

Water Conservation Programs— A Planning Manual

AWWA MANUAL M52

First Edition



**American Water Works
Association**

Science and Technology

AWWA unites the entire water community by developing and distributing authoritative scientific and technological knowledge. Through its members, AWWA develops industry standards for products and processes that advance public health and safety. AWWA also provides quality improvement programs for water and wastewater utilities.

MANUAL OF WATER SUPPLY PRACTICES—M52, First Edition

Water Conservation Programs—A Planning Manual

Copyright © 2006 American Water Works Association

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Disclaimer

The authors, contributors, editors, and publisher do not assume responsibility for the validity of the content or any consequences of their use. In no event will AWWA be liable for direct, indirect, special, incidental, or consequential damages arising out of the use of information presented in this book. In particular, AWWA will not be responsible for any costs, including, but not limited to, those incurred as a result of lost revenue. In no event shall AWWA's liability exceed the amount paid for the purchase of this book.

Project Manager and Technical Editor: Melissa Christensen
Production Services and Composition: Claro Systems
Manuals Coordinator: Beth Behner

Library of Congress Cataloging-in-Publication Data

Water Conservation Programs : a planning manual.-- 1st ed.

p. cm. -- (AWWA manual ; M52)

T & E ballot draft dated 5/05.

ISBN 1-58321-391-0

1. Water conservation. I. American Water Works Association. II. Series.

TD491.A49no. M52 2005

[TD388 .W36 2005]

628.1 s--dc22

[333.91'16]

2005054555

Printed in the United States of America
American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

ISBN 1-58321-391-0



Printed on recycled paper

Contents

Figures, v

Tables, vii

Foreword, ix

Acknowledgments, xi

Chapter 1 Introduction 1

What Is Water Conservation?, 1
Why Conserve Water?, 3
Ten Steps to Develop a Water Conservation Plan, 4
Develop a Work Plan, 7
Responsibility of Program Participants, 8
Partnership Opportunities, 9
Organization of Manual, 9
Appendix 1 to Chapter, AWWA Water Conservation White Paper, 11

Chapter 2 Need for Efficiency and Setting Goals 15

Typical Incentives for Water Utilities, 15
Qualitative Need for Conservation, 17
Identify Mutual Goals With Other Utilities or Departments, 18
Overview of Demand Management Approaches to Implement Goals, 22
Alternative Approaches to Target Setting, 35
References, 37

Chapter 3 Analysis of Water Use and Water Savings 39

Evaluate Current Water Use and Project Future Use, 39
Evaluation of Supplier Accountability and Water Loss Control, 46
Identify and Screen Alternate Water Conservation Measures, 52
Prepare List of Potential Conservation Measures, 56
Screening of Conservation Measures, 56
Evaluation of Water Savings, 60
Example of Unit Water Savings Expressed on an End Use Basis, 62
References, 66

Chapter 4 Evaluation of Benefits and Costs 67

Introduction, 67
Overview of Benefit–Cost Analysis Methodology, 68
Typical Benefits and Costs, 70
How to Calculate Water Savings, 71
How to Determine the Benefits of Efficiency Measures, 73
How to Determine the Costs of Conservation Measures, 78
How to Perform a Benefit–Cost Analysis, 79
Other Considerations, 81
Other Perspectives on Benefits and Costs, 81
Calculation Example: Benefit–Cost Case Study for a Residential Survey Measure, 84

Chapter 5 Creating a Formal Water Conservation Program Plan 89

Introduction, 89
Use Benefit–Cost Analysis to Evaluate Packages of Potential Measures, 89
Plan Selection Criteria, 91
Select the Program, 94
Example of a Conservation Plan Report’s Contents, 94
Implementation Considerations, 97
Program Monitoring and Evaluation, 100
Reevaluate Program Cost-Effectiveness, 105
Examples of Successful Programs, 106
References, 107

Chapter 6 Conservation Plan Development and Implementation: Dealing With Perceptions, Barriers, and Obstacles to Effective Water Conservation 109

Introduction, 109
Mitigating Revenue Impacts, 109
Maintaining an Adequate Budget, 113
Involve the Public in Support of the Program, 113
Overcoming Obstacles, 117
Data Needs, 118
Summary of Recommendations, 119
References, 119

Appendix A Case Studies 121

Case Study A—City of Austin: Alternate Water Sources Save Money and
Water, 121
Case Study A—City of Austin (continued): Apartments Cut Water Use by 25%
through Plumbing Retrofits, 122
Case Study A—City of Austin (continued): Volume Purchase Clothes Washer
Program, 123
Case Study A—City of Austin (continued): Water Conservation Cuts Water Use
and More, 124
Case Study B—Landscape and Agricultural Area Measurements and Water Use
Budgets, 128
Case Study C—Water Smart Technology Program: Industrial, Commercial, and
Institutional Water Conservation Case Study, 129
Case Study D—Evaluating Conservation Program Implementation, Tampa Bay
Water, Florida, 132
Case Study E—Block Leader Program Overview, Town of Cary, North
Carolina, 132
Case Study F—Case Study: City of Fort Collins Utilities (FCU), 133
Case Study G—Water Loss Control in Philadelphia, 135
Case Study H—Water Conservation Voucher Incentive Programs, San Diego
County Water Authority, San Diego, California, 141

Index, 143

AWWA Manuals, 149

Figures

- 1-1 AWWA official policy on water use efficiency, 2
- 2-1 Water-saving landscape design—before and after appearance, 31
- 3-1 Analysis of historical single-family residential water use—example of a humid area, Atlanta, Georgia, 43
- 3-2 Analysis of historical single-family residential water use—example of an arid area, Walnut Creek, California, 44
- 3-3 Overview of water projection process, 45
- 3-4 Components of water balance for a transmission system or a distribution system, 47
- 3-5 Water-saving fixture—waterless urinal, 60
- 3-6 Typical water sales breakdown and single-family end uses, 61
- 3-7 Assess market penetration, 62
- 4-1 Benefit–cost analysis methodology, 69
- 4-2 Example of delaying and/or downsizing a capital facility, 75
- 4-3 Estimated water savings for a 10-year versus ongoing residential water survey program. Note that the savings decay at the end of the 5-year measure life, unless the program continues, 85
- 5-1 Example of the relationship between present value of utility costs and water saved in a future year, 92
- 5-2 Example water conservation plan report table of contents, 98
- 5-3 Example of a plan element implementation schedule for first year of implementation, 99
- 5-4 Example of a conservation performance model, 103
- 6-1 Seattle Area Utilities *Saving Water Partnership* sponsored vendor fair for landscape contractors featured efficient weather-based irrigation technologies, 117
- 6-2 Average indoor end uses of water in single-family homes in the United States, 118
- A-1 Retrofit of 45 apartment complexes in Austin, Texas, 123
- A-2 City of Philadelphia—water delivery & nonrevenue water, 136

This page intentionally blank

.....

