Water Conservation Programs—A Planning Manual

Second Edition

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Foreword


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

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).

**REFERENCES**


