

Water Conservation Programs

A Planning Manual

Second Edition



American Water Works
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Water Conservation Programs – A Planning Manual

Second Edition



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Water Conservation Programs – A Planning Manual

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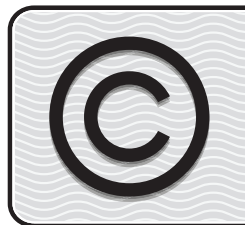
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Foreword



This publication is the second edition of the American Water Works Association Manual M52, *Water Conservation Programs – A Planning Manual*. The manual provides information on how to develop, implement, and measure the success of a utility conservation program.

This manual is intended for use by water utilities that are contemplating the development of a conservation program. In addition, water suppliers that already have a conservation program can use this information to make improvements and to gain the benefits of a more comprehensive approach.

With the development of this second edition, not only has the material throughout the manual been updated, but three chapters (5, 6, and 7) and a robust appendix full of case studies have been included. Chapter 5 presents the process of developing a utility water conservation plan, including an example outline for the plan. Chapter 6 aims to foster an understanding of the importance of public participation in developing publicly supported programs as well as building a group of community advocates and partners. Chapter 7 describes the implementation and evaluation of ongoing efforts of a utility conservation program and plan. Appendix A contains 13 case studies representing utilities across the US and Canada, sharing their various experiences with regards to conservation programming, hotel water use, water loss management, greywater reuse initiatives, and other topics.

The Water Conservation Division and its working committees welcome feedback on the content of this manual. As this field evolves, adjustments to the manual will be necessary. Reader comments are a critical part of the review and revision process.

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Abbreviated Terms/Acronyms

af	acre-foot/acre-feet
AMI	advanced metering infrastructure
AMS	advanced metering system
ANOVA	analysis of variance
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
AwwaRF	American Water Works Association Research Foundation
BMP	best management practice
CalWEP	California Water Efficiency Partnership
CARL	current annual real losses
CII	commercial, industrial, institutional
COM	commercial
CUWCC	California Urban Water Conservation Council
DEP	Department of Environmental Protection
DMM	demand management measure
DSS model	demand-side management least cost planning decision support system
EPA	Environmental Protection Agency
ET	evapotranspiration
FTE	full-time equivalent
GIS	geographic information system
gpcd	gallons per capita per day
gpd	gallons per day
gpd/a	gallons per day per account
gpf	gallon per flush
gpm	gallon per minute
HECW	high-efficiency clothes washer
HET	high-efficiency toilet
HEU	high-efficiency urinal
HOA	homeowners association
ILI	infrastructure leakage index
INST	institutional
IRR	irrigation
IWA	International Water Association
LEED	US Green Building Council Leadership and Excellence in Environmental Design
MG	million gallons

mgd	million gallons per day
MOU	memorandum of understanding
MWM	Maddaus Water Management
NRW	non-revenue water
O&M	operations and maintenance
PG&E	Pacific Gas and Electric
RMF	residential multifamily
RSF	residential single-family
TWDB	Texas Water Development Board
UARL	unavoidable annual real losses
ULF	ultra low flow
ULFT	ultra-low-flow toilet
USEPA	United States Environmental Protection Agency
WEF	Water Education Foundation
WRF	Water Research Foundation

Chapter **1**

Introduction

Water conservation is a key component of overall water resources planning. Conservation programs that are carefully designed and implemented can bring many benefits. Among these are the efficient utilization of available sources of supply, public recognition and participation, and improved support for water pricing adjustments.

WHAT IS WATER CONSERVATION?

If this question was asked of water professionals in the 1930s through the 1960s, most would have said “water conservation involves building a reservoir to capture runoff that would otherwise be wasted by flowing into an unusable water body, like the ocean.” Starting in the 1970s, water professionals became aware that minimizing water waste was essential. For example, AWWA’s water resources policy in 1975 included the statement, “Every effective means to prevent and minimize waste and promote wise use should be employed by all entities, public and private, engaged in water resource activities.” AWWA’s first handbook on water conservation, *Water Conservation Management*, was published in 1981 followed by an updated handbook, *Water Conservation*, in 1987 (AWWA 1981; AWWA 1987).

The first edition of this manual published in 2006 was an update of these original works (AWWA 2006). This second edition, published in 2017, is a further update with revised case studies, two more chapters, and additional content.

Shown in Figure 1-1 is AWWA’s policy on water conservation. The most up-to-date policy statement can be found at www.awwa.org/about-us/policy-statements.aspx. A more extensive description of the role of water conservation in water resources management is contained in AWWA M50, *Water Resources Planning* (AWWA 2017).

Long-Term Versus Short-Term Conservation

A common and long-held public perception is that water conservation means restricting or curtailing customer use as a temporary response to drought. Today, while water use restrictions are still a useful short-term drought management tool, most utility-sponsored water conservation programs emphasize lasting long-term improvements in water use efficiency while maintaining quality-of-life standards. In a growing number of communities, this now includes permanent water use restrictions such as limiting the number of

Adopted by the Board of Directors Jan. 27, 1991, revised Jan. 31, 1993, and June 15, 1997, and reaffirmed Jan. 20, 2002. This policy statement was approved by the Administrative & Policy Council on Sept. 28, 2007, and the Executive Committee on Nov. 3, 2007. Reaffirmed January 2011. Revised June 8, 2014. The most up-to-date policy statement can be found at <http://www.awwa.org/about-us/policy-statements.aspx>.

The American Water Works Association (AWWA) encourages water and wastewater utilities to support and adopt codes, policies, procedures, and programs that sustain the efficient use of their water resources, through a comprehensive approach integrating demand management with supply-side management practices.

AWWA supports the use and integration of a variety of water conservation principles and practices. Utilities should use comprehensive integrated resource planning to fully utilize conserved water in water supply planning, and participate in regional coordination and integration approaches for this use.

Utilities should accurately meter, monitor and track consumption data and bill customers based on accurately metered usage in a timely manner, using full-cost pricing and conservation rate structures.

Utilities should define and implement cost effective/beneficial best water conservation practices for customer end uses, including the conversion of high-water-use plumbing fixtures, appliances and equipment to more efficient designs; the promotion of efficient irrigation; and the use of appropriate landscape materials. Utilities should also implement cost-effective services which may include the provision of water use audits and technical assistance and the provision of education and public information on local water resource issues and water conservation.

Utilities should also support the development of appropriate new water efficiency certification programs and standards for plumbing fixtures and appliances. Utilities should encourage appropriate on-site water reuse, including rainwater and stormwater harvesting and the use of air conditioner condensate and gray water, consistent with the protection of public health. Utilities should also support continued research into efficient water use practices.

Finally, water and wastewater utilities can provide leadership for water conservation by adopting policies and regulations that mandate efficient water use practices in all public facilities.

Figure 1-1 AWWA official policy on water use efficiency

hours and days per week permitted for lawn and landscape watering because such measures can realize significant reductions in long-term demand. Water conservation, very simply, is doing more with less, not doing without. There are many published definitions of water conservation and water use efficiency. An Internet search will result in dozens of definitions, each slightly different.

Legal Definitions in State Water Codes. Long-term water conservation is often used interchangeably with the terms *demand management* and *efficient use*. For example, the California Water Code states (Section 10611.5):

Demand management means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

California goes on to define efficient use separately as (Section 10613):

“Efficient use” means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

The Texas Water Code (Section 11.002) defines water conservation in two ways:

1. The development of water resources

2. Those practices, techniques, and technologies that will reduce the consumption of water, reduce loss or waste of water, improve the efficiency of the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

The first part of the Texas definition is based on the earlier concept of retaining water for later use. The second part broadly defines water conservation as including separate concepts of efficiency, reducing use, and recycling water.

The State of Florida defines water conservation [(Section 62- 40.412(1), F.A.C.)] as:

Preventing and reducing wasteful, uneconomical, impractical, or unreasonable use of water resources.

The State of Georgia defines water conservation [SWP (391-3-32-01)] as:

The beneficial reduction of water use, water waste, and water loss.

Georgia offers this guidance relative to preparing water conservation implementation plans:

Water conservation is defined as the beneficial reduction of water use, water waste and water loss. Conservation, implemented as a long-term water management practice, is fiscally responsible and can enhance our ability to grow. Water conservation does not lower our quality of life or deter business. It can lead to more efficient and effective business operations and help water users recognize the value of water. The ultimate goal of water conservation is to maximize the benefit from each gallon used, while not preventing water use.

Dictionary Definitions. The Ecology dictionary (www.ecologydictionary.org/WATER_CONSERVATION) offers the following definition of water conservation:

The physical control, protection, management, and use of water resources in such a way as to maintain crop, grazing, and forest lands, vegetative cover, wildlife, and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy. Water conservation measures result in a reduction in applied water due to more efficient water use such as the implementation of Best Management Practices (BMP): Urban Water Use, or Efficient Water Management Practices (EWMP): Agricultural Water Use. The extent to which these actions actually create a savings in water supply depends on how they affect new water use and depletion.

The Ecology dictionary defines water use efficiency as:

A measure of the crop production per unit of water used, irrespective of water source, expressed in units of weight per unit of water depth per unit area. The concept of utilization applies to both dryland farming and irrigated agriculture.

Water Efficiency and Water Conservation Expert Definitions. Amy Vickers, author of the *Handbook of Water Use and Conservation* (Vickers 2001), presented a paper entitled “Water Conservation or Water Efficiency: What’s the Difference?” (Vickers 2008) in which she defined water conservation as a “beneficial reduction in water loss, waste or use,”

which implies using less or no water. She defined water efficiency, on the other hand, as “minimization of the amount of water used to accomplish a function, task or result.” This implies better use of water applied, but not necessarily using less water.

The dictionary definitions suggest that *water use efficiency* is a common term in agricultural use management and *water conservation* applies more to urban water use. Water conservation and water efficiency are often used interchangeably, and the differences are subtle.

For this manual, the following subtle differences will be recognized. Water use efficiency is focused on improvements in water use by means of fixtures and equipment technology. Water conservation focuses on taking action to improve the effectiveness of water use through various means, such as choosing to change behavior by using those fixtures and appliances less. Water efficiency often refers to the state of water use in a community, and higher levels of efficiency implies the community uses less according to metrics such as gallons per person per day or gallons per acre of irrigated area.

WHY CONSERVE WATER?

There are many reasons for water utilities to pursue wise water use and establish a water conservation program. The specific reasons will be different for each utility, and the appropriate level of conservation for a utility should be tailored to local needs. This manual will show utilities how to customize a program to local needs.

There is a broad array of reasons to pursue efficient water use. Some examples for consideration are included below:

- **Cost savings:** Lowering water production and/or distribution costs will save the utility and its customers (or ratepayers) money in reduced operating costs and possibly deferred capital costs. Conservation is often an important part of a least-cost future water supply plan.
- **Wastewater treatment and disposal benefits:** Reduction of indoor water use cuts wastewater flows, resulting in cost savings and lessened environmental impacts of treated wastewater disposal.
- **Environmental benefits:** Water removed from a water body for human use could be used for environmental and other purposes. For example, protection of endangered species often requires a reliable source of good quality water, which might be lessened by water withdrawals.
- **Competing beneficial uses:** In addition to the environment, water left in place could be used for agriculture, power production, recreation, aesthetic enjoyment, wildlife, and so on.
- **Water supply limitations:** Few places now enjoy unlimited water supplies. Water conservation can stretch existing supplies, whether supply is from groundwater or surface water.
- **Avoiding the need for new supply development:** Developing new water supplies is often controversial, and those opposed to supply projects often declare a preference for conservation as an alternative.
- **Utility stewardship and sustainability:** Utilities that conserve water demonstrate leadership in resource management and are working toward a goal of sustainability. The same water resources can sustain enhanced economic activity.
- **Energy savings:** Reducing water production will save energy and reduce greenhouse gas emissions.

- **Improved supply reliability:** Conservation can reduce or postpone drought water use curtailments by essentially increasing supply (i.e., building a drought reserve).
- **Customer benefits:** Customers who conserve water may enjoy lower water bills and possibly lower wastewater and energy bills.
- **Regulatory compliance:** Some state regulatory agencies require water conservation plans and/or implementation progress to qualify for permits, grants, and loans. Some states have set per capita use reduction targets, which implies the need to increase conservation efforts.
- **Public perception:** The public often insists on demonstrating efficient use of existing water supplies before supporting expansion of supplies to meet new water needs.

Considerations to Pursuing Efficient Water Use

Sometimes there are factors that must be carefully weighed before pursuit of aggressive conservation is implemented. Considerations may include the following:

- Reduction of water use requires utilities to modify their demand and revenue forecasts, rates, and/or rate structures.
- Some utilities still are concerned about *demand hardening* – the impact of long-term demand reductions on the ability to reduce demand further in times of droughts or water shortages. Analysis should also consider how reduced demand stretches existing supplies, delaying the need for drought or shortage measures (*curtailment*).
- Some utilities need assistance from specialists in water conservation to provide specific expertise on how to implement conservation programs and properly assess the benefits from such programs. Water utilities are selling the service that water provides to meet customer needs. This is a new focus and perspective for water utilities – to meet customer needs with current revenue levels, rather than just looking at the total number of gallons of water that are sold.
- Many utility billing systems do not support customer sector water use data needs and analysis. Implementing a conservation program may require reprogramming of billing software to support the utility programs.
- In some locations, conservation can threaten the “use it or lose it” doctrine of water law and water rights. Thus, during times when they are water efficient, some senior water rights holders have begun considering the option of selling their excess water to others so as not to “lose” their water rights because of reduced usage.

This manual attempts to give utilities ways to address many of these considerations and to identify potential drawbacks so they can pursue new ways of meeting customers’ needs or improving existing methods.

PLANNING AS PART OF A WATER CONSERVATION PROGRAM

In 2013, AWWA released the G480 standard Water Conservation Program Operation and Management (AWWA 2013). The voluntary G-series standards are intended to help utilities improve their overall operation and services. The guidelines include appropriate practices, procedures, and actions that can help promote effective and efficient utility operations.

The key elements of the standard include:

- **Top-level organizational functions:** Staff, planning, education, ordinances
- **Internal utility actions and requirements:** Metering, rate structure, billing practices, landscape efficiency program, distribution system, and pressure management program
- **External policy requirements:** Codes and standards
- **Wholesale agency requirements:** Regulatory requirements, education, internal utility actions, and requirements

The development of a water conservation plan is a critical element of an effective water conservation program and is a requirement to meet the G480 standard, which is also discussed in chapter 5. The actions and requirements that are included to meet the standard will also be evaluated and considered as part of the planning process. Users of this manual are encouraged to review the G480 standard to ensure that they are developing an effective holistic program to manage water demand in their service area.

Steps to Develop a Water Conservation Plan

To start a water conservation program, a water conservation plan should be developed. In 1998, a group of water efficiency experts participated in the development of USEPA's Water Conservation Planning Guidelines (USEPA 1998). The guidelines included ten basic steps to outline the activities undertaken in a water conservation planning effort. Although the structure of this manual does not strictly align with these ten steps, reviewing them clarifies the scope of efforts that need to be considered in developing a cost-effective program. The ten steps focus on the technical content of a water conservation plan, relying on cost-effectiveness analysis to determine the scope of the conservation program (i.e., the measures selected to be implemented). These steps are covered in chapters 3 and 4 of M52. Preparing the written conservation plan involves getting it adopted, funded, staffed, implemented, and monitored (tracking progress versus conservation goals). These topics are covered in chapters 5, 6, and 7 of M52.

1. Review detailed demand forecast
2. Review existing water system profile and descriptions of planned facilities
3. Evaluate the effectiveness of existing conservation measures
4. Define conservation potential
5. Identify new conservation measures or enhancements to existing conservation measures
6. Determine feasible measures
7. Perform benefit–cost evaluations
8. Select and group conservation measures into alternative scenarios
9. Combine overall estimated savings
10. Optimize demand forecasts

Review detailed demand forecast. A baseline forecast of the water use analyses and the demographic (customer account or population) projections should be created. The impacts of current and selected additional conservation measures can be superimposed on the baseline forecast.

Review existing water system profile and descriptions of planned water supply facilities. As water demands increase, utilities need to maintain information necessary to develop and update a system profile from an inventory of existing resources and conditions. A review of this information is essential for accurately targeting water conservation measures (e.g., reductions in peak-day water use) as appropriate emerging needs.

Evaluate the effectiveness of existing conservation measures. If existing conservation measures are present in the water use analyses, the degree of current and prospective conservation stemming from these measures needs to be quantified. Some of this effect could be naturally occurring if it results from code requirements, for example, in the US Energy Policy Act of 1992, which requires that replacement fixtures and fittings in new construction meet water efficiency standards. Forecasts of the overall water savings from naturally occurring conservation measures is about 5 to 15 percent of total water needs by 2030 (CUWCC 2001).

Define conservation potential. A detailed assessment of indoor and outdoor water use by existing and new customers is essential to determine the conservation potential. A comparison of the water use profile with those in industry studies such as *Residential End Uses of Water, Version 2* (WRF 2016) and *Commercial and Institutional End Uses of Water* (Awwarf 2001) should be made to identify the potential for additional conservation.

Identify water conservation measures. Even though many water conservation measures are transferable among locations, water conservation measures should be tailored on a case-by-case basis to develop the most effective program for local conditions within a given service area.

Numerous water agencies around the world, particularly in arid climates (for example the arid parts of the southwestern United States), have been implementing water conservation programs for well over 20 years. General conservation methods, both as internal utility actions and through customer participation, that can be targeted include both basic and more advanced measures.