Tables

2-1	Overview of benefits from water use efficiency, 19
2-2	Overview of potential constraints and perceptions, 20
2-3	Urban water conservation best management practices for the California Urban Water Conservation Council, 28
2-4	Recommended practices (selected), 33
3-1	Describe service area (example), 40
3-2	Example of a detailed water use description, 42
3-3	Example forecast future water demand, 45
3-4	Definition of terms for international standard water audit, 49
3-5	Summary of water-efficient devices, 53
3-6	Example of potential conservation measures, 57
3-7	Example of screening potential conservation measures and results of screening, 59
3-8	Example of end-use water savings and market penetration of conservation measures, 63
3-9	Example results of a conservation-measure savings evaluation, 65
4-1	Water system elements affected by conservation, 76
4-2	Wastewater system elements affected by conservation, 76
4-3	Summary of Direct Cost Calculation Example, 86
4-4	Summary of Utility Benefits Calculation, 87
4-5	Summary of Utility Benefit–Cost Ratio Calculation, 88
5-1	Results of an example alternative packages evaluation, 91
5-2	Example of a rating matrix for comparing alternative conservation plans, 94
5-3	Example of a detailed budget for first two years of implementation (in \$), 99
5-4	New water savings achieved in 2003 (mgd), 102
A-1	End-user and utility savings for various conservation measures, 125

- A-2 Air pollution reduction through water conservation measures, 126
- A-3 City of Philadelphia annual water balance in IWA/AWWA format, 138

.....

Foreword

This publication is the first 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. Also, water suppliers that already have a conservation program can use this information for improvement and gain the benefits of a more comprehensive approach.

The Water Conservation Division (and its working committees) welcomes 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.

This page intentionally blank

Acknowledgments

This first edition of the AWWA Manual M52, *Water Conservation Programs—A Planning Manual*, was approved by the Water Conservation Division. Following are the primary authors:

William O. Maddaus, Maddaus Water Management, Alamo, Calif.
and
Lisa A. Maddaus, Brown and Caldwell, Rancho Cordova, Calif.

The authors acknowledge the significant contribution of the review team chair, Allan Dietemann, who took on the difficult task of consolidating diverse reviewer comments and worked directly with the authors on chapter revisions. The authors carefully considered the reviewer comments. Selected sections were rewritten by the authors to reflect these comments. This manual represents consensus of the Technical and Educational Council, the Water Conservation Division and its committees.

The following were Water Conservation Division members at the time of approval:

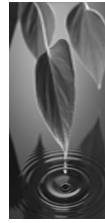
Ane Deister (chair), El Dorado Irrigation District, Calif.
Thomas Babcock, Phoenix Water Services Department, Ariz.
Alice Darilek, New Mexico State Engineering, N.M.
Allan Dietemann, Seattle Public Utilities, Wash.
Lloyd Hathcock, City of North Miami Beach, Fla.
Bill Hoffman, Austin Water Utilities, Texas
Bill Jacoby, San Diego County Water Authority, Calif.
Eva Opitz, CDM, Ill.
Linda Moody, AWWA Staff Secretary, Denver, Colo.
Bill Lauer, AWWA Staff Advisor, Denver, Colo.

The Water Conservation Division wishes to thank the DPOD Water Loss Committee for their review and input and also the following individuals for their thoughtful comments:

Mary Ann Dickinson, Executive Director, California Urban Water Conservation Council, Sacramento, Calif.
Amy L. Vickers, President, Amy Vickers & Associates, Inc., Amherst, Mass.

The authors and workgroup members wish to thank Beth Behner (AWWA manuals coordinator) for her tireless efforts to bring this manual to print. Bill Lauer (AWWA staff advisor) provided assistance during manual preparation.

This page intentionally blank



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.

This manual is an update of these original works. Shown in Figure 1-1 is AWWA’s current policy on water conservation. A more extensive description of the role of water conservation in water resources management is contained in AWWA M50, *Water Resources Planning*. AWWA’s White Paper on conservation can be found at the end of this chapter.

Long-Term Versus Short-Term Conservation

A common public perception is that water conservation means restricting or curtailing customer use as a temporary response to drought. Though water use restrictions are 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. Water conservation, very simply, is doing more with less, not doing without.

Accepted definitions. 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.” The Texas Water Code (Section 11.002) defines water conservation as “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.”

Adopted by the Board of Directors Jan. 27, 1991, revised Jan. 31, 1993, and June 15, 1997, and reaffirmed Jan. 20, 2002.

The American Water Works Association (AWWA) strongly encourages water utilities to adopt policies and procedures that result in the efficient use of water, in their operations and by the public, through a balanced approach combining demand management and phased source development.

To this end, AWWA supports the following water conservation principles and practices:

1. Efficient utilization of sources of supply;
2. Appropriate facility rehabilitation or replacement;
3. Leak detection and repair;
4. Accurate monitoring of consumption and billing based on metered usage;
5. Full cost pricing;
6. Establishment of water-use-efficiency standards for new plumbing fixtures and appliances and the encouragement of conversion of existing high-water-use plumbing fixtures to more efficient designs;
7. Encouragement of the use of efficient irrigation systems and landscape materials;
8. Development and use of educational materials on water conservation;
9. Public information programs promoting efficient practices and water conservation by all customers;
10. Integrated resource planning;
11. Water reuse for appropriate uses; and
12. Continued research on efficient water use practices.

Figure 1-1 AWWA official policy on water use efficiency

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 constituents money in reduced operation cost 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 interior 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, etc.
- Water supply limitations—few places now enjoy unlimited water supplies. Water conservation can stretch existing supplies, whether supply is from groundwater or surface water.
- Utility stewardship and sustainability—utilities that conserve water demonstrate leadership in resource management and are working toward a goal of sustainability. More economic activity can occur on the same water resource.
- Energy savings—reducing water production will save energy and reduce greenhouse gas emissions.
- Improved supply reliability—conservation can reduce the frequency and duration of drought water use curtailments by essentially increasing supply.
- 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.
- Public perception—the public often insists on demonstrating efficient use of existing water supplies before supporting expansion of supplies to meet new water needs.

Are There Any Drawbacks to Pursuing Efficient Water Use?

Sometimes there are factors that must be carefully weighed before deciding to pursue aggressive conservation. Considerations may include the following:

- Reduction of water use often requires utilities to modify their demand and revenue forecasts, rates, and/or rate structures.
- 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. Selling less water seems unconventional.
- Many utility billing systems do not support customer sector water use data needs and analysis.
- In some locations, conservation can threaten the “use it or lose it” doctrine of water law and water rights.

This manual attempts to overcome many of these considerations and potential drawbacks to enable utilities to pursue new ways to meet the needs of customers or to improve existing methods.

TEN STEPS TO DEVELOP A WATER CONSERVATION PLAN ____

To start a water conservation program, a water conservation plan should be developed. The following ten basic steps outline the activities undertaken in a water conservation planning effort to develop a cost-effective plan.*

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

Review 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 as appropriate emerging needs, for example reductions in peak-day water use.

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,

*USEPA Water Conservation Planning Guidelines, EPA-832-D-98-001, August 1998

for example, in the US Energy Policy Act of 1992, which requires that replacement fixtures and fittings in new construction are the water-efficient types. Forecasts of the overall water savings from naturally occurring conservation measures is about 5 to 15 percent of total water needs by 2030 (*Impact of the National Plumbing Efficiency Standards on Water Infrastructure Investments* [California Urban Water Conservation Council, 2001]).

Define conservation potential. A detailed assessment of the indoor and outdoor water use for existing and new customers is essential to determine the conservation potential. A comparison of the water use profile with AwwaRF studies, such as the *Residential End Uses of Water Study* (AwwaRF, 1999) and the *Commercial and Institutional End Uses of Water Study* (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 the arid climates (for example the arid parts of the southwest-US), 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

Basic measures:

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

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 interior and exterior retrofits
- Low-flush toilet replacements
- Commercial landscape ordinances
- Industrial and institutional efficiency projects
- A conservation rate structure using water budgets—consumption benchmarking tool against local standard—versus individual customer

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 ULFT replacements). Measures can be qualitatively screened to a shortlist of the most promising measures. The short-listed measures can be evaluated for water savings, benefits, costs, and practicality.

Perform benefit–cost evaluations. If supply is critical, 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 package conservation measures. Individual conservation measures should be packaged into a comprehensive program for implementation. The package will include that array of justifiable outdoor and indoor measures that meet the payback criteria and will achieve needed and targeted results. This package 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 package 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 ULFT replacement). Also, an overall program implementation schedule for the package of measures is necessary to determine the timing of conservation effects on the demand forecasts.

Optimize demand forecast. 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 packages of conservation measures to meet desired conservation targets. 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

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 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 startups
- Advertise the measures to the target participants
- 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 on the system such as industries, universities, parks, etc.
- 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 the program 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 who 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 planning process. This can reduce plan preparation and implementation costs and make for more effective programs. Opportunities to partner include

- **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. For example, 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, storm water, 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.

ORGANIZATION OF MANUAL

The manual is organized into six chapters and three appendices. The content is briefly described as

- **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 Need for Efficiency and Setting Goals**—This chapter describes how to assess the need for conservation and describes the pros and cons of establishing a program in more detail. 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 costs 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 detailed with schedule, budget, etc.
- **Chapter 6 Dealing With Perceptions, Barriers, and Obstacles to Provide Effective Demand Management—**Involving the public in developing and carrying out the program is covered. The final chapter describes what is necessary to carry out a successful program. Having an adopted conservation plan is important but having the tools to carry it out and overcome obstacles requires a unique set of skills and support of key stakeholders.
- **Appendixes—**References are provided in Appendix A, and case studies of successful implementation of conservation measures are contained in Appendix B. Appendix C is an example drought ordinance.

10 WATER CONSERVATION PROGRAMS—A PLANNING MANUAL

APPENDIX 1 TO CHAPTER 1

AWWA WATER CONSERVATION WHITE PAPER

(www.awwa.org/advocacy/govtaff)

Approved June 28, 1995.

Water conservation can be defined as practices, techniques, and technologies that improve the efficiency of water use. Increased efficiency expands the use of the water resource, freeing up water supplies for other uses, such as population growth, new industry, and environmental conservation.

Water conservation is often equated with temporary restrictions on customer water use. Although water restrictions can be a useful emergency tool for drought management or service disruptions, water conservation programs emphasize lasting day-to-day improvements in water use efficiency.

The Role of Water Conservation

Community water supply management requires balancing the development of adequate water supplies with the needs of the utility's customers. Traditionally, water utilities have focused primarily on developing additional supplies to satisfy increasing demands associated with population growth and economic development. Increasingly, however, water utilities throughout the United States are recognizing that water conservation programs can reduce current and future water demands to the benefit of the customer, the utility, and the environment.

The increasing efforts in water conservation, often called demand-side management, are spurred by a number of factors: growing competition for limited supplies, increasing costs and difficulties in developing new supplies, optimization of existing facilities, delay or reduction of capital investments in capacity expansion, and growing public support for the conservation of limited natural resources and adequate water supplies to preserve environmental integrity.

The focus of any supply strategy is to satisfy customer water needs in the most cost-effective and efficient manner, minimizing any adverse environmental impact and preserving the quality of life. Although conservation is sometimes an alternative to developing additional supplies, it is more often one of several complementary supply strategies for a utility. A conservation strategy, like any supply strategy, is part of a utility's overall planning and part of the integrated resource planning to ensure that all important community objectives and environmental goals are considered.

Water conservation in the broad sense is a key element in the day-to-day management of the modern water utility. Sound management includes the following basic water conservation practices:

- Reduction of water losses through universal metering and accounting of water use, routine meter testing and repair, and distribution system leak detection and repair
- Cost-of-service-based water rates
- Public information and education programs to promote water conservation and to assist residential and commercial customers with conservation practices

Beyond these fundamental conservation practices, effective water conservation programs are tailored to the needs and priorities of each community and recognize local and regional water demand characteristics and water supply availability.

Water Savings and Reliability

Conserved water can be considered a reliable water source. Great strides have been made over the past decade in evaluating and documenting the effectiveness of various conservation programs. Today there is a body of knowledge on water conservation, gained from the experiences of utilities, that provides a relatively high degree of confidence in the reliability and predictability of various water conservation measures. Some water planners feel, however, that the predictability and permanence of conservation measures have not been proven to the same degree as traditional supply measures.

The reliability of conserved water depends on accurate estimates of potential savings, expected benefits, and costs. Careful analysis and planning is a prerequisite to major utility investments in conservation programs. Reliability concerns also underscore the ongoing need for utilities to monitor and document the effectiveness of their conservation programs, just as they do water supplies and facilities.

Long-term conservation programs can affect short-term demand management practices. Reductions in water demands from long-term conservation programs and reductions from short-term demand management measures can overlap. Customers who have installed retrofit devices under long-term conservation programs may have less ability or willingness to further conserve.

In the event of water shortages, agencies with broad-based water conservation programs are able to mitigate short-term and long-term effects better than those without a conservation program.

Financial Aspects of Conservation

Conservation programs typically involve up-front costs, including revenue losses. The full benefits of conservation are realized only after all savings have materialized. However, reduced water sales because of conservation often develop slowly in small increments that can be accommodated in periodic rate adjustments.

Over the long-term, conservation can decrease a utility's need for new capital facilities for supply acquisition, treatment, storage, pumping, and distribution. It may also reduce the costs of operating those facilities. Deferring investment in such facilities or reducing their size can provide significant cost savings. In areas experiencing population growth, conservation can provide additional capacity to accommodate growth, resulting in a larger customer base over which to spread future capital costs. Water rates may be lower with conservation than without.

Water conservation can affect wastewater collection and treatment systems. Reduced hydraulic loadings can improve treatment performance in terms of effluent quality and reduced operating costs. Reducing wastewater flows through conservation can result in cost savings by deferring the need to enlarge wastewater treatment facilities.

Rates. The first goal of any rate structure is to generate sufficient revenues to maintain efficient and reliable utility operations, and the second is fairness in the allocation of utility service costs. Generally, it is possible to satisfy both of these goals in a rate structure that encourages water conservation or penalizes excessive water use.

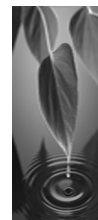
Conservation-oriented water rate structures by themselves do not constitute an effective water conservation program. Rate structures work best as a conservation

tool when coupled with a sustained customer education program. Customer education is important to establish and maintain the link between customer behaviors and their water bill. Utility customers require practical information about water-conserving practices and technologies. Participation in other water conservation programs, such as plumbing-fixture retrofit and replacement programs, can also be enhanced by rate incentives and customer education. Finally, public acceptance of rate structure changes is often enhanced if customers understand the need for and benefits of water conservation.

This page intentionally blank



Documents
Document Sharing Hub



Chapter 2

Need for Efficiency and Setting Goals

This chapter presents an overview of incentives for conservation, discusses the overall need for conservation, outlines the iterative process of setting goals, explores potential advantages and disadvantages, defines the potential benefits of partnerships with other types of local utilities or public works departments, and gives an overall approach to demand management programs.

Given that the focus of this manual is exclusive to defining the appropriate, cost-effective level of water use efficiency for a water utility, basic goals that will direct the analysis of cost-effectiveness, as discussed in chapter 4, should be established. General descriptions of the issues that demand management measures may help to solve are the first step. Some of these issues that commonly serve as incentives for an efficiency program are discussed in the following section. Clarity in transforming these fundamental goals into cost-effective water conservation targets is essential; and the targets will be further refined through the planning process. Goals focus the program and allow for tracking implementation efforts, which is the key to demand management program success.

TYPICAL INCENTIVES FOR WATER UTILITIES

Water use efficiency is a necessary component of a successful overall water supply plan. Efficiency is achieved when demand is decreased to optimize available or planned future water supplies. When investigated as part of the integrated resources planning (IRP) process, efficiency may serve as a complementary parallel partner to water supply planning or as a stand-alone supply (deferral) alternative. These concepts are further described in the AWWA M50 *Water Resources Planning* and the AWWA White Paper on integrated resources planning (www.awwa.org/advocacy/govtaff).

The principal reasons for undertaking efficiency programs are to reduce demand and extend water supplies, reduce long-term customer cost, or to address utility

emergencies. However, drought emergencies have led to the start of overall long-term water conservation programs in numerous communities. Long-term shortages are the overall focus of this manual with short-term shortages discussed in various other AWWA publications, such as the AWWA *Drought Management Handbook*.

The primary incentives for efficiency are (1) cost savings on water and wastewater capacity and operating expenses; (2) regulatory requirements; (3) long-term water supply planning needs; (4) customer service; and (5) short-term emergencies (or curtailment needs).

Regulatory Requirements

Increasing pressure from local, state, and federal regulatory authorities is leading utilities to establish water efficiency programs. This trend is expected to continue as more new water sources grow more scarce and concerns escalate over water quality, environmental issues, aquatic habitat of endangered species, etc. In some cases, regulatory agencies are mandating water use efficiency programs before authorizing the development of new water sources or the construction of capital facilities.

In the US, 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.

Long-Term Planning Considerations and Issues

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

- Rates of increased demand can be slowed by conservation, even though demand often increases because of demographic influences.
- Conservation will reduce both the average and the peak demand.
- Conservation will decrease operation and management (O&M) (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 are provided as a customer service from a political basis with elected officials and directors.

These themes will serve as a foundation for the qualitative goals of a water efficiency program.

QUALITATIVE NEED FOR CONSERVATION

The qualitative need for conservation will be individual to each utility. This need should be guided by a stakeholder (utility personnel, public officials, customers, regulators) involvement process to brainstorm the key reasons to undertake an efficiency program. To assist in the brainstorming process, the following section outlines some key questions and some potential advantages and disadvantages for pursuing water efficiency alternatives.

Setting Goals

Water demand reduction goals are essential to water conservation programs. Goals provide a yardstick against which to measure progress in reducing consumption and should be set by local water utilities, based on meeting the targets established. Goal setting should also be based on the need to save water, taking into consideration the region-wide need to extend available water supplies and prevent capacity shortages in individual utility water systems, as well as to provide important environmental benefits. On the supply side, answers to the following questions will help 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 region-wide 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.
- Does the supply 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 enable a quantifiable goal to reduce demand to be set:

- What level of water use reduction is needed? (Typically a 5–10 percent reduction could be considered small, 10–20 percent medium, 20 percent or more is a large reduction or an ambitious goal.)
- What type of users will be impacted the most?
- What categories of use are growing the fastest?
- Where is the conservation potential?
- How much can be saved in a cost-effective manner?
- How are the revenue impacts 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; and

- benefits realized, such as a major project deferred or avoided and water made available for future growth.

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

Measurement of 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 modify goals, if necessary. Water savings for some measures, such as public information, are not easily quantified. Water savings from measures such as plumbing fixture retrofits are easier to quantify, because reliable water savings data have been published. Water savings are best approached on an individual measure basis, as described further in chapter 3.

Defining Program Advantages and Disadvantages

By defining the overriding benefits to the utility and identifying any potential disadvantages, the planner will establish a tailored set of qualitative goals. 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 of the demand management program assists with identifying approaches to implementing measures that are targeted at end uses of water that have the highest probability of gaining desired water savings.

Potential Advantages

The benefits of water efficiency apply to utilities of all sizes located throughout the US and abroad. An overview of general benefits to water efficiency programs is summarized in Table 2-1.

Potential Constraints and Perceptions

Relying on demand management measures may also have some potential constraints for utilities or have negative perceptions from stakeholders. Some of these issues are summarized along with potential solutions in Table 2-2.

The process of reviewing both the advantages and disadvantages will be beneficial, as the goals become defined and further refined.

IDENTIFY MUTUAL GOALS WITH OTHER UTILITIES OR DEPARTMENTS

There is synergy available through working with other local utilities or internal public works departments. A brief summary of each type of organization and their potential interest in water efficiency programs follows.

Wastewater: There are two primary benefits to 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, and in some limited cases, concentration based (e.g., reductions in oil and grease from limiting household garbage disposal use).

Table 2-1 Overview of benefits from water use efficiency

Recipient of Benefit	Type of Benefit	Description
Water Utility	Supply System 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 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 in-stream 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.
Community	Economic/Political	Fiscal savings from avoided or delayed new capital expenditures or bond indebtedness.

Adapted from: AWWA M50, *Water Resources Planning Manual*.

Energy utilities: The benefits from less heated water use (e.g., water efficient showerheads and clothes washers) directly translate into energy savings for energy utilities. Many energy utilities cofund programs with local water utilities to capture these mutual benefits.

Stormwater: Reductions in runoff translate into decreases in pollutant loading of nutrients from fertilizers and pesticides through stormwater systems in summer

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).	Marketing and customer education 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.	Adjustments in rate structure may be necessary. Similarly, adjustments would be needed to raise capital for the investment in the next water supply project. The cost savings from avoided O&M costs and deferred capital facilities are directly accounted for as a benefit to the demand management program, see chapter 4.
Expense of demand management program	Efficiency programs, particularly rebate incentive programs, are not always cost-effective.	As described in chapter 4, evaluate demand management measures 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, recent successes of other utilities) and adjust as needed (see below). 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 <i>demand hardening</i> may limit a future drought response in ability of customers to save water.	Long-term conservation programs result in reducing 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 (\$5mil one year and none the next) and even 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. Consider establishing a rate structure that includes a "sustainability fund," "reliability fund," or "surcharge for excessive peak summer use," which creates reserve funds to assist with funding the demand management program. These reserve funds are similar to the fees assessed to pay for new water supply projects. See case study for city of Albuquerque (Appendix B).

Table continued next page.

Table 2-2 Overview of potential constraints and perceptions—*continued*

Issue	Perception	Potential Solution
Reduction in indoor water use creates insufficient sewer flows	Public works staff concerned that retrofitting older homes with newer water-efficient toilets, showerheads, etc., will increase sewer system maintenance	A huge benefit has not been mentioned—that of deferring the capital costs for plant expansion. For example, the City of San Jose’s primary reason for originally implementing a water conservation program was to reduce the wastewater flows to their regional wastewater facility. It may be instructive to note that while most wastewater treatment plants exceed their ability to treat the organic loading, oftentimes this problem can be addressed by simply adding to the existing facility. However, 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.

months. Opportunities for rain catchments systems in some areas may be an option for irrigation with nonpotable supplies.

Solid waste: Similar to stormwater benefits, overwatering of landscapes produces more green waste to be taken to landfills. The primary benefits are seen in reductions in O&M (trucking) costs and landfill space. However, if bioreactors, which convert green waste into energy, are used, reductions in green waste are not beneficial.

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. Additionally, water supply reliability benefits exist for water systems overseen by the local or state health departments. Demand reductions allow utilities that use multiple sources to optimize and use the sources with the highest water quality. Additionally, programs using both surface and groundwater sources to meet demands may adjust to accommodate improvements in in-stream water quality, which further enhances the ability to treat higher quality water by downstream users.

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 and/or the quantity and water quality of wastewater discharges.

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

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 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, for example, local watershed groups that may have interest in partnering on water use efficiency programs. The California Urban Water Conservation Council funds research, provides

program guidance publications, and tracks water conservation implementation by water utility member programs. The American Water Works Association Research Foundation (AwwaRF) has also funded research and publications on water conservation.

Federal agencies: The US Environmental Protection Agency (USEPA), Office of Water, assists with disseminating information, funding grants, and developing guidelines for water conservation planners. Partnered with the USEPA, the US Department of Energy oversees both regulatory requirements and the Energy Star program (www.energystar.gov), which promote water-efficient plumbing fixtures and appliances. The US Bureau of Reclamation has an active role, particularly in the western US with promotion of water conservation requirements in their contracts, reporting requirements on implementation, and funding assistance. Also Federal Energy Management Program (FEMP), US Army Corps of Engineers, and the Department of Housing and Urban Development have interest in demand reductions on military facilities and federally owned housing projects.

OVERVIEW OF DEMAND MANAGEMENT APPROACHES TO IMPLEMENT GOALS

In a large region, sometimes defined by watershed boundaries, there will be a variety of regional, state, and federal agencies, and other groups interested in the demand-reduction programs that will want to verify that the plan finally adopted is being carried out.

As a matter of foresight when planning a water use efficiency program, this section lays out options on how the demand management portion of the plan can be verified. This section does not imply that plan performance should be verified or implementation should be regulated, only that plan implementation may be verified. To that end, this section reviews how other areas have addressed this issue and what they have learned from their experiences. At the end of this section, options are offered on how plan implementation could best be verified.

Summary of Approaches

There are three major demand management approaches to consider in reviewing options for evaluating program implementation progress. About half of the states have some form of conservation requirements. Programs in the states of Texas, Kansas, California, Arizona, and Rhode Island, in addition to a program in the United Kingdom, are good examples and are described below:

- Environment Agency and the Office of Water Services (OFWAT) (UK)
<http://www.environment-agency.gov.uk/subjects/waterres/286587/?version=1>
- State of Arizona http://www.water.az.gov/Water_Use_it_Wisely.htm
- California Urban Water Conservation Council's Memorandum of Understanding (MOU) Regarding Urban Water Conservation
<http://www.cuwcc.org/home.html>
- State of Texas, on Environmental Quality (TCEQ) Commission
<http://www.tceq.state.tx.us/permitting/waterperm/wrpa/conserve.html>
- State of Kansas Water Office <http://www.kwo.org/>
- State of Rhode Island Department of Environmental Management
<http://www.rules.state.ri.us/rules/wrappers/767.html>

Although there is probably no system that can be directly imported into a region or specific utility, the listed programs have implemented approaches that have considerable merit in the context for which they were designed. Although none are recommended, the best features are worth considering in the development of a possible hybrid approach, should that be desired by local utilities. A discussion of the approaches adopted by these organizations is provided in the following section. Web sites listed provide access to considerably more detail on what follows. Readers are encouraged to review that material carefully and weigh the options fully, rather than form opinions based on the summary provided below.

United Kingdom Leakage Targets

United Kingdom (UK) water regulators have successfully used leakage targets to require water companies to take action to reduce leakage. Historical leakage rates in the UK were high, averaging 36 percent of water produced. This meant that more water was being withdrawn from rivers than necessary, and customers were charged for the lost water. In many cases, water loss could only be roughly estimated, as the majority of residential properties were unmetered. The regulatory agency, the Office of Water Services, required the water companies to provide auditable data on the level of leakage in 1992–1993. In 1997, following the 1995 drought, OFWAT set leakage targets based on the principles of reducing leakage to a defined economic level. This approach was based on cost-effectiveness and the desire to reduce diversion of surface water from UK rivers, which had regularly experienced drought conditions. OFWAT also encouraged the installation of residential meters. Demand management programs for customers were also encouraged, although not mandated.

By 2002–2003, leakages had fallen by 29 percent, to a level closer to 23 percent, from their peak in 1994–1995¹. Most companies have adopted the following policies in reducing their levels of leakage:

- Comprehensive district metering where District Metering Areas (DMAs) are sized at 2,000–3,000 properties with data downloaded for analysis either weekly or monthly, with consequent prioritization of detection activity by zone
- Repairs carried out quickly (typically 2–3 days) following detection
- Maximizing opportunities for pressure reduction
- Localized replacement of mains with high-burst frequencies
- The use of leakage modeling software to optimize policies

Failure to meet leakage targets carried the threat of a water company losing its operating license, which proved highly successful in focusing water companies on leakage management.

A decrease in leakage of 35 percent in six years represents an almost unqualified success. Because water companies are required to submit water balance component data to both OFWAT and more recently the Environment Agency, the reductions in leakage can for the most part be substantiated and verified.

OFWAT has not allowed funding through customer pricing mechanisms on the basis that it is in the company's interests to reduce leakage to their economic level (ELL). Water companies are now stating that if they are required to reduce leakage below their ELL, they will require additional funding for this at a regulated price setting.

The keys to success have been

- the drought of 1995 placing leakage in the media and political spotlight;
- political pressure at the highest level to address the issue;
- the water industry publishing its detailed series of reports, *Managing Leakage*², referencing p. 41 in 1994, which placed the UK at the forefront of understanding the issues on a global basis;
- reporting of water balance data in the public domain;
- a strong regulatory framework resulting in a high level of scrutiny (and pressure) from the economic and environmental regulators;
- water companies responding by making the necessary resources and expertise available.

The principal benefits of leakage reduction have been the deferment of new resources to meet predicted imbalances in supply and demand. This has benefited the customer through reduced prices and an improved water environment.

Other benefits have been reported:

- Water companies, by regularly monitoring in some cases thousands of DMAs, have a better understanding of the systems they manage.
- Water companies have developed expertise in leakage management that has allowed them to bid successfully for contracts worldwide.
- The UK is at the forefront of technological development in leakage hardware and software as water companies have been receptive to more efficient approaches to achieve their leakage targets.
- In the drought of 1995, when companies appealed to their customers to reduce demand, because of their high leakage levels, they lacked credibility. This is no longer the case.

In summary, the water companies and the regulator worked together to identify the ELL of leakage specific to local conditions and established targets for improvement. The International Water Association's (IWA), *Performance Indicators for Water Supply Services*³, presented methods that evolved from the UK process, and the current practice described therein can be used to identify current leakage levels and manage reductions.

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), 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 ADWR is currently implementing

the “Third Management Plan,” which will be in effect until 2010⁴. Water use is slowly being reduced, on a per capita basis, and groundwater pumping is being reduced as areas switch 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 US. The targets were modest and ranged from a 6 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 is being used in the third period (2000–2010). Providers who do not meet their targets are subject to fines and sanctions. All but five cities in the state are 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 impacted 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-sized 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 and to implement the RCMs in a specified way, agree to an implementation schedule, and agree 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 the following section), 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

California built massive water transfer projects in the period from 1930 to 1970. Water is imported, in some cases hundreds of miles, to accommodate the needs of growing cities in the San Francisco Bay Area and Southern California. In the 1960s, it became apparent that more projects would be needed to maintain water supply reliability. By this time, however, the environmental damage caused by existing projects was becoming evident. Laws were passed to require that environmental impacts of projects be mitigated and endangered species be protected. At the same time, "water wars" erupted with northern versus southern urban water suppliers, and both versus agricultural water users (who consume 85 percent of all water used in the state). All urban and agricultural water users opposed the views of environmental groups. The stated water needs of all groups far exceeded the supply, and no progress was made to increase supply or reduce demand. In the 1970s and 1980s, the level of trust among stakeholders was at an all time low.

In 1987, the state of California water regulatory agency, the State Water Resources Control Board, announced that they had found a solution. All that was needed was for cities to conserve and recycle more water, and the problem would be easily solved. Water agencies were very outspoken in their initial criticism of what appeared to them to be an oversimplified and unreasonable solution. However, reasonable minds prevailed and a group of the larger agencies from the north and the south decided to work together to find a solution. Environmental groups were invited to join the negotiations. This was an unprecedented step, because the agencies did not trust each other and especially did not trust the environmental groups, because the groups and agencies had no history of working together. At the time, California was two years into a drought and shortages were evident.

For the next two years, a dedicated group of 15 individuals spent many hours in numerous meetings, negotiating an agreement. A "Memorandum of Understanding regarding Urban Water Conservation in California" (MOU) was developed⁵. 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 "Best Management Practices" or 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.
- The signatories recognize that other forums will decide the issue of how the conserved water should be used and that there are other methods to meet urban water supply reliability and protect the environment.

The MOU was completed in 1991 and signed by more than 120 urban water agencies, environmental groups, and civic, business, and industrial interests in a ceremony on the State Capitol building steps. Interestingly, none of the original signatories of the MOU were state or federal agencies. This was a true breakthrough, in that water utility organizations committed themselves to implementing 16 BMPs.

In the 10 years since the original MOU was signed, it has been amended seven times. The most significant change was collapsing or dropping four BMPs and adding two. In addition to BMPs, a list of about 10 potential BMPs has been maintained. These are possibly good ways to save water but further research is needed to clarify their effectiveness. Two BMPs were added to this list, and four were dropped that proved ineffective or had already been implemented. Thus, the MOU is a living document and not a rigid, inflexible document that locks a water agency into a program that may turn out to be ineffective. Table 2-3 presents a summary of the current best management practices.

Additional features of the MOU:

- An agency is not obligated to implement a program that is not cost-effective. At any time they may request a cost-effectiveness exemption, where they are given the opportunity to prove to their peers that local circumstances show that a particular BMP is either too costly or would not save enough water to justify its pursuit.
- The MOU gives credit for past accomplishments.
- The MOU is supported by periodic research, and savings estimates are changed when new findings become available.
- There are a number of subcommittees working on refining and optimizing how a particular BMP should be implemented, and changes to BMPs are made when a better way of implementing the BMP is agreed on.

This MOU began as a voluntary process and some utilities were more diligent in implementing its provisions than others. Periodic audits over the years showed that overall performance was less than desired, because the incentives were not sufficient for some utilities to make major investments in conservation. Consequently, two important changes have been made:

1. A BMP reporting process has been established. Water utilities now fill out forms in an interactive database on the Internet that shows clearly how much progress is being made on implementing the BMP. Reporting is done every two to four years (depending on the size of the agency—larger utilities report more frequently) and includes details on the implementation schedule, expenditure, and in some limited cases, estimated water

Table 2-3 Urban water conservation best management practices for the California Urban Water Conservation Council⁴

1. **Water survey program for single-family and multifamily residential customers** (Survey 15% of residential customers within 10 years)
2. **Residential plumbing retrofit** (Retrofit 75% of residential housing constructed prior to 1992 with low-flow showerheads, toilet displacement devices, toilet flappers and aerators)
3. **System water audits, leak detection, and repair** (Audit the water distribution system regularly and repair any identified leaks)
4. **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)
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)
6. **High-efficiency washing machine rebate program** (Provide cost-effective customer incentives, such as rebates, to encourage purchase of these machines that use 40% less water per load)
7. **Public information program** (Provide active public information program in water agencies to promote and educate customers about water conservation)
8. **School education program** (Provide active school education program to educate students about water conservation and efficient water uses)
9. **Conservation program for commercial, industrial, and institutional accounts** (Provide a water survey of 10% of these customers within 10 years and identify retrofitting options; reduce water use by an amount equal to 10% of the baseline use within 10 years)
10. **Wholesale agency assistance program** (Provide financial incentives to water agencies and cities to encourage implementation of water conservation program)
11. **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)
12. **Conservation coordinator** (Designate a water agency staff member to have the responsibility to manage the water conservation program)
13. **Water waste prohibition** (Adopt water waste 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)
14. **Residential ultra-low-flush toilet replacement program** (Replace older toilets for residential customers at a rate equal to that of an ordinance requiring retrofit on resale)

savings (based on calculations defined in the MOU). BMP reporting is publicly available after forms are completed. It is planned to use this database to estimate water savings to-date from BMP implementation on an agency and statewide basis (www.cuwcc.org has the latest findings).

2. A process to certify water agency compliance with the terms of the MOU is being set up. Utilities will have their reported performance audited and their status made public. If an agency does not perform, it will be subject to the following penalties or sanctions:

- Adverse publicity on performance;
- No water use efficiency grants;
- Lack of support from signatories (particularly environmental groups) for proposed water supply projects; and
- Civil penalties.

The California Urban Water Conservation Council administers the MOU. The Council responds to the needs of over 320 more signatories and works on implementation issues. They have a small staff of approximately five persons. Funding for their base operations (staff) comes from dues paid by the signatory members. Research projects and special projects, such as setting up the BMP reporting process over the Internet, were funded by in-kind contributions of utilities that provided staff as well as state and federal grants. The function of the California Council, the MOU, and other documents and research reports, may be viewed at www.cuwcc.org.

One interesting comparison is that the Arizona and California conservation measure implementation systems appear to be converging toward the same approach. Arizona started with a mandatory per capita program, found it was problematical, and is moving toward a mandatory RCM or BMP process. California started with a voluntary BMP process, found that the incentives were not sufficient to ensure implementation in most cases, and is moving to a nearly mandatory BMP process. Compliance is based on a schedule of activity levels, not on water use or water savings.

Texas Water Conservation and Drought Contingency Plans

An entity applying for a new water right or an amendment to an existing water right must prepare and implement a water conservation/drought contingency plan and must submit that plan with the water right application. To be accepted, the plan must meet all minimum requirements contained in Texas Environmental Quality Commission (TCEQ) rule Title 30 Texas Administrative Code (TAC), Chapter 288.

The TCEQ is required to determine whether requested appropriations of state water are reasonable and necessary for the proposed use(s) and that water right applicants will conserve and avoid wasting water. This determination is made through reviewing the applicant's water conservation plan and is considered in the decision to approve or deny a water right application.

Senate Bill 1 (SB1), passed by the Texas Legislature in 1997, increased the number of entities required to submit water conservation and drought contingency plans. Under SB1, in addition to water rights applicants, the following entities were also required to develop, implement, and submit water conservation plans that meet the requirements:

- All municipal, industrial/mining, and other water right holders of 1,000 acre-feet of water per year or more, and
- All irrigation water right holders of 10,000 acre-feet of water per year or more.

- In addition, all wholesale and retail public water suppliers and irrigation districts were required to develop drought contingency plans.

The regulations are based on state legislation passed in 1985. TCEQ and the Texas Water Development Board (TWDB) are both involved in conservation. The TCEQ requires water supply permits and a water conservation plan. They issue the regulations that are used by them and by the TWDB. The TWDB gives financial assistance, and one of the conditions is a water conservation plan, if the grant/loan is more than \$500,000. The original regulations of 1986 were modified in 1993. In June 1997, a new water resources bill was passed, SB 1.

Submittal triggers. All utilities are required to submit long range, regional plans. The requirements are fewer for utilities that serve less than a population of 5,000 people. Submittal to the TCEQ with very specific BMPs for all water using sectors is required for a new water supply permit or to the TWDB for a grant/loan of more than \$500,000. SB 1 will require water conservation plans for water suppliers using more than 1,000 acre-feet per year.

Utilities serving fewer than 5,000 people are required to submit a minimum plan. Utilities serving more are required to set water conservation goals, do a more thorough analysis of their situation, and evaluate additional water conservation measures.

Plan contents. Plan content is as follows:

Historical/projected water use. As a part of the plan, a worksheet is required to be submitted. The data includes annual water use, by customer class, for the current year and the last five years. Monthly total system water use and per capita use data (residential and municipal) is to be submitted. Water projections over the planning horizon for the utility are also to be submitted.

Recommended conservation measures. The minimum required conservation measures for systems of all sizes:

- Universal metering
- Measures to determine and control unaccounted-for water
- A public education program
- A water rate structure that is not *promotional*
- A drought management plan
- A reservoir systems operation plan
- A means of implementation and enforcement such as an ordinance indicating official adoption of the water conservation plan by the provider

Water conservation plans for utilities of more than 5,000 persons are required to have additional elements including

- a leak detection program;
- a record management system that includes water deliveries, water sales by customer class, water losses;
- a requirement that all water wholesaled will be covered by a water conservation plan by the customer

Additional conservation strategies shall be selected by the utility, if necessary, to meet the goals of the plan. The TCEQ may require these strategies to achieve the goals of the plan:

- Conservation-oriented water rates
- Plumbing codes for new facilities
- Water conservation retrofit programs
- Reuse/recycling of treated wastewater
- A program for pressure control
- Ordinances for landscape water management (Figures 2-1a & b)
- A method to monitor the effectiveness of the water conservation plan

A benefit–cost analysis or alternatives analysis is not required as a part of the plan.



.a Before



.b After

Figure 2-1 (a & b) Water-saving landscape design—before and after appearance

State of Kansas Water Office Guidelines

A unique feature of these guidelines is that certain measures are required to be evaluated in the conservation plan. The guidelines include a table that lists 25 water use efficiency practices and specifies whether they are optimal, recommended, or highly recommended. Recommendations depend on utility size (small, medium, or large) and per capita consumption (low, medium, or high). Per capita use figures for all utilities are published, and those that have a per capita use 25 percent above the regional average are expected to have a more aggressive conservation program. A submitted plan must be approved.

The original guidelines went into effect in 1986. After some experience with this version, a new version was issued in November 1990, which is still in use.

Submittal requirements. Under laws passed in 1986, certain water users are required to prepare water conservation plans, including (1) applicants to appropriate water after January 1, 1989; (2) applicants for a contract for the sale of water from state-owned conservation water supply storage (water marketing program); (3) members of a water assurance district (stakeholders below key reservoirs); and (4) applicants for a water transfer. Additionally, water users with high unaccounted-for water, or close to their supply limit, are asked to voluntarily prepare a plan.

The submittal requirements do not vary with utility size, but the recommended measures do.

Plan contents. Regarding historical/projected water use, no data is required to be submitted as a part of the plan, but annual water use reporting is required.

Recommended conservation measures. Kansas has a unique way of encouraging adoption of selected long-term water conservation measures. An excerpt from the state's *recommended practices* table in the guidelines is shown in Table 2-4. Twenty-five practices are covered in the table, two of which are listed in Table 2-4.

The measures to be evaluated are

1. Education

- Water bills that show consumption in gallons and the cost
- Water bills that show current and previous year's use
- Water conservation tips
- Water conservation articles/issues
- School education program
- Water-conserving landscape information
- Lawn-watering requirements
- Other

2. Management

- Source meters
- Source meter testing/replacement
- Residential meters
- Customer meter testing/replacement

- Monthly/bimonthly meter reading
- Coordinate meter readings
- Leak detection and repair if unaccounted-for water is greater than 20 percent
- Pressure regulation
- Water sales based on amount of water used
- Nonpromotional water rate structure
- Water-conserving landscapes for new development
- Irrigation management
- Industrial wastewater recycling
- Other

3. Regulation

- New and replacement toilets that use less than 3.5 gallons per flush, low-flow showerheads
- Adopt landscape water conservation ordinance
- Other

The low, medium, and high per capita water use in Table 2-4 refers to published data in the state. If a utility's water use is more than 25 percent above the regional average, it is defined as high, otherwise it is low or medium. The state publishes *Kansas Municipalities Water Use* periodically, the most recent is dated 1994. This publication ranks all the municipalities in each of eight regions in the state by GPCD so it is easy to see if the utility is in the top 25 percent.

The plan is to be developed using locally derived criteria; a benefit-cost or alternatives analysis is not mentioned or required. The plan includes a drought/emergency element.

Table 2-4 Recommended practices (selected)

Water Use Efficiency Practices	Small Utilities with Low or Medium GPCD*	Small Utilities with High GPCD	Medium Utilities with Low or Medium GPCD	Medium Utilities with High GPCD	Large Utilities with Low or Medium GPCD	Large Utilities with High GPCD
Meters on Residential Services	Optional	Highly Recommended	Recommended	Highly Recommended	Recommended	Highly Recommended
Water Sales based on the amount of water used	Recommended	Highly Recommended	Recommended	Highly Recommended	Highly Recommended	Highly Recommended

*GPCD = total system gallons per capita per day

Rhode Island Water Supply Plans and Conservation Requirements

The Water Supply Management Act (Rhode Island General Law 46-15.4 et seq.) was enacted in July 1991. Passage of the Act has its roots in the USEPA's veto of construction of the Big River Reservoir, a keystone element of the state's water supply plan proposed by the Rhode Island Water Resources Board. A subsequent report, *Water Supply Analysis for the State of Rhode Island*, October 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. In 1992, the Department of Environmental Management implemented Regulation DEM-DWSM-01-92 setting forth the Rules and Regulations for the Water Supply Management Act. The regulations have been updated several times, including October 2002. The latest version is on their Web site.

Submittal requirements. Utilities providing water on a wholesale or retail basis in amounts of 50 million gallons of water or more per year must submit plans.

Plan contents. Plans are required to contain:

1. Detailed System Description
 - Source of supply, treatment and transmission, interconnections with other suppliers
 - Service area, number of services, population served
 - Historic water production
2. Supply/Demand Analysis
 - Forecast of demand consistent with land use plans
 - Forecast of demand considering demand management measures (including state building code requirements)
 - Available water supply (safe yield of surface reