33.2 million. Savings in landscape water totaled 61,419 acre-feet, valued at $26.5 million. Landscape water usage dropped from an average of 4.11 acre-feet to less than 2 acre-feet per year. The residential sector showed a 12 percent reduction in use following a major drought, because awareness of water conservation issues was still high. Since then, usage is, on average, 9 percent lower per household than in 1990. From 1992 to 1998, savings totaled 15,611 acre-feet, valued at $6 million in avoided purchases. IRWD also was able to avoid raising water rates for 5 years.

Summary of Results for Irvine Ranch Water District, CA

Water Savings	
Water savings (1990/91 to 1991/92)	19%
Landscape water impact savings (1991 to 1997)	61,419 acre-feet (20 billion gallons)
Residential water impact savings (1991 to 1997)	12% per year
Residential water impact savings (1991 to 1997)	15,611 acre-feet (5 billion gallons)
Water Cost Savings	
Conservation program (6-year period)	$5 million
Avoided water purchases (6-year period)	$33.2 million
Net savings in avoided water purchases (6-year period)	$28.2 million

Resources

Tom Ash, "How an Effective Rate Structure Makes Conservation Work For You," AWWA Conserve99 Proceedings, Monterey, CA, January 31-February 3, 1999.

Irvine Ranch Water District, "Irvine Ranch Water District Rates and Charges: Residential," Irvine Ranch Water District, <www.irwd.com/FinancialInfo/ResRates.html>.

Lessick, Dale, "IRWD's Water Budget Based Rate Structure," Irvine Ranch Water District, January 1999.

Contact

Dale Lessick
Irvine Ranch Water District
Phone: 949 453-5325
Fax: 949 453-0572
E-mail: lessick@irwd.com

Massachusetts Water Resources Authority: Deferring Capital Needs Through Conservation

Background

The Massachusetts Water Resource Authority (MWRA) is a wholesale water provider for 2.2 million people in 46 cities, towns, and municipal water districts in Massachusetts. From 1969 to 1988, MWRA withdrawals exceeded the safe yield level of 300 million gallons per day (mgd) by more than 10 percent annually. Consequently, MWRA was under pressure to make plans to increase supply capacity. One plan it developed was to divert the Connecticut River, which would cost $120 million to $240 million (in 1983 dollars) and have an annual operation and maintenance cost of $3 million. MWRA also developed a plan for a new water treatment facility that complied with the Safe Drinking Water Act. The plant was originally designed with a 500 mgd demand maximum. Ultimately, the Commonwealth of Massachusetts determined that a water conservation plan would be the best initial solution for its supply needs, with other plans to follow as needed.

Approach

Although adequate precipitation helped avoid a major water-supply crisis during the 20-year period of exceeding the safe yield, MWRA began a water conservation program in 1986 to help address the supply problem. The conservation program included the following:

- Vigorously detecting and repairing leaks in MWRA pipes (270 miles) and community pipes (6,000 miles).
- Retrofitting 370,000 homes with low-flow plumbing devices.
- Developing a water management program for area businesses, municipal buildings, and nonprofit organizations.
- Conducting extensive public information and school education programs.
- Changing the state plumbing code to require new toilets to use no more than 1.6 gallons of water per flush.
- Improving meters to help track and analyze community water use.
- Using conservation-minded water/sewer rate structures on the community level.

Results

MWRA's conservation efforts reduced average daily demand from 336 mgd in 1987 to 256 mgd in 1997. The decrease in demand allowed for a reduction in the size of MWRA's planned treatment plant, as well as a 20-year deferral of the need for an additional supply source.

The present-value cost savings of deferring the water supply expansion are estimated to be $75 million to $117 million, depending on the initial capital investment. The capacity of the treatment plant has been reduced from 500 mgd to 405 mgd—an estimated $36 million cost reduction. Together, the deferral of the water-supply expansion project and the reduction in the capacity of the treatment plant amount to a total savings of $111 million to $153 million. The estimated cost of the conservation program is $20 million.

Summary of Results for Massachusetts Water Resources Authority

Water Savings	
Total demand reduction (1987-1997)	80 mgd
Capacity reduction of planned treatment facility	95 mgd
Capital Savings	
Present value savings of deferring supply expansion	$75-$117 million
Present value savings of reducing treatment plant capacity	$36 million
Total savings (deferring water supply and reducing treatment plant capacity)	$1.39 mil./mgd to $1.91 mil./mgd

mgd= million gallons per day

Resources

Daniel B. Bishop and Jack A. Weber, *Impacts of Demand Reduction on Water Utilities* (Denver: American Water Works Association, 1996), pp. 44-45, 98-102.

Massachusetts Water Resources Authority, <www.mwra.state.ma.us/water/html/wat.htm>.

Contact

Stephen Estes-Smargiassi
MWRA Water Conservation
Phone: 617 788-4303
Fax: 617 788-4888
E-mail: smargias@mwra.state.ma.us

Metropolitan Water District of Southern California: Wholesale Conservation

Background

The Metropolitan Water District ("Metropolitan") is the wholesale supplier of water for Southern California. Metropolitan "imports" water for its 26 member water agencies from the Colorado River and Northern California, providing 60 percent of the water needed by a population of more than 17 million. In recognition of increasing demands and limited supplies, Metropolitan provides significant local assistance to develop more reliable local supplies through conservation, water recycling, and groundwater cleanup. Since its initiation in the late 1980s, Metropolitan has spent $155 million on conservation programs alone.

Approach

Metropolitan provides financial support for conservation programs in one of two ways—it pays local agencies either 50 percent of the cost of the water conservation project or $154 per acre-foot of conserved water, whichever is less. Projects are generally conducted in partnership with Metropolitan's member agencies, which include retailers and other wholesalers. Projects must directly or indirectly reduce the demand for potable water from Metropolitan. Examples include education and training, research, and support for new legislative initiatives or improved fixture efficiency standards.

One of the largest initiatives has been toilet retrofit rebates. More than 2 million pre-1992 toilets have been replaced with new high-efficiency toilets, thanks to local water agencies across the area. Other efforts have included water-efficiency site surveys, irrigation equipment improvements, distributions of new high-efficiency showerheads, rebates for high-efficiency washing machines, and research into toilet performance and leakage rates.

Results

As of 2001, the water savings from Metropolitan's conservation programs were estimated to be 66,000 acre-feet per year, or 59 million gallons daily. These savings are in large part due to the fact that residents in numerous municipalities replaced more than 2 million inefficient toilets with 1.6 gallons-per-flush models. The conservation credits program also resulted in the distribution of 3 million high-efficiency showerheads and 200,000 faucet aerators. Local offi-

cials in different areas surveyed approximately 60,000 households for water use information, and performed 2,000 large landscape irrigation audits. In addition, officials conducted 1,000 commercial water use surveys. Metropolitan's and its member agencies' efforts have made many customers view their water agencies as resources for finding solutions to high water use problems. Metropolitan is counting on conservation efforts to continue reducing demand in the future.

Summary of Results for Metropolitan Water District of Southern California

Conservation Program Activities and Water Savings	
Number of pre-1992 toilets replaced	2 million
Number of high-efficiency showerheads distributed	3 million
Number of faucet aerators distributed	200,000
Number of high-efficiency clothes washer rebates issued	20,000
Number of residential water-use surveys conducted	60,000
Number of large landscape irrigation audits	2,000
Number of commercial water use surveys conducted	1,000
Total water savings from conservation program	66,000 AFY (59.1 mgd)

AFY= acre-feet per year

Resources

Metropolitan Water District, Southern California, <www.mwd.dst.ca.us/mwdh2o/pages/conserv/conserv01.html>.

Edward R. Osann and John E. Young, Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters (Potomac Resources, Inc., Washington, DC, April 1998), pp. 51-52.

Contact

Ed Thornhill
Metropolitan Water District of Southern California
Los Angeles, CA
Email: ethornhill@mwdh2o.com

New York City, New York: Conservation as a Water Resource

Background

New York City's infrastructure includes more than 6,100 miles of water pipes and more than 6,400 miles of wastewater lines. By the mid-1970s, increased demand resulted in water-supply facilities repeatedly exceeding safe yields. By 1990, three of New York's wastewater treatment plants were exceeding permitted flows. Water and sewer rates more than doubled between 1985 and 1993 due to the cost of meeting federal mandates (including the prohibition of dumping sewage sludge into the ocean), the end of subsidies from the city's general revenue budget to the water and sewer system, and reductions in federal funding for water pollution control projects. The city faced the need for costly water-related infrastructure projects.

In 1992, the city conducted an avoided-cost analysis of the available supply alternatives. It compared current supply costs with the costs of a toilet rebate program. In the end, conservation offered the most economical option.

Approach

Beginning in 1985, New York implemented a series of conservation initiatives, including education, metering (1985 to present), leak detection (1981 to present), and water use regulation. For example, the city initiated computerized sonar leak detection of all city water mains and used an advanced flow-monitoring program to help detect leaks in large sewer mains that lead to wastewater treatment plants operating at high capacity. The city installed magnetic locking hydrant caps between 1992 and 1995 to discourage residents from opening hydrants in the summer, and these are still used when appropriate.

A program to install water meters at unmetered residences began in 1991. The city also began conducting a door-to-door water-efficiency survey with homeowners that included educational information, free showerheads and aerators, and a free leak inspection. New York's program to replace water-guzzling toilets with high-efficiency toilets (1.6 gallons per flush) was a particularly impressive example of modern water-demand management. The program aimed to replace more than 1 million toilets over a 3-year period (1994 to 1997). Homeowners, apartment-building owners, and commercial-property owners received rebates of $150 or $240 per toilet.

Results

The leak-detection program saved 30 to 50 million gallons per day (mgd) in its early years and continued to help reduce losses. In 1996, leak detection and repair efforts saved approximately 11 mgd. Savings from metering total more than 200 mgd at a cost of $150 million. New York City performed more than 200,000 homeowner inspections, resulting in the elimination of more than 4 mgd in leaks. The city also replaced 1.3 million inefficient toilets between March 1994 and April 1997, saving an estimated 70 to 80 mgd. Customers realized 20 to 40 percent savings in total water and wastewater bills. Overall, New York's conservation efforts resulted in a drop in per capita water use from 195 gallons per day in 1991 to 167 gallons per day in 1998.

Summary of Results for New York City

Water savings from leak detection program	30 to 50 mgd
Water savings from meter installation	200 mgd
Homeowner inspections	200,000
Water savings from homeowner inspections	4 mgd
Number of inefficient toilets replaced	1.3 million
Water savings from toilet replacement program	70 to 80 mgd

mgd = million gallons per day

Resources

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), pp. 37-38.

U.S. Environmental Protection Agency, "Regional Approaches to Efficient Water Uses: Tales from the Trenches," Cleaner Water Through Conservation (1998), <www.epa.gov/OW/you/chap4.html>.

New York City Department of Environmental Protection Web site, <www.nyc.gov/html/dep/html/about.html>.

Contact

Warren Liebold,
Director of Conservation
New York City Department of Environmental Protection
Phone: 718 595-4657
Fax: 718 595-4623

Phoenix, Arizona: Using Less, Conserving More

Background

The Phoenix Water Services Department provides water for 350,000 retail connections and a population of approximately 1.3 million people in one of the fastest-growing communities in the United States. As the sixth largest city in the United States and the 17th largest metropolitan area, Phoenix also has the second largest land area of all cities in the United States. Average annual rainfall in Phoenix is 7.25 inches. Approximately 98 percent of Phoenix proper relies entirely on surface water, and the surrounding growth areas (consisting of an additional 1.5 million people) use a combination of ground and surface water sources. The major source of water is a very old agricultural reclamation project that has been devoted to urban use. This project has helped keep water prices the lowest in the area and lower than any other comparable city in the country. Unfortunately, the area's inexpensive water sources have been depleted, and new water-supply projects pose environmental and financial problems. The state legislature has required that after 2025, Phoenix and suburban communities must not pump groundwater faster than it can be replenished. Accordingly, the city has been pressed to either look for alternative surface supplies or reduce demand. City facilities—mostly parks—constitute the city's single largest water customer. Because of irrigation and cooling uses, Phoenix summer demand is nearly twice that of winter use. Planners determined that conservation was the best solution to the problem.

Approach

Phoenix has maintained a water conservation program since 1982 and, in 1986, the city approved a comprehensive water conservation program. The plan outlined five water conservation programs:

- Water pricing reform
- Indoor residential water conservation
- Industrial and commercial water conservation
- Plant and turf irrigation efficiency
- Water-efficient landscaping

Residential water use amounts to 70 percent of Phoenix's water deliveries; consequently, residential water conservation is a high priority. Phoenix uses a rate structure that nearly reflects marginal costs, with three seasonal variations reflecting the city's seasonal costs. The rate includes a monthly service charge and a volume charge that varies by season. Under the 1986 plan, Phoenix offered to replace old, high-flow fixtures (showerheads and faucets) in homes built before 1980. The program distributed educational materials, offered installation, and provided materials and support for community organizations to facilitate implementation. In 1990, the city amended its plumbing code to require water-conserving fixtures (including high-efficiency toilets) in new construction and renovation. That code requires the same flow reduction as those required 2 years later by the federal Energy Policy Act, 42 U.S.C., Chapter 77.

Phoenix's water conservation program provides assistance to low-income, elderly, and disabled customers. For more than 10 years, the city offered energy and water audits and plumbing retrofits through senior-citizen organizations. In another program, the city used high-school students to help low-income residents with audits, repairs, and replacements.

In 1998, Phoenix developed a new water conservation plan that focuses on public education and public awareness, technical assistance, regulations, planning and research, and interagency coordination. This plan focuses less on structural fixes, such as plumbing retrofitting, and more on changing behaviors and educating the next generation of water users. Many of the elements in the 1998 plan reflect a continuation or adaptation of elements in the 1986 plan. Other elements reflect new program initiatives in response to citizen interests and preferences. Most notable are mandates for school education programs, public education about conservation techniques, and city/citizen partnerships at the neighborhood level to address conservation needs. Phoenix was a key player in the development of the "Water—Use it Wisely" regional advertising and promotion campaign.

Results

Estimates suggest that by 1987, Phoenix's conservation program was saving approximately 20,000 acre-feet per year (18 million gallons per day (mgd)), which constitutes a 6 percent decrease in per-capita water use since 1980. From 1982 to 1987, Phoenix saved approximately 10,000 acre-feet of water per year (9 mgd) due to its conservation rate structure. A modified conservation rate implemented in 1987 saved an additional 25,000 acre-feet per year (22.5 mgd). Through the voluntary residential conservation program, more than 170,000 homes have been retrofitted with water-saving fixtures. Through programs for low-income, elderly, and disabled residents, the city installed approximately 1,500 high-efficiency toilets annually. Implementation of recent rate changes and water conservation measures has boosted average annual water savings to more than 45,000 acre-feet (40 mgd).

Summary of Results for Phoenix, AZ

Activities and Actual Water Savings	
Water savings from conservation programs (1982–1987)	20,000 acre-feet/year (18 mgd) (6% per capita)
Current savings from conservation program	45,000 acre-feet/year (40 mgd)
Number of homes retrofitted with water saving devices	170,000
Number of high-efficiency toilets distributed through low-income, elderly, and disabled program	1,500 per year

mgd = million gallons per day

Resources

Daniel B. Bishop and Jack A. Weber, *Impacts of Demand Reduction on Water Utilities* (Denver: American Water Works Association, 1996), pp. 48-50.

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), p. 39.

Phoenix Water Services Department, Water Conservation Plan 1998, <www.ci.phoenix.az.us/WATER/waterpln.html>.

Contact

Thomas M. Babcock
Phoenix Water Conservation Office
Phone: 602 261-8377
Fax: 602 534-4849
E-mail: tbabcock@ci.phoenix.az.us

Santa Monica, California: Conservation in a Sustainable City

Background

Like many Southern California cities, Santa Monica has faced rapid urban development and increased strain on water supplies. Residential customers consume approximately 68 percent of the water, while commercial and industrial customers consume 32 percent. The city draws water from local groundwater wells and imports water from the Metropolitan Water District of Southern California (MWD). Prior to 1996, the groundwater aquifers provided approximately 65 percent of total supplies. In 1996, the city found methyl tertiary-butyl ether (MTBE) contaminants in several wells, forcing Santa Monica to increase purchases to approximately 78 percent of total supplies. The city has four reservoirs with a total capacity of 40 million gallons for storing imported water. In 2002, 15 percent of supplies came from local groundwater and 85 percent from MWD.

In 1992, Santa Monica's city council initiated a Sustainable City Program. The program provides the city with a coordinated, proactive approach to implementing existing and planned environmental programs. The program consists of five major policy areas: (1) community and economic development, (2) transportation, (3) pollution prevention, (4) public-health protection, and (5) resource conservation. Resource conservation encompasses the city's programs in water, energy, recycling, and waste management.

Approach

Santa Monica has instituted a multifaceted approach to water conservation, including numerous policies and programs. The city's policies include:

- No Water Waste Ordinance
- Plumbing code
- Water-conserving landscape regulations
- Water demand mitigation fee
- Wastewater mitigation for large development projects
- Retrofit-Upon-Sale Ordinance
- Water and wastewater rate structure

Santa Monica's water conservation programs include:

- Residential water-use surveys
- Commercial and industrial water-use surveys
- Demonstration sustainable gardens
- Sustainable landscape workshops and garden tours
- Sustainable landscape guidelines
- California irrigation management information system
- Bay Saver Toilet Retrofit Program
- Water Efficiency Revolving Loan Program

The No Water Waste Ordinance regulates through notification-education—the use of fines for violating water use practices, such as lawn watering hours, hosing down driveways, swimming pool filling, and leakage. The Retrofit-Upon-Sale Ordinance requires the installation of water-saving plumbing devices whenever any residential or commercial property is sold or transferred. In 1996, the city modified the fixed and variable charges in the rate structure to encourage water conservation. Through the water use surveys, residents can receive free showerheads, faucet aerators, and garden-hose nozzles. The city encourages efficient irrigation and landscaping through several programs.

The Bay Saver Toilet Retrofit Program, at a total cost of $5.4 million, offers a $75 rebate for individuals to purchase and install high-efficiency toilets (1.6 gallons per flush). The Water Efficiency Revolving Loan Program provides no-interest loans to institutional, commercial, and residential water customers to pay for plumbing fixture retrofits, irrigation system upgrades, and other cost-effective water efficiency measures.

Results

Based on 1990 usage levels, Santa Monica established a water reduction goal of 20 percent by 2000. In 1990, water usage amounted to 14.3 million gallons per day (mgd). In one year, water use dropped almost 22 percent—to 11.4 mgd. The drop could be explained primarily by emergency measures instituted in response to a drought. When the city dropped the emergency measures in 1992, water use rose gradually to 12.3 mgd in 1995—reflecting a 14 percent savings from the 1990 level.

The city also established a wastewater flow reduction goal of 15 percent—from 10.4 mgd in 1990 to a target of 8.8 mgd in 2000. The city surpassed its goal by reducing flow to 8.2 mgd, a 21 percent reduction from 1990.

Santa Monica replaced more than 1,200 institutional plumbing fixtures in all city-owned or operated facilities. Between 1990 and July 1996, the Bay Saver Toilet Retrofit Program replaced more than 41,000 residential toilets and 1,567 commercial toilets. Estimates indicate that the program was

responsible for the permanent reduction of 1.9 mgd in water use and wastewater generation, as well as $9.5 million in avoided sewage treatment capacity purchases and avoided purchases of imported water.

Summary of Results for Santa Monica, CA

Activities and Water Savings	
Water savings, 1990-1995	2 mgd (14% decrease)
Number of residential toilets replaced	41,000 (53%)
Number of commercial toilets replaced	1,567 (10%)
Number of city-owned plumbing fixtures replaced	1,200
Wastewater flow reduction, 1990-1995	2.2 mgd (21% reduction)
Cost Savings	
Net savings from Bay Saver Toilet Retrofit Program	$9.5 million

mgd = million gallons per day

Resources

City of Santa Monica Environmental Programs Division, <pen.ci.santa-monica.ca.us/environment/policy/water>.

"Santa Monica Sustainable City Program," Sustainable Communities network, Case Studies, <64.226.148.229/casestudies/SIA_PDFs/SIA_California.pdf >.

"Sustainable City Progress Report," City of Santa Monica, Task Force of the Environment, December 1996.

"Sustainable City Progress Report," City of Santa Monica, Task Force of the Environment, October 1999.

Contact

Kim O'Cain
Water Resources Specialist
200 Santa Monica Pier, Suite K
Santa Monica, CA 90401
Phone: 310 458-8972 x1
Fax: 310 260-1574
E-mail: kim-o'cain@santa-monica.org

Seattle, WA: Commercial Water Savings

Background

Seattle Public Utilities provides water to approximately 1.3 million people in Seattle and surrounding areas. The Seattle area has experienced steady population growth. Although the city is known for its rain, Seattle experiences dry summers with water demand at its peak due to increases in watering, irrigation, and recreation use. The Seattle area has very little carryover storage capacity from year to year and usually depends on the slow melting snow; an unusually dry winter can lead to summer water shortages. Adequate river flow is necessary for survival of the area's valued aquatic life, including Puget Sound's threatened Chinook salmon. The natural environment and the growing population compete for water resources, particularly during the dry season. Increasing demand and limits on existing supplies have forced the development of a dual strategy of demand reduction and cooperative supply management.

City of Seattle and 26 wholesale water utility partners

Approach

Seattle uses a multifaceted approach to water conservation. Strategies include an increasing block rate structure during the peak season for residential customers, plumbing fixture codes and regulations, operational improvements to reduce leaks and other water losses, market transformation to encourage and support water-saving products and appliances, customer rebates and financial incentives to encourage customers to use water-saving technology, and public education. Seattle targets several specific programs at residential customers. The Home Water Savers Program distributes water-efficient showerheads and provides free installation for apartments. WashWise promotes the purchase of resource-efficient washing machines through a mail-in cash rebate. Seattle also actively encourages water-wise gardening and landscaping, and the city strongly supports public education.

Seattle places special emphasis on its Water Smart Technology (WST) Program, in particular, understanding the needs and preferences of commercial customers to help them understand the benefits of conservation. The commercial program provides financial incentives, including technical and financial assistance, for the purchase and installation of cost-effective and water-efficient equipment, commercial toilet rebates for replacing older inefficient toilets and urinals, free irrigation-system assessments and audits, financial assistance for upgrading irrigation systems, and promotion of storm water and wastewater reuse.

Results

By all indications, Seattle's water conservation programs are successful. In the 1990s, annual average water consumption dropped 12 percent—from 171 million gallons per day (mgd) to 150 mgd. Per capita water consumption dropped by 20 percent. Estimates indicate that Seattle's water demand is approximately 30 mgd less than it would have been without conservation. Regional water consumption in 1997 was the same as in 1980. The seasonal rate structure is credited with saving close to 5 mgd since 1990. Plumbing codes and regulations have saved more than 4 mgd. Improvements in system efficiency have saved approximately 13 mgd since 1990. The Home Water Savers Program involved 330,000 customers and saved nearly 6 mgd.

Seattle's WST Program has been a remarkable success. Estimated median water savings for a commercial incentive program are approximately 6,000 gallons per day. More than 150 businesses have participated in the incentive program for total savings of approximately 1 mgd. By the end of 1997, 600 businesses participated in the commercial toilet-rebate program, replacing nearly 10,000 fixtures and saving approximately 0.8 mgd. Water efficient irrigation improvements for businesses have saved an additional 3 million gallons each year. Together, the commercial incentive programs could save Seattle approximately 8 mgd—reflecting a 20 percent overall reduction in commercial water use. The average avoided cost associated with new or expanded supply and transmission facilities is $1.89 per one hundred cubic feet ($2.53 per 1,000 gallons). On a per unit basis, commercial conservation programs have proved to be approximately twice as cost-effective as developing new supplies.

Summary of Actual and Projected Results for Seattle, WA

Water Savings 1990–1998	
Water savings from seasonal rates	5 mgd
Water savings from plumbing regulations	4 mgd
Water savings from system efficiency improvements	13 mgd
Home Water Savers Program participants	330,000 residences
Water savings from Home Water Savers Program	6 mgd
Water savings from commercial incentive programs	8 mgd
Commercial Toilet Rebate Program participants	600 businesses
Water savings from Commercial Toilet Rebate Program	0.8 mgd
Water savings from commercial irrigation improvements (1990-1998)	3 mgd

Cost Savings	
Conventional supply cost (avoided supply cost for all customers)	$1.89 per ccf ($2.53 per 1,000 gals)
Cost of commercial conservation	$0.93 per ccf ($1.25 per 1,000 gals)
Cost to participating customers	$0.36 per ccf ($0.48 per 1,000 gals)
Additional benefits to participating customers (water-bill savings)	$0.74 per ccf ($0.99 per 1,000 gals)
Net additional benefits (water savings less program participation costs)	$0.38 per ccf ($0.51 per 1,000 gals)
Total net benefits (avoided supply cost plus net additional benefits)	$1.42 per ccf ($1.90 per 1,000 gals)

ccf = hundreds of cubic feet

mgd = million gallons per day

Resources

Allan Dietemann and Philip Paschke, *Program Evaluation of Commercial Conservation Financial Incentive Programs* (Seattle Public Utilities), <www.ci.seattle.wa.us/util/RESCONS/accmpReport/ar98-99/Accomplishment.htm>.

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), pp. 44-45.

"Regional Water Conservation Accomplishments, 1990-1998," Seattle Public Utilities and Purveyor Partners.

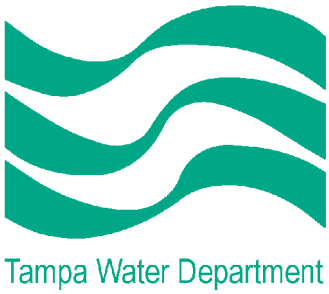
Seattle Water Department, *Seattle Water Department Water Supply Plan.* Seattle, WA: Seattle Water Department, July 1992.

Contact

Allan J. Dietemann
Senior Technical Analyst
Seattle Public Utilities
Phone: 206 684-5881
Fax: 206 684-8529

Tampa, Florida: Growth and Water Management

Background



Florida's Tampa Bay region has experienced rapid economic and population growth for many years, and the demand for water has grown even faster. In the 1980s, Tampa's and Hillsborough County's population grew by 8 percent, and water demand grew by more than 25 percent. Florida experiences periodic droughts, with an average of four drought years in every 10-year period. In Florida, Tampa is unique for its heavy dependence on surface water supplies—75 percent of its drinking water comes from the Hillsborough River, which is greatly affected by periods of drought.

Approach

Since 1989, the Tampa Water Department has implemented several measures to reduce water usage, including water-conserving codes, an increasing-block rate structure, public education, in-school education, and other conservation projects. The city promotes water efficiency through water use restrictions, fines for water use violations, and plumbing and landscaping codes. Outdoor irrigation is limited to one day per week and prohibited between 8 a.m. and 6 p.m., and all new irrigation systems must have rain sensors. The city also provides homeowners with free Sensible Sprinkling irrigation evaluations and distributes free rain sensors. The landscape code limits the amount of irrigated turfgrass to 50 percent in new developments and encourages the use of Florida-friendly plants and low-volume irrigation methods.

The city modified the plumbing code to require water-efficient plumbing fixtures in all new construction and renovation. Tampa's Water Department began distributing water conservation kits to homeowners in 1989. The kits include toilet tank dams, efficient showerheads, aerators, leak detection kits, and information. In 1994, the department conducted a pilot toilet rebate program to retrofit toilets in existing buildings with high-efficiency toilets (1.6 gallons per flush). The pilot program was well received, with high rates of participation and product satisfaction. Tampa expanded the rebate program and now offers rebates as high as $100 for replacement toilets in single family and multi-family homes, as well as for commercial customers.

Results

Tampa has experienced much success with its water conservation programs. The Sensible Sprinkling irrigation evaluation program resulted in a 25 percent drop in water use. Estimates indicate that the distribution of more than 100,000 conservation kits resulted in savings of 7 to 10 gallons of water per person per day.

An evaluation of the pilot toilet rebate program revealed that household water use decreased from an average of 258 gallons per day to 220 gallons per day—a 15 percent reduction. The city replaced 27,239 older toilets with high-efficiency toilets, accounting for 245.9 million gallons of water saved each year. Although the city's water service population increased 20 percent from 1989 to 2001, per capita water use decreased 26 percent.

Summary of Results for Tampa, FL

Number of Sensible Sprinkling landscape evaluations performed	915
Water savings from Sensible Sprinkling landscape evaluation program	25%
Number of water-saving kits distributed	100,000
Water savings from distribution of water-saving kits	7 to 10 gallons per day per person
Number of inefficient toilets replaced	27,239
Water savings from toilet rebate program	38 gallons per day per household

Resources

Edward R. Osann and John E. Young, *Saving Water, Saving Dollars: Efficient Plumbing Products and the Protection of America's Waters* (Potomac Resources, Inc., Washington, DC, April 1998), pp. 46-47.

U.S. Environmental Protection Agency, "Regional Approaches to Efficient Water Uses: Tales from the Trenches," *Cleaner Water Through Conservation* (1998), <www.epa.gov/OW/you/chap4.html>.

Tampa Water Department, "Water Conservation and Education," <www.TampaGov.net/savewater>.

Contact

Sandra E. Anderson
Consumer Affairs Manager
Tampa Water Department
306 E. Jackson St.
Tampa, FL 33602
Phone: 813 274-8653
Fax: 813 274-7435
E-mail: Sandra.Anderson@TampaGov.net

Wichita, Kansas: Integrated Resource Planning

Background

A decade ago, analysts determined that Wichita's available water resources could not meet the city's needs beyond the first decade of the 21st century. Based on conventional operating practices, the city was fully utilizing existing water supplies and had no new supplies readily available. The city explored the option of drawing water from a water reservoir located 100 miles away. Due to the high cost of transporting water, as well as social, environmental, and political opposition, the city chose to reevaluate its options.

Wichita eventually opted for a more holistic approach to water management, in which water conservation is a significant component. In the early 1990s, the city adopted an integrated resource planning approach. The process of developing a long-term plan encouraged the involvement of various stakeholders, including the community, water users, and regulatory agencies. Ultimately, the group investigated non-conventional water sources that do not typically have firm yields.

Approach

The Wichita case is noteworthy for its very long-term perspective, the number and variety of water resource options considered, and the emphasis on regional coordination issues. The case is especially useful in recognizing how regulatory institutions affect the feasibility of water resource options. Regulatory considerations in Wichita included water rights, source water protection, drinking water standards, environmental impacts, and historic preservation.

Analysts in Wichita summarized the key elements of their "customized" integrated planning approach as follows:

- Implement water conservation to help control customer demand and water use.
- Evaluate existing surface water and groundwater sources to determine their capacity and condition, methods of enhancing their productivity, and ways to protect their quality.
- Evaluate nonconventional water resources for meeting future water needs.
- Optimize all available water resources to enhance water supply.
- Pursue an application for conjunctive water resource use permit from state agencies.
- Evaluate the effects of using different water resources on water supply, delivery, and treatment facilities with consideration of risk and reliability.
- Communicate with key stakeholders including regulatory agencies, other water users, and the public.

Results

The comprehensive analysis of resource options for Wichita resulted in a large matrix with a total of 27 conventional and nonconventional resource options and their key characteristics. For each option, the analysis considered: construction costs, expected available flow (including alternative scenarios when applicable), unit costs, general advantages and disadvantages, and specific implementation issues related to policy or political, legal, environmental, and water quality concerns. Analysts used a screening process to eliminate several options from further consideration, including the "no action" option (because of adverse economic development consequences). Then they ranked the remaining options in terms of overall desirability.

Planners in Wichita recognized that water supply operations are growing in complexity and that operational tradeoffs are necessary when implementing an integrated approach. The key benefit to better planning, however, is the more effective use of the region's water resources.

Summary of Results for Wichita, KS

Resource Alternative	Expected Yield (mgd)	Construction Cost ($mil)	Unit Cost ($/mil. gal.)	Rank*
Low-range water conservation	15	23	77	1
Little Arkansas River supply to water treatment plant	0 to 44	21	23	2
Little Arkansas River: subsurface storage	34	26 to 126	46 to 219	3A
Little Arkansas River: bank storage	7 to 39	6.2 to 175	45 to 221	3B
Little Arkansas River: bank storage	7 to 39	11.5 to 164	41 to 207	3B
Gilbert-Mosley remediated groundwater	3	1.5	25	4
Cheney Reservoir: operations modifications	up to 60	0	0	5
Reserve Wellfield	10.8	1.0	4.7	6
Reserve Wellfield (peak use only)	10.8	1.0	37	6
Cheney overflow pipeline to water treatment plant	28	53	96	7
Cheney overflow pipeline to water treatment plant	35	60	87	7
Equis Beds: purchase water rights	As available	$400/acre-ft	1,227	8
Milford Reservoir (existing)	60	155	141	9
Cheney overflow: subsurface storage	34	65 to 165	94 to 237	10
Treated wastewater reuse: local irrigation	1.1	15	1,336	11
No action	23	0	0	ns

Source: David R. Warren, et al., "IRP: A Case Study From Kansas," *Journal American Water Works Association* 87, no. 6 (June 1995): 57-71.

ns = not selected as a viable alternative based on screening level cost.

* Rankings were based on a variety of criteria, including, but not limited to, the cost criteria provided.

Resources

Jeff Klein, Frank Shorney, Fred Pinkney, Rick Bair, David Warren, and Jerry Blain, "Integrated Resource Planning at Wichita, Kansas: Addressing Regulatory Requirements," Proceedings of Conserv96 (Denver, CO: American Water Works Association, 1996), pp. 417-421.

David R. Warren, Gerald T. Blain, Frank L. Shorney, and L. Jeffrey Klein, "IRP: A Case Study From Kansas," *Journal American Water Works Association* 87, no. 6 (June 1995): pp. 57-71.

City of Wichita Water Conservation, <www.ci.wichita.ks.us/Water_Sewer/water_conservation.asp>

Contact

Jerry Blain
Water Supply Projects Administrator
Phone: 316 268-4578
Fax: 316 269-4514
E-mail: blain_j@ci.wichita.ks.us

Barrie, Ontario: Wastewater Capital Deferral

Background

Barrie, Ontario, is located 80 miles north of Toronto on the shore of Lake Simcoe. Due to rapid population growth, the city's groundwater supplies, managed by the Barrie Public Utilities Commission, suffered serious capacity limitations. In 1994, the city planned a new surface-water supply at a cost of approximately $27 million (Canadian dollars). Wastewater flows began reaching capacity at the Water Pollution Control Center, forcing consideration of a $41 million addition to accommodate future growth and development.

Approach

To help ease the water use burden, Barrie developed a conservation partnership with the Ontario Clean Water Agency (OCWA) and the Ministry of the Environment (MOE). The program focused on replacing inefficient showerheads and toilets and delivering information kits to homeowners and landlords. The city offered homeowners a $145 rebate per toilet and $8 per showerhead; the OCWA and MOE covered materials and program administration costs. The goal was to achieve a 50 liters per person per day (13.2 gallons per person per day) reduction in water use for 15,000 households, which would constitute a 5.5 percent reduction in average daily wastewater flows from the 1994 level.

Results

Between 1995 and 1997, a total of 10,500 households received 15,000 high-efficiency toilets (1.6 gallons per flush), representing 60 percent of the program goal. A pre-and-post analysis of participating households indicated an average reduction of 62 liters per person per day (16.4 gallons per person per day)—24 percent higher than the goal of 50 liters per person per day (13.2 gallons per person per day). Total program savings translated to 55 liters per person per day for the system (14.5 gallons per person per day). Based on the total number of participating households, the conservation program generated water savings totaling 1,628 cubic liters per day. More than 90 percent of the program participants were satisfied with the program and the products installed.

The reduction in wastewater flows in Barrie enabled a 5-year deferral of the capital expansion project at the Water Pollution Control Center. Water conservation efforts also made it possible to scale back the cost of the upgrade to

$19.2 million—for a net saving of $17.1 million after accounting for the cost of the conservation program. The reductions in wastewater flows and the planned upgrades at the facility mean that no new hydraulic capacity will be needed until 2011. Barrie also will delay construction of a lake-based water filtration plant beyond 2020 and defer the associated cost and rate impacts.

The conservation program also results in environmental, economic, and social benefits to the community. The conservation program is credited for creating more jobs than the proposed capital-works program, as well as preserving individual disposable incomes due to lower water and energy bills.

Summary of Results for Barrie, Ontario

Activities and Water Savings	
Participating households	10,500
Installations of high-efficiency toilets	15,000
Water savings in retrofitted homes	62 l/c/d (19 g/c/d)
System water savings from total program	55 l/c/d (14.5 g/c/d)
Wastewater flow reduction	1,335 m^3/day (0.35 mgd)
Capital Savings (millions of Canadian dollars)	
Original cost of upgrade	$41.0
Revised cost of upgrade	$19.2
Savings	$21.8
Cost of program	$4.7
Net capital deferral	$17.1

l/c/d = liters per capita per day; g/c/d/ = gallons per capita per day;

m3 = cubic meters; mgd = million gallons per day

Resources

"Canadian City's Water Conservation Project Produces Multiple Benefits," *Water Online* (1/14/99).

City of Barrie, <www.city.barrie.on.ca/edopages/wstwtr.htm#cons>.

Contact

Barry Thompson
Barrie Water Conservation
Phone: 705 739-4220 ext. 4557
Fax: 705 739-4253
E-mail: bthompson@city.barrie.on.ca

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For copies of this publication contact:

EPA Water Resources Center (RC-4100)
U.S. Environmental Protection Agency
Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460

For more information regarding water efficiency, please contact:

Water Efficiency Program (4204M)
U.S. Environmental Protection Agency
Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460
<www.epa.gov/owm/water-efficiency/index.htm>

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