Basic measures:

- Public education
- Codes and standards
- Water waste restrictions
- Consumption-based metering and billing
- Water distribution system improvements (leakage reduction)
- Metering water use

More advanced measures:

- Irrigation efficiency improvements
- New-home xeriscaping (low water use landscaping)
- Large landscape irrigation improvements
- Residential home water efficiencies
- Large commercial efficiency projects
- Small commercial efficiency projects
- Municipal publicly owned building indoor and outdoor retrofits
- Replacement of inefficient toilets
- Commercial landscape ordinances
- Industrial and institutional efficiency projects
- A rate structure that promotes conservation, such as seasonal rates or water budgets

Most utilities that have not implemented a conservation program will want to look first at the basic measures. After they have some experience, they can proceed to the more advanced measures.

Determine feasible measures. Not all conservation measures will be practically, politically, or economically feasible for a given utility. For example, drought-tolerant landscaping is not suitable for some climates or some utilities; an inclining block rate structure is not suitable for an unmetered area or where there is strong customer resistance; and capital-intensive reclamation facilities will not provide an economic return in smaller communities. To complete the feasibility analysis, the number of accounts that could and would use each measure and the specific savings over time that would accrue to its implementation must be determined. In addition, the existence of legislative or institutional obstacles to implementation needs to be researched. Estimates of market penetration are based on measure design and experience from similar measures implemented by other water utilities.

More than 100 individual conservation measures could be implemented among the residential, commercial, industrial, irrigation, agricultural, and public authority accounts in large metropolitan areas. The implementation of conservation programs usually includes customer education, sometimes financial assistance (toilet rebates), sometimes financial incentives (conservation rates), and sometimes legislation (plumbing codes for ultra-low-flow [ULF] toilet replacements). Measures can be qualitatively screened to a shortlist of the most promising measures. The shortlisted measures can be evaluated for water savings, benefits, costs, and practicality.

Perform benefit–cost evaluations. If supply is severely limited, the benefits of conservation are virtually priceless: It is a matter of having enough water for essential indoor residential and commercial needs. Under less extreme circumstances, however, it is necessary to conduct a basic benefit–cost analysis that relates the value of water saved to the cost of implementing the program over a useful program life. A frequent basis for valuing conservation programs is through the benefits associated with the delay, downsizing, or averting of new facilities. Some communities engage in modest conservation efforts as part of public-spirited programs that link with ecological and environmental goals for a better world to live in. Benefits are often measured from the consumer’s point of view, usually in terms of less water consumption to pay for and less energy cost for heating water.

Select and group conservation measures. Individual conservation measures should be formulated into one or more comprehensive programs for further review to decide on the best program for implementation. Each program scenario will include that array of justifiable outdoor and indoor measures that meet the payback criteria and will achieve needed and targeted results. The recommended program scenario must also be acceptable to the utility management and governing bodies to be included in long-range demand forecasts. A stakeholder–public process should be used to confirm or guide the selection of the best alternative program scenario of measures.

Combine overall estimated savings. Once an optimal mix of conservation measures has been determined, an overall estimate of program water savings can be developed with a cautious summation that avoids counting estimated water savings from individual measures more than once (e.g., residential toilet leak water savings and toilet replacement). Also, an overall program implementation schedule for the recommended program of measures is necessary to determine the timing of conservation effects on the demand forecasts.

Optimize demand forecasts. The baseline demand forecast should be modified for quantification of demand reductions and graphical comparison of the water forecast with and without conservation. Modification of demand forecasts may be done iteratively or simultaneously with different cost-effective groups of conservation measures that have been formulated into alternative scenarios to meet desired conservation targets.

Alternative program scenarios could include a mandated savings goal, most cost-effective measures, most water savings, and so on. By integrating anticipated conservation, utilities can avoid rate revenue surprises. By integrating demand with the rate forecasters, utilities should recognize that implementing water conservation is successful.

DEVELOP A WORK PLAN

Responsibilities of the Water Conservation Program Manager

To ensure a successful water conservation program, it is important to have a water conservation coordinator who is responsible for planning and implementing the plan. The responsibilities of the water conservation program manager are, initially, to develop the long-range efficiency plan and then organize and direct the various measures that the recommended program comprises. This begins with preparing a work plan that defines the schedule and budget for each task identified to implement the plan. In a small utility, the manager will work part time on water conservation and be responsible for carrying out most tasks. In larger utilities, managers will have the option of assigning other staff to individual tasks while they coordinate the overall program.

Work Plan

Implementation can be a long, slow process, similar to planning, designing, and building capital facilities. A 10-year time period from implementation to actual water savings benefits may often be appropriate. Many conservation measures take about three to four years to become fully operational.

The following guidelines may help utilities with implementation:

- Establish clear lines of communication for staff and management
- Obtain the necessary funding for selected measures
- Decide on appropriate mix of staff and contractors for each measure
- Consider teaming with neighboring utilities to capitalize on economies of scale
- Hire or assign staff to coordinate each measure
- Design the individual measure setup; actively market the programs to potential participants, which may include advertising or individual contacts (for commercial enterprise, for example)
- Involve elected officials in the launching of each measure
- Involve the public in marketing measures
- Publicize the success of each measure
- Evaluate the cost-effectiveness of each measure
- Update the efficiency plan every two to three years

Examples of implementation tasks for specific measures may include:

- Developing a public information and in-school education program
- Setting up and conducting speakers' groups with volunteer or paid presentations about the water efficiency program
- Disseminating information and conducting public education activities
- Supervising retrofit device or fixture distribution

- Offering assistance to large users of the system such as industries, universities, parks, and so forth
- Overseeing the utility water loss control and leak reduction program
- Revising local laws, codes, or ordinances to require the installation of water-saving fixtures
- Developing incentives to encourage efficiency, including appropriate water pricing and rebates
- Liaising and coordinating with programs run by neighboring water supply utilities

Responsibility of Program Participants

In addition to the water conservation program manager, other individuals and groups may be involved in program implementation. These persons or groups and their roles include:

- The water utility manager approves the final efficiency plan and authorizes budget and staffing requests. The manager will also extend formal requests for participation on a water efficiency advisory committee, if desired.
- The water utility board of directors, whose members may be publicly elected, is often supportive of water conservation programs, as such programs are popular with customers and public interest groups. The efficiency program manager should use all possible opportunities for presenting success stories at board meetings to advocate the authorization of additional programs and funding.
- The water efficiency advisory committee. Medium-sized and large utilities often have an advisory committee, the role of which is to review and comment on plans, potential measures, and implementation strategies. The committee can either be internal or a citizen advisory committee.
- Consultants specializing in developing efficiency plans, providing advice on the implementation of measures, and evaluating water savings and cost-effectiveness resulting from completed measures.
- Contractors, who are sometimes hired to conduct programs.
- Public information specialist. Special skills are required to handle the program aspects related to publicity and public education. In the beginning and periodically, this specialist can direct the stakeholder–public process used to help select the plan and periodically update it. The task can be implemented in house or contracted to a public relations company.
- Participants. The program will not succeed without the participation of targeted customers. They should be encouraged, with an offer that is too attractive to decline, to participate in making the changes in order to achieve efficiency. Education, regulations, and incentives such as rebates can all convince customers to participate.

PARTNERSHIP OPPORTUNITIES

One way to prepare and implement a conservation plan is to work with another water utility or city/county department during the planning process. This can reduce plan preparation and implementation costs and make for more effective programs. Opportunities to partner include the following:

- **Integrated resource plans (IRPs)** can be prepared to address future supply and demand imbalances. This is probably the best way to address the role of conservation in utility water resources planning. IRPs often identify stakeholders and potential partners.
- **Wholesale water agencies** may offer an opportunity to partner on planning and implementing water conservation programs. Often the wholesale agency can implement certain elements of the plan more cost-effectively. Preparation of regional educational materials, regional promotions, discount purchases, and purchase of media time are examples of getting the wholesale agency involved. Often funding this approach is a matter of amending one master agreement.
- **Energy, stormwater, solid waste, and wastewater utilities** sometimes have common interests relating to water conservation. Oftentimes, partnerships increase the likelihood of program implementation. Examples of water and energy partnerships abound, such as promoting water-efficient clothes washing machines that save both water and energy. Wastewater agencies may be interested in jointly funded flow reduction programs, such as a toilet rebate program, if it can help them meet discharge requirements or capacity constraints. These partnerships are more likely to help in the area of program implementation, rather than in plan preparation.
- **City/county departments**, such as planning, building, and parks departments, can work with a water utility to achieve common goals, including saving water, energy, and money.

ORGANIZATION OF MANUAL

The manual is organized into seven chapters and four appendixes.

- **Chapter 1 – Introduction:** The first chapter sets the stage for what follows by defining water conservation, listing reasons to conserve water, and stating AWWA's policies and positions on efficient water use.
- **Chapter 2 – Understanding Conservation and Setting Goals:** This chapter describes how to assess the need for conservation and describes in more detail the pros and cons of establishing a program. A process to set conservation program goals, qualitatively and quantitatively, is proposed. Coordination of utility goals with other department and agency goals is described. The goals of leading organizations focused on water conservation are highlighted.
- **Chapter 3 – Analysis of Water Use and Water Savings:** Chapter 3 provides a method to forecast future water needs before additional conservation is considered. Methods to assess and reduce water losses are covered, and a list of customer conservation measures is presented. The reader is referred to various sources for cost and savings data on conservation measures. A screening process can be used to reduce the number of measures to be quantitatively evaluated.
- **Chapter 4 – Evaluation of Benefits and Costs:** This chapter describes how to estimate water savings from conservation measures, benefits, and costs and how to find the ratio of benefits to costs so as to be able to compare cost-effectiveness of alternate conservation programs. Different perspectives on benefit–cost analysis are offered, and an example calculation is provided.
- **Chapter 5 – Creating a Formal Water Conservation Program Plan:** Once future water needs have been assessed, options to conserve water have been analyzed,

and goals set, the recommended plan can be selected and details including schedule and budget can be established.

- **Chapter 6 – Stakeholder Involvement:** It is important to have the support of key stakeholders when developing, implementing, and adopting a plan. This chapter describes how to involve the public in developing and carrying out the program.
- **Chapter 7 – Plan Implementation, Managing Revenue Impacts, and Evaluating Performance:** Failure to adapt to changing circumstances can hinder the success of a conservation program. This chapter provides information on implementation issues, including balancing the need for conservation with utility revenue needs. It also provides details on monitoring and evaluating plans with discussion of review cycles as triggers for when plans should be revisited. Metrics and reference lists are provided for use in evaluating the efficiency of different types of facilities (e.g., gallons per hotel room, gallons per square foot of office space).
- **Appendixes:** Appendix A includes several case studies from water utilities highlighting successful implementation of conservation measures. Appendix B provides a checklist for the AWWA G480 standard for Water Conservation Program Operation and Management. Appendix C provides guidelines unique to conservation for involving both internal stakeholders across the utility (finance, operations, public affairs, and planning/engineering department staff) and externally across the community (business, residents, etc.). Appendix D provides details related to data management (e.g., customer service, operations and finance) necessary to monitoring and evaluating conservation program long-term effectiveness (may also aid during short-term drought emergencies).

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Chapter **2**

Understanding Conservation and Setting Goals

This chapter presents an overview of typical water conservation programs and incentives that water utilities undertake, and how these programs can be designed to achieve goals for multiple purposes as defined by the water utility. The building blocks for designing conservation programs are provided in this chapter: It discusses the overall need for conservation programs, outlines the iterative process of setting qualitative goals, describes the typical incentives that exist for promoting conservation, explores potential advantages and disadvantages, defines the potential benefits of partnerships with other local utilities or public works departments, and gives an overall approach to planning and implementing conservation programs.

Defining the appropriate level of water conservation for a water utility is a complex process. It requires that basic goals be identified that will direct the planning and analysis of conservation options, in order to help choose appropriate strategies that are cost-effective, as discussed in chapter 4, and that will shape the overall long-term efficacy of the conservation programs for the utility. Goals focus the conservation program and shape tracking implementation efforts. The key to success is setting the right goals at the outset in a clear and transparent process. Transforming initial goals into cost-effective water conservation targets is essential, and further refining the targets and goals throughout the implementation phase will result in higher-value conservation benefits in the long run.

TYPICAL CONSERVATION DRIVERS FOR WATER UTILITIES

Water conservation is a necessary component of a successful overall water supply plan. Utilities undertake water conservation programs to (1) reduce water and wastewater demand and capacity utilization and operating expenses, thus achieving significant cost savings; (2) meet regulatory requirements; (3) meet long-term water supply planning

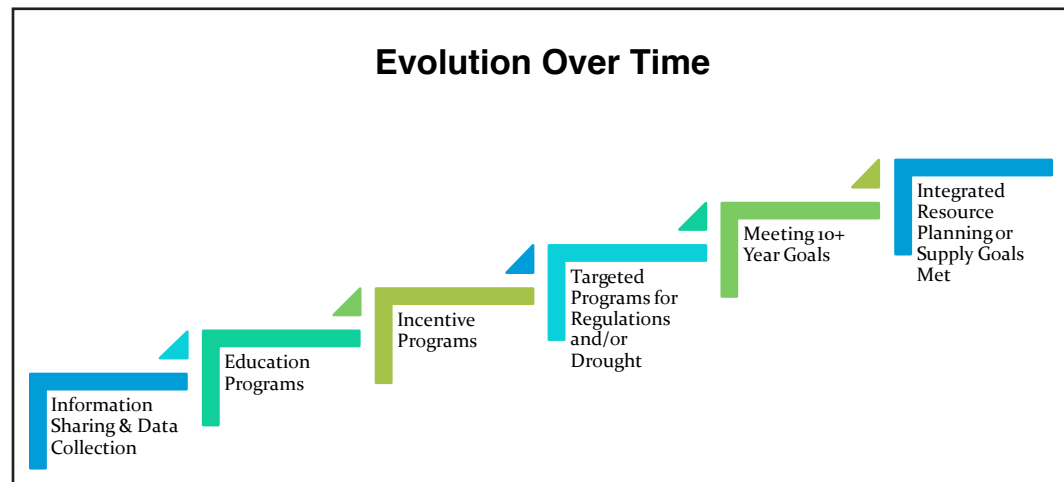


Figure 2-1 The evolution of water efficiency drivers

needs; (4) improve customer service and lower customer costs; (5) reduce greenhouse gases; and (6) address short-term emergencies (or curtailment needs). Efficiency in a system is achieved when demand is decreased to optimize available or planned future water supplies and treatment capacity. When investigated as part of the integrated resources planning (IRP) process, conservation may serve as a complementary partner to water supply planning or as a stand-alone supply (deferral) alternative.

Figure 2-1 shows an evolution of drivers for water conservation over time. As the program matures, more innovative programs are implemented and goals are set, and water conservation becomes a source of new water supply. These concepts are further described in AWWA Manual M50, *Water Resources Planning*. Note that drought emergencies and other short-term shortages are covered in AWWA M60, *Drought Preparedness and Response*. Long-term shortages and the need to plan for them are the overall focus of this manual.

Figure 2-2 shows a new home built without a front lawn, thereby increasing overall household water use efficiency.

In the United States, federal and state agencies encourage conservation through implementation of laws and regulations, codes, and standards; development of guidelines; sponsorship of research; dissemination of information to water utilities; and assistance with program funds through grants or loans. For example, the US Department of Energy oversees the National Plumbing Efficiency Standards, which mandate water efficient plumbing fixtures. In addition, many states require a water conservation plan before a new water right or permit of use is granted or as a condition of financial assistance. Some states mandate per capita water reductions on water utilities and their customers.

Technology has changed in the United States over time. Figure 2-3 shows a very old toilet that is no longer in use.

Long-Term Planning Considerations and Issues

AWWA Manual M50, *Water Resources Planning*, along with many other leading resources on IRP, addresses the complex matrix of long-term planning issues that face a water utility. Certain themes focused on water conservation are repeated in many of these references, for example:

- Rates of increased demand can be slowed by conservation, particularly on a per capita basis, even though demand can increase overall because of population growth.



Figure 2-2 New home built without front lawn

Source: Maddaus Water Management (MWM)



Figure 2-3 Old toilet technology

Source: Maddaus Water Management

- Conservation will reduce both the average and the peak demand.
- Conservation will decrease operation and management (O&M) expense (see chapter 4) as well as capital expenditures.
- The full benefits of conservation can be measured only by including the financial value of deferring capital expenditures.
- In addition to downsizing or avoiding water supply costs, some wastewater capital expenditures can also be deferred. These benefits should also be counted as avoided costs.
- Geographic differences need to be considered in estimating avoided conservation cost.
- Environmental externalities and energy savings must be evaluated.
- Long-term planning goals should be developed in a stakeholder process with utility managers, elected officials, and customers.

These themes should be incorporated into the qualitative goals of a water efficiency program.

GOALS FOR CONSERVATION

The level of conservation needed will be unique to each utility, and assessing that need should be done in a stakeholder involvement process that includes utility personnel, public officials, customers, and regulators and is designed to brainstorm the key reasons to undertake a conservation program. To assist in the brainstorming process, the following section outlines some key questions and some potential advantages and disadvantages for pursuing water conservation alternatives.

Setting Goals

Developing appropriate water demand reduction goals is an essential step to properly designing water conservation programs. Goals provide a yardstick against which to measure progress in reducing consumption, and should be set by local water utilities and their stakeholders at the outset. Goal setting is often primarily based on the need to save water, taking into consideration the regionwide ability to extend available water supplies and prevent capacity shortages in individual utility water systems, as well as to provide important environmental benefits to the watershed as a whole. Goals can be set on the supply side as well as the demand side, and for other general purposes.

On the supply side, answers to the following questions will help to formulate specific goals for individual utilities:

- If the system has a water supply shortage, is it limited to one utility or one portion of the service area, or is it a regionwide shortage?
- Is the supply constrained by a drought emergency or long-term (multiyear) occurrence?
- Is the shortage occurring now or is it projected to occur in the future?
- What is the primary cause of the long-term supply shortage? Possibilities could include high growth in demand, system leaks, withdrawal permit limits, transmission mains or water treatment plant capacity issues, distribution pipeline delivery limitations, or inadequate water supply.
- Is the shortage related to water or wastewater treatment capacity?

- Does the supply or treatment shortage occur during peak demand periods each day, during the high-use seasons of the year only, or does it occur throughout the year?

On the demand side, answers to the following questions will help to set a quantifiable goal to reduce demand:

- What level of water use reduction is needed over what time frame? (Typically a 5–10 percent reduction could be considered small and can usually be achieved within 3–10 years, 10–20 percent is a medium goal that may require 10 or more years, and 20 percent or more is a large reduction or an ambitious goal that should be set over a longer period such as 15 or more years.)
- Is there a per capita water use target that has been set by an outside entity like a regulator that must be met?
- What class of customers will be impacted the most by conservation?
- What categories of water use are growing the fastest?
- Where is the most obvious conservation potential?
- How much can be saved in a cost-effective manner?
- How will the revenue impacts from the reduced sales be defined and integrated?

General overall goals can be expressed in terms of:

- Total water savings at some point in the future, expressed as a percent of total production and/or quantity of water saved
- Benefits realized, such as a major project deferred or avoided and water made available for future growth
- Lowered per capita consumption, to reflect the community's balance with the environment, or to meet regulatory or environmental constraints

Specific goals for conservation measures should be developed. Goals that measure implementation progress in terms of specific activities, such as the number of audits completed in a year, can be useful for monitoring progress. This information is easier to acquire and track and is generally available before water savings can be accurately measured.

Measuring progress against goals is useful to the utility to ensure continued program support and funding; to state and federal regulatory or permitting authorities to show that water is being used efficiently and progress can be ascertained; and to adaptively manage goals, as necessary. Measuring savings is an important part of measuring progress, and chapter 3 of this manual describes methods of evaluating savings on an individual measure basis. Water savings for some measures, such as public information, are not easily quantified because savings may be intertwined with other measure effects, and data to separate the effects is rarely available. Water savings from other measures, such as plumbing fixture retrofits, are available because reliable water savings data has already been published.

Defining Program Benefits and Constraints

By defining the clear benefits to the utility and identifying any potential constraints, the planner can establish a tailored set of *qualitative* goals. This is an important first step. Once established, the utility planner will be better organized when assessing the *quantitative* goals for water savings, as presented in chapter 3. In addition, understanding the benefits

Table 2-1 Overview of Benefits From Water Conservation

Recipient of Benefit	Type of Benefit	Description
Water utility	Supply system operations and maintenance (O&M)	Short-term and long-term O&M costs reduced as a result of lower energy expenses because of reduced pumping and chemical use in water treatment and disposal. (The Electric Power Research Institute estimates that from 4% to 5% of all electricity used in the US is used for pumping water.) For city governments, energy usage for water and wastewater utilities can exceed 60% of total energy expenses.
Water utility	Supply system capital investment	Capital facilities for storage and treatment can be deferred or downsized.
Water utility	System reliability	Less water purchased from wholesale water purveyors and more reliability of supply yield, depending on capacity availability.
Wastewater utility	System O&M	Short-term and long-term O&M costs reduced as a result of lower energy expenses because of reduced hydraulic loading on collection systems, volume pumping, aeration, and chemical use in wastewater treatment.
Wastewater utility	Disposal system capital investment	Capital facilities for land disposal can be deferred or downsized. Additional benefits when wastewater discharge restrictions exist.
Environment	Quality enhancement	Decreased need for dams and reduced construction disturbance in natural waterways.
Environment	Quality enhancement	Higher instream flows for fish and wildlife habitat and lower withdrawals from supply sources.
Environment	Quality enhancement	Lower discharges of treated wastewater to receiving waters.
Environment	Quality enhancement	Reduced pollution because of less construction of capital facilities.
Community	Aesthetic quality	Diminished aesthetic effects on waterways from avoided capital projects.
Community	Environmental justice	Fewer social equity issues with facility concerns.
Community	Economic	Increased economy on the same resource, creation of water conservation jobs, and customer savings in utility bills for both water and energy.
Community	Economic/political	Fiscal savings from avoided or delayed new capital expenditures or bond indebtedness.

Source: Adapted from AWWA M50, *Water Resources Planning*, 2nd ed.

of the conservation program can help refine approaches to implementing measures that are targeted at end uses of water that have the highest probability of gaining desired water savings.

Potential Benefits. The benefits of water conservation apply to utilities of all sizes located throughout the United States and abroad. An overview of general benefits of water conservation programs is summarized in Table 2-1.

Potential Constraints and Perceptions. Relying on conservation measures may also pose some potential constraints for utilities or solicit negative perceptions from stakeholders. Some of these issues are summarized along with potential solutions in Table 2-2.

The process of reviewing both the benefits and constraints will be valuable as the goals become defined and further refined.

Mutual Goals With Other Utilities or Departments

There is great benefit and synergy to working with other local utilities or internal public works departments in putting together a conservation program. A brief summary of each type of organization and their potential interest in water conservation programs follows.

Wastewater utilities: There are two primary benefits to wastewater systems from the reductions of wastewater volumes caused by decreases in indoor water use from more efficient plumbing fixtures and appliances. Most notably, benefits are in the form of (1) reductions in O&M costs (energy, chemicals, land disposal); (2) assistance in meeting waste discharge regulatory requirements that are volume based and, in some limited

Table 2-2 Overview of Potential Constraints and Perceptions

Issue	Perception	Potential Solution
Lack of customer participation/understanding	Customer's view: conservation vs. rationing (sacrifice only needed in times of drought).	Educate customers on their water use and opportunities for everyday cost savings on energy and water bills, such as looking at life-cycle costs of more efficient clothes washers.
Conserving water reduces revenues	Lower water sales results in less revenue for the utility.	Educate customers, utility management, and political leaders on how conservation can reduce system costs. Examine rate structures for possible needed adjustments. Evaluate adjustments needed to raise capital for the investment in the next water supply project. The cost savings from avoided operations and maintenance (O&M) costs and deferred capital facilities are directly accounted for as a benefit to the demand management program (see chapter 4).
Expense of water conservation program	Efficiency programs, particularly rebate incentive programs, are not always cost-effective.	Evaluate demand management measures, as described in chapter 4, for level of cost-effectiveness prior to implementation.
Ineffectiveness in achieving desired water savings	Estimated water savings do not develop.	If water savings do not develop, reevaluate program design (e.g., delivery mechanisms, community attitudes, and recent successes of other utilities) and adjust as needed. Water savings estimates continue to be refined with new information and technologies becoming available. Quantifying water savings with best available information is necessary, as discussed in chapter 5.
Short-term drought savings become more difficult	Conservation measures over the long term reduce the available amount of water savings. Otherwise known as demand hardening, may limit a future drought response in the ability of customers to save water.	Evaluate the role of long-term conservation programs in reducing the negative impacts of both the frequency and severity of drought.
Capital investment up front required to start programs	Water savings accrue over time with avoided costs to the utility, but the investment is required at beginning of the program.	Avoid disjointed investments (\$5 million one year and none the next) and spread the investment out over multiple years. Seek grant or loan funding to assist with subsidizing program costs and evening out the cost outlay to match the cost savings.
Impact on water quality	Water aging due to longer residence times in the distribution system may mean more system flushing to preserve chlorine residual.	Evaluate residence times throughout the system and devise appropriate measure to control pathogen growth. Conservation is not the only cause of water aging. Other causes are (1) slower growth planned for an area so infrastructure is oversized, (2) lower peak day flow due to less landscaping water use, (3) use of recycled water for irrigation rather than potable water, (4) urban development that increases longer transit times between water treatment plant and end uses, and (5) effects of drought that permanently reduce water use in an area where infrastructure has already been installed.
Impact of lower flows on drain lines	Reductions in indoor water use can create insufficient drain line flow, particularly in commercial buildings.	Evaluate if any drain line blockages have been reported in green buildings. Consult the Plumbing Efficiency Research Coalition's Report on this issue (PERC 2016).
Impact of lower flows on wastewater treatment plants	Wastewater treatment operations may need to be managed differently for load.	Evaluate whether reduced flows would cause problematic loading at the wastewater treatment plant. Most load issues can be resolved through careful management. Excessive hydraulic capacities often need to be addressed through a new and expanded facility, a problem that can often be addressed or delayed through conservation.

cases, concentration based (e.g., reductions in oil and grease from limiting household garbage disposal use).

Energy utilities: The benefits from less use of heated water (e.g., water efficient showerheads and clothes washers) directly translate into energy savings for energy utilities. Many energy utilities already co-fund programs with local water utilities to capture these mutual benefits. An example of this co-funding is the Pacific Gas and Electric Company's joint program for high efficiency clothes washer rebates undertaken with its local water utilities (PG&E). But some electricity providers fund programs beyond just saving the heating of hot water. Southern California Edison has funded leak detection and water loss management programs in some of its high energy use water utilities to avoid leaking water that has a high embedded energy cost (SCE).

Stormwater: Reductions in runoff translate into decreases in pollutant loading of nutrients from fertilizers and pesticides through stormwater systems in summer months. Conservation programs that make outdoor landscape watering more efficient will reduce pollutant-laden runoff and provide an environmental benefit to receiving streams. Opportunities for rain catchment systems in some areas may be an option for irrigation with nonpotable supplies.

Solid waste: Overwatering of landscapes produces more green waste that needs to be taken to landfills. The primary benefits of solid waste reduction are seen in decreases in O&M (trucking) costs and landfill space. However, if bioreactors, which convert green waste into energy, are used, reductions in green waste will not be a driving factor for water conservation programs.

Health departments: Principal benefits are found in leakage reduction programs, which lead to repairing leaks that further lowers the risk of contamination into the distribution system. Demand reductions also allow utilities that use multiple sources to optimize and use the sources with the highest water quality first.

Environmental organizations: Other organizations include those focused on environmental quality, such as aquatic ecosystems or wildlife habitat, that seek improvements in water quality or time and place of water withdrawals or the quantity and water quality of wastewater discharges.

Professional nonprofit organizations: Organizations such as the American Water Works Association, Water Environment Federation, and the American Society of Civil Engineers track the status and research needs of the water industry, including efforts to promote water conservation.

Other nonprofit organizations: Numerous nonprofit organizations assist with educating the public on health, environmental, water security, and other concerns. These organizations typically conduct research that may have interest in partnering in demonstration projects with water utilities. Such organizations that have national recognition include the Alliance for Water Efficiency, US Green Building Council, Rocky Mountain Institute, Global Energy Partners, Consortium for Energy Efficiency, and American Council for an Energy-Efficient Economy. Other state or local nonprofit organizations exist, such as the California Water Efficiency Partnership and local watershed groups that may have interest in partnering on water conservation programs. The Water Research Foundation (WRF) has also funded research and publications on water conservation.

Park departments: National, state, and local parks can team with water utilities and/or take on water conservation measures on their own, like installing water efficient fixtures and landscape.

Federal agencies: The US Environmental Protection Agency (USEPA), Office of Water, assists with disseminating information, funding grants, and developing guidelines for water conservation planners, as well as administering the WaterSense product labeling program (www.epa.gov/watersense/). Partnered with the USEPA, the US Department of Energy oversees both regulatory requirements for energy and the Energy Star labeling program (www.energystar.gov), which promotes water efficient plumbing fixtures and

appliances. The US Bureau of Reclamation has an active role, particularly in the western United States, with promotion of water conservation requirements in their contracts, reporting requirements on implementation, and funding assistance. The Federal Energy Management Program (FEMP), US Army Corps of Engineers, and the Department of Housing and Urban Development have interest in demand reductions at military facilities and federally owned housing projects.

ALTERNATIVE APPROACHES TO TARGET SETTING

Should the utility find it advisable to set targets or specific goals on which to gauge whether utilities are performing up to expected levels, the following alternatives could be considered.

- **Sector target approach:** This could take the form of
 - a per capita water use target for residential use
 - a per-account target for nonresidential use
 - a volumetric or Infrastructure Leakage Index (ILI) target for leakage reduction
- **Best practices program approach:** The two options include different methods of agreeing activities and are described as follows:
 - **Option A:** Develop a memorandum of understanding (MOU) comprising a range of activities (best management practices [BMPs] or reasonable conservation measures [RCMs]), through a stakeholder consensus process, similar to the California approach. Penalties for noncompliance would be sufficiently harsh to ensure performance.
 - **Option B:** Mandate, using a regulatory framework, a requirement to develop and implement specific activities (BMPs or RCMs). This would be similar to the current Arizona Non-Per Capita Conservation Program discussed later in this chapter. See sidebar “State of Arizona Municipal Water Use Requirements.”
- **Hybrid approach to target setting:** If targets must be set, a hybrid approach based on the UK leakage targets (Strategic Management Consultants 2012) and the California BMP and MOU consensus model can be considered. The utility would benefit from direct involvement of stakeholders in the process of developing goals, an MOU, and/or BMPs. A hybrid approach could involve the following:
 - **Water efficiency program:** Include milestones involving specified actions and schedules that could be termed water efficiency activities (WEAs) for the residential and business sectors. The reporting should follow the key details of the WEAs (or BMPs) and should include the following:
 - Planned versus actual activities
 - Planned versus actual expenditures
 - Estimated water saved
 - Any variations made (if allowed) to implement the program in a manner that is at least as effective as originally planned. Reasons for variations should be justified.
 - **Leakage reduction program:** Include targets for reduction of leakage. Reporting on leakage and recycling progress will, at least initially, be partly activity based and partly results based. Utilities will need to calculate the true potential in water zones and then assess what is cost-effective to pursue, set a goal, and proceed to achieve this goal.

OVERVIEW OF STATE AND LOCAL WATER CONSERVATION PROGRAMS

There are a variety of local, regional, state, and federal entities interested in water conservation programs proposed and undertaken by local water utilities. In some cases, there are state or regional requirements enacted as laws or regulations that must be followed in the development of a plan and in its implementation. This section discusses federal, state, and local examples.

USEPA Guidelines

The United States Safe Drinking Water Act of 1996 required that the USEPA develop guidelines for water conservation plans to address three categories of public water supply systems serving (1) fewer than 3,300 persons, (2) between 3,300 and 10,000 persons, and (3) more than 10,000 persons. Drinking Water State Revolving Fund programs can require applicants to develop a plan that meets these guidelines as a condition for financial assistance.

These categories are referred to as small, medium-size, and large water utilities. In general, the majority of utilities are very small, serving fewer than 500 persons. In California, for example, the large majority of the state's 2,900 utilities each serve fewer than 500 persons. It has been recommended that all but the very small utilities should have a minimum level of water conservation program. Utilities serving fewer than 500 persons could be exempted from the conservation planning requirement, and small utilities could have reduced requirements. Because of the higher potential for water conservation savings, large utilities should be required to analyze water conservation measures in addition to those in the minimum plan and should submit a formal water conservation plan.

One way that states can handle the utility size issue is to adopt the following guidelines:

- No plan required for utilities serving fewer than 500 persons
- No plan required for systems serving 500 to 3,300 persons unless in an area designated by the state as a "critical water supply area"
- A minimum plan/program for systems serving between 3,300 and 10,000 persons
- A full conservation plan for systems serving more than 10,000 persons

State Requirements

Twenty-eight states have some form of conservation planning or water loss monitoring requirements (the remaining 22 do not as of 2012). California, Arizona, Georgia, Texas, Colorado, Washington, Kansas, and Rhode Island are some examples. In a 2012 study undertaken by the Alliance for Water Efficiency and the Environmental Law Institute (AWE and ELI 2012), all 50 states were evaluated for water conservation requirements that are embedded in laws and regulations (www.allianceforwaterefficiency.org/2012-state-information.aspx). A standard set of 20 questions were asked of every state. The report found that some states have water conservation planning requirements that are tied to the permitting process, other states incorporate planning with funding eligibility as is suggested in the Safe Drinking Water Act, and others require that all public water suppliers submit regularly updated plans.

In another study (Rashid et al. 2010), progress in US water conservation planning and implementation was tracked from 1990 to 2009. It was found that nine states had planning requirements in 1990 and 23 states had requirements by 2009 (Figure 2-4). About 20 other states recommend or encourage conservation. Population growth and water shortages were found to be the main drivers for these 23 states to take a more proactive role in

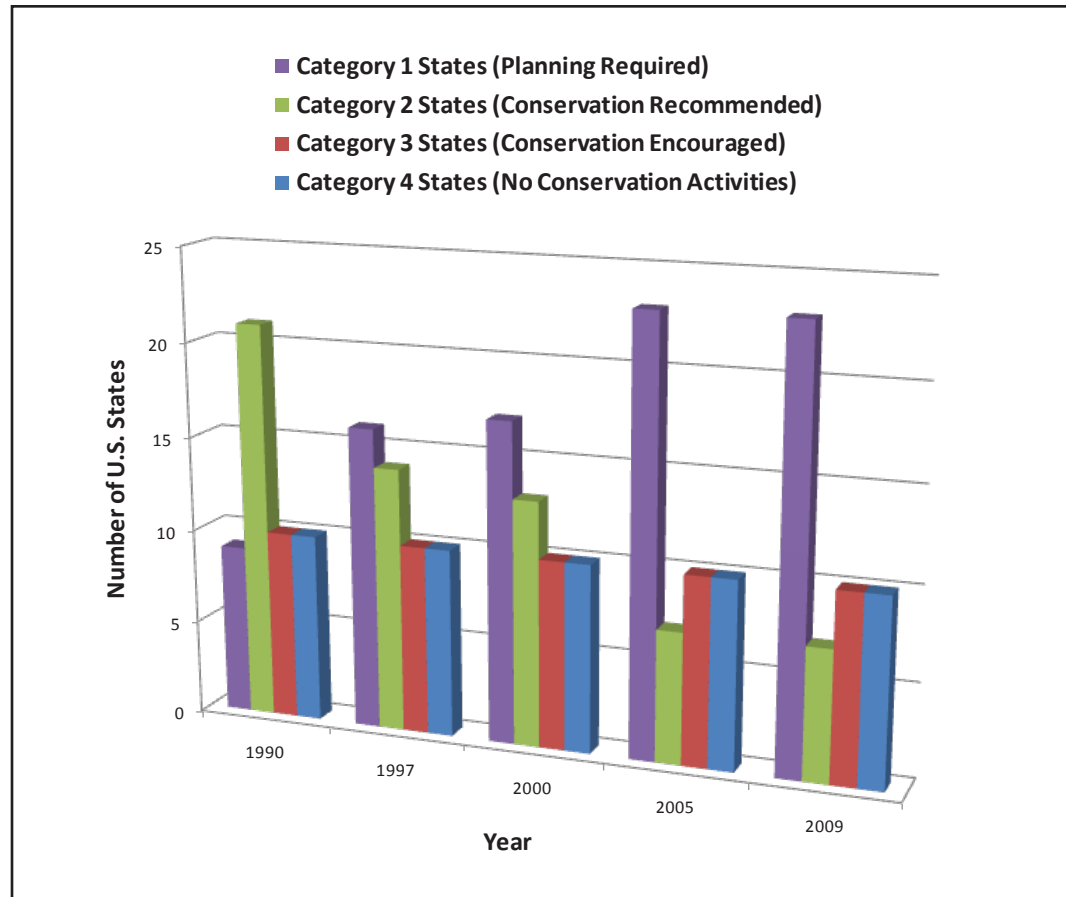


Figure 2-4 Progress of state-level water conservation activities 1990–2009

Source: Rashid et al. 2010

conservation. As these state guidelines and requirements change, it is important for plan preparers to make sure they have the latest standards.

Specific State Examples. The following list contains information on activities that have been undertaken by leading state programs.

- **Arizona:** Water utilities must report their consumption in gallons per capita per day to meet designated targets. See <http://www.azwater.gov/AzDWR/WaterManagement/AMAs/PhoenixAMA/RegulatoryPrograms.htm>. See sidebar “State of Arizona Municipal Water Use Requirements.”
- **California:** (1) California requires five-year urban water management plans (UWMPs) from all water utilities. The law details specific requirements for conservation planning and implementation. See www.water.ca.gov/urbanwatermanagement/. (2) The California Water Efficiency Partnership’s MOU specifies best management practices for conservation program implementation. www.cuwcc.org. See sidebar “California’s Memorandum of Understanding on Urban Water Conservation.” (3) Adopted plumbing standards stricter than those required by the 1992 Federal Energy Policy Act.
- **Colorado:** Adopted plumbing standards stricter than those required by the 1992 Federal Energy Policy Act.

- **Georgia:** (1) The 2010 Georgia Water Stewardship Act requires annual water loss audits of utilities serving 3,000 or more in population. See <http://extension.uga.edu/publications/detail.cfm?number=C995>. (2) Adopted plumbing standards stricter than those required by the 1992 Federal Energy Policy Act.
- **Kansas:** The Kansas Division of Water Resources requires that utilities prepare water conservation plans to qualify for any state revolving loan fund money or due to a number of other criteria. See <http://agriculture.ks.gov/divisions-programs/dwr>.
- **Texas:** (1) Texas Council on Environmental Quality requires water conservation plans for certain water rights permits. See www.tceq.texas.gov/permitting/water_rights/conserv.html. See sidebar “Texas Water Conservation Plans.” (2) Texas Water Development Board (TWDB) requires water loss audits. All retail public water systems with more than 3,300 connections or a financial obligation to TWDB are required to complete and submit a water loss audit annually. All other retail public water suppliers are required to submit a water loss audit to the agency every five years. See www.twdb.texas.gov/conservation/resources/water-loss-resources.asp. (3) Adopted plumbing standards stricter than those required by the 1992 Federal Energy Policy Act.

Utility Examples

In addition to examples provided in chapters, appendix A includes 13 case studies of water conservation programs undertaken by water utilities in the United States and Canada (Table 2-3).

Table 2-3 Case Studies in Appendix A of AWWA Manual M52

Case Study	Geographic Location	Topic	Supports Chapter(s)
1	Phoenix, Ariz.	State of Arizona Municipal Water Use Requirements	2
2	Tampa Bay, Fla.	Long-Term Supply/Demand Management Plan	3 & 4
3	Philadelphia, Pa.	Water Loss and Water Loss Control in Philadelphia, Pennsylvania	3
4	Abbotsford, B.C.	Using Advanced Metering Infrastructure to Enhance Conservation Efforts	3
5	Seattle, Wash.	Saving Water Partnership – Water Smart Technology Program: Industrial, Commercial, and Institutional Program	3
6	Fort Collins, Colo.	Assessments Lead to Customer Action: Sprinkler System Audit Program – Landscape	3
7	Cobb County, Ga.	Cobb County Water System’s Give Them an Inch . . . Grow a Yard Program	3
8	New York, N.Y.	New York City Challenges Hotels to Save Water	3
9	Guelph, Ont.	Graywater Reuse and Rainwater Harvesting Rebate Programs	3
10	Austin, Texas	Mature Conservation Program Shifts Focus From Rebates to Codes Due to Saturation	4
11	Waukesha, Wis.	Comprehensive Municipal Water Conservation Plan for Mid-Size Suburban Community	5
12	Sacramento, Calif.	Engaging Stakeholders in Water Conservation Planning	6
13	Town of Cary, N.C.	Block Leader Program Overview: Environmental Program for Public Education of Water Customers	6

STATE OF ARIZONA MUNICIPAL WATER USE REQUIREMENTS

In the 1970s, the state of Arizona was facing a water crisis. Surface supplies had been fully utilized, and groundwater table levels were falling rapidly because of agricultural and municipal pumping far in excess of the natural recharge rate. Arizona had rights to the Colorado River, shared with California, Utah, Nevada, and Colorado, but the water was hundreds of miles away from the areas in need. The federal government offered to build the canals and pumping stations to bring the water to Phoenix and Tucson, but only if Arizona would agree to reduce groundwater pumping to the safe yield level by 2025. A state law was passed, and it created a new state agency, the Arizona Department of Water Resources (ADWR) (<http://www.azwater.gov/AzDWR/WaterManagement/AMAs/PhoenixAMA/RegulatoryPrograms.htm>), which devised a plan to reduce groundwater pumping in Arizona's three most populous areas. ADWR decided to reduce extraction in stages and created 10-year plans. The first went from 1980 to 1990; the second from 1990 to 2000; and the third from 2000 to 2010. Water use was slowly reduced, on a per capita basis, and groundwater pumping was reduced as areas switched over to the new (and more expensive) surface water.

ADWR regulates municipal water use in one of three ways. Originally, there was only one program, the total gallons per capita per day program. Now, there are two other programs, the alternative program and the non-per capita program. These programs are defined as follows:

- **Total gallons per capita per day (GPCD) program.** For the first management plan, all water providers were assigned a total system GPCD target based on their 1980 water use, future demand projections, and the potential savings from water conservation measures commonly used in the western United States. The targets were modest and ranged from a 6 percent to an 11 percent reduction over a 10-year period. Generally, the higher the current water use, the higher the target. For the second management period (1990–2000), each provider was assigned a GPCD target based on an extensive analysis of the water use in each provider's area and the conservation potential. A similar approach was used in the third period (2000–2010). Providers who did not meet their targets were subject to fines and sanctions. All but five cities in the state were regulated in this way.
- **Alternative conservation program.** This alternative was created to provide flexibility by establishing a limit on groundwater use, a GPCD target for residential water use only, and requirements addressing specific nonresidential uses. Only one small city has signed up for this program.
- **Non-per capita conservation program.** Factors such as rapid commercial and industrial development and changing population characteristics affected the ability of some providers to meet their GPCD targets. In 1992, the state legislature established this alternative to the GPCD regulatory program. This program requires providers to eliminate groundwater pumping, unless replaced by groundwater recharge, and to implement reasonable conservation measures (RCMs). Four medium-size cities are now using this program (Chandler, Gilbert, Scottsdale, and Tempe). Several others are considering switching to this program, because compliance is generally easier.

Currently, the ADWR specifies 12 RCMs and provides four substitute RCMs that can be used in lieu of the original 12 RCMs. These RCMs cover all aspects of municipal water use from residential to nonresidential. Agencies that adopt this program agree to the water supply requirements, to implementation of the RCMs in a specified way, to an implementation schedule, and to detailed annual progress reporting. Progress reporting covers details on implementation, costs, and estimated water saved per reporting period. Cities can opt for this program at any time and enter into a memorandum of understanding with ADWR to carry out the program. ADWR expects most

cities to migrate to the Non-Per Capita Program because of the difficulty of managing total per capita water use. The Non-Per Capita Program is similar to California's use of best management practices (see sidebar "California's Memorandum of Understanding on Urban Water Conservation"), except that compliance is mandatory.

In terms of compliance with management plan requirements, the ADWR can levy civil penalties for use of groundwater beyond the agreed limit. This would be triggered by not meeting the provisions of the selected municipal conservation program, for example, if per capita goals are not met or, depending on the program, agreed-on RCMs were not carried out as specified. The civil penalty can be up to \$10,000 per day. In deciding whether to levy a fine or not, the ADWR considers the seriousness of the violation and the extent of the water provider's attempts at compliance and mitigation.

California's Memorandum of Understanding on Urban Water Conservation

The California Water Efficiency Partnership (CWEP) is the only organization operating on a statewide basis that addresses implementation of utility-based water conservation programs. Central to its mission is a Memorandum of Understanding Regarding Urban Water Conservation in California, which was first signed in 1991 and has since been signed by most large water suppliers within the state. The recitals to the MOU present the essence of the agreement and are summarized as follows:

- Signatories recognize the need to provide reliable water supplies and to protect the environment.
- Increasing demands for urban, agricultural, and environmental water uses call for conservation and the elimination of waste as important elements of the overall management of water resources.
- Many organizations and groups in California have an interest in urban water conservation, and the MOU is intended to gain much-needed consensus on a complex issue.
- The urban water conservation practices included in the MOU (referred to as BMPs) are intended to reduce long-term urban demands below what they would otherwise be and are in addition to programs that may be instituted during occasional water supply shortages.
- It is the intent of the MOU for agencies to pursue cost-effective water conservation in a structured manner and consider water conservation on an equal basis with other water management options.
- The signatories agree to use the MOU as the basis for determining future water needs. This is a major step toward achieving consensus on one major issue related to approving new water supply projects. However, the MOU does not provide agreement on other issues surrounding new supplies.

In the 26 years since the original MOU was signed, it has been amended numerous times. The following chart presents a summary of the current best management practices. In 2007, the California legislature passed a law requiring water agencies in California to certify that they were meeting or planning to meet the goals in the BMPs in order to qualify for state grants or loans. In 2008, the CWEP adopted wholesale changes to the BMPs to encourage more aggressive conservation. These changes included giving credit to agencies that met the specific water savings goals with more creative flexible approaches, and those that achieved overall reduction in per capita water demand beyond the level which the original BMPs would achieve.

Urban Water Conservation Best Management Practices for the
California Water Efficiency Partnership

1. Utility Operations
 - 1.1 Conservation coordinator – Designate a water agency staff member to have the responsibility to manage the water conservation program. Water waste prohibition – Adopt water waste rules or ordinances to prohibit gutter flooding, single-pass cooling systems in new connections, nonrecirculating systems in all new car wash and commercial laundry systems, and nonrecycling decorative water fountains. Wholesale agency assistance program – Provide financial incentives to water agencies and cities to encourage implementation of water conservation program.
 - 1.2 Water loss control – Audit the water distribution system annually using the AWWA water loss methodology and proactively control water loss and leaks.
 - 1.2.1 Metering with commodity rates for all new connections and retrofit of existing connections (install meters in 100% of existing unmetered accounts within 10 years; bill by volume of water use; assess feasibility of installing dedicated landscape meters).
 - 1.2.2 Retail conservation pricing – Eliminate nonconserving pricing policies and adopt pricing structure, such as uniform rates or inclining block rates, incentives to customers to reduce average or peak use, and surcharges to encourage conservation. Meet one of two options for volumetric proportionality.
2. Public Education and Information
 - 2.1 School education program – Provide active school education program to educate students about water conservation and efficient water uses.
 - 2.2 Public information program – Provide active public information program in water agencies to promote and educate customers about water conservation.
3. Residential Programs
 - 3.1 Residential assistance/landscape water survey program for single-family and multifamily residential customers – Survey 15% of residential customers within 10 years.
 - 3.2 High-efficiency washing machine rebate program – Provide cost-effective customer incentives such as rebates to encourage purchase of machines that use 40% less water per load.
 - 3.3 Residential WaterSense toilet replacement program – Replace older toilets for residential customers at a rate equal to that of an ordinance requiring retrofit on resale.
 - 3.4 WaterSense toilets in residential new construction – Maintain an incentive program or require WaterSense high-efficiency toilets (HETs) in all new residential construction projects.
4. Conservation program for commercial, industrial, and institutional accounts – Reduce water use by an amount equal to 10% of the baseline use within 10 years through a number of potential business-specific and general measures.
5. Large landscape conservation program and incentives – Prepare water budgets for 90% of all commercial and industrial accounts with dedicated meters; provide irrigation surveys to 15% of mixed-metered customers.

Source: CUWCC, www.cuwcc.org

The following figure shows a Commercial/Industrial Water Audit workshop where attendees are educated on water conservation methods and taught how to conduct audits at their own facilities.



Figure 2-5 Commercial/industrial water audit workshop

Source: Maddaus Water Management

Texas Water Conservation Plans

Texas Administrative Code (TAC) Title 30, Chapter 288, requires utilities across the state to submit water conservation plans to the Texas Commission on Environmental Quality (TCEQ) and/or the Texas Water Development Board (TWDB) no less than every five years. The information reported in these plans assists state agencies in evaluating water usage trends and conservation strategies, projecting the state's long-term water needs, and developing regional and state water plans. Water conservation plan information also allows TCEQ to determine whether requested appropriations of state water by water rights applicants is reasonable and necessary for the proposed use(s) and whether the applicants will conserve and avoid wasting water. In 2011, the 82nd Texas Legislature passed Senate Bill 181, which improved conservation reporting procedures and established a consistent methodology for reporting water use data in gallons per capita per day (GPCD). Along with the conservation plan, utilities must submit an implementation report evaluating progress toward meeting the goals established in the prior planning period.

Submittal triggers: Under state statute and TCEQ rules, the following are required to submit water conservation plans:

- Applicants for a new municipal, industrial, or irrigation water right or an amendment to an existing water right

- Any existing non-irrigation surface water right greater than 1,000 acre-feet/year.
- Any existing irrigation surface water right greater than 10,000 acre-feet/year.

Additionally, TWDB rules require entities applying for Board financial assistance greater than \$500,000 and entities with 3,300 connections or greater to also submit water conservation plans.

Plan contents: The water conservation plan establishes a strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, and for increasing the recycling and reuse of water. The utility profile is the foundation for water conservation plan development and ensures that important information and data are considered when establishing conservation targets and goals. It contains information about a utility's water and wastewater systems, as well as service-area population, customer type, connection numbers, water use, projected water demand, and water loss. In addition to the utility profile, water conservation plans must contain at minimum:

- Specific, quantified 5- and 10-year targets for water savings to include goals for water loss programs and goals for municipal use and residential use measured in GPCD;
- Information about the accuracy of the metering devices used to account for the amount of water diverted from the source of supply;
- Universal metering;
- A record management system that includes water deliveries, water sales by customer class, and water losses;
- Measures to determine and control unaccounted-for water;
- A public education program;
- A non-promotional water rate structure;
- A reservoir systems operations plan;
- A means of implementation and enforcement such as an ordinance indicating official adoption of the water conservation plan by the provider; and
- Documentation of coordination with the regional water planning group for the supplier's service area.

Utilities with populations of 5,000 persons or more must also have a program for leak detection and repair, and require new and renewed wholesale water supply contracts to include water conservation measures.

If the requirements above are insufficient for a utility to achieve its conservation goals, they may also select any combination of the following strategies:

- Conservation-oriented water rates
- Plumbing codes for efficient fixtures in new facilities and/or retrofit programs for existing facilities
- Reuse/recycling of treated wastewater and/or gray water
- A program for pressure control
- Ordinances for landscape water management
- Incentives for landscape conversion (Figure 2-6)
- A method for monitoring the effectiveness of the water conservation plan
- Any other conservation practice that is appropriate for achieving the goals of the water conservation plan

TCEQ may require implementation of any of these additional strategies if it determines that they are necessary for a utility to achieve its conservation plan goals.

Rhode Island Water Supply Plans and Conservation Requirements

The Water Supply Management Act (Rhode Island General Law 46-15.4 et seq.) was first enacted in July 1991. A subsequent report, Water Supply Analysis for the State of Rhode Island (A.D. Little 1990), predicted that under a moderate supply and demand and system management scenario that sufficient water would be available for all of the state's needs through year 2010. This led to passage of the Water Supply Management Act in 1991 to ensure the demand and system management elements would in fact be implemented. The Act designates the Department of Environmental Management as the responsible authority to see that the provisions of the Act were carried out and to review mandatory water supply system management plans (which include water conservation) that must be filed by all wholesale or retail water utilities serving 50 million gallons or more per year. Regulations implementing the 1991 Act have been updated regularly, most recently in 2011 (<http://sos.ri.gov/documents/archives/regdocs/released/pdf/WRB/6393.pdf>). The regulations include per capita targets for water utilities. Guidelines for preparing the plans are located at www.wrb.state.ri.us/work_programs_wssmp.html.

Utilities are required to review and update the plan every five years. Water suppliers must also report progress on plan implementation every two and a half years. These reports include updates on demand and production data.

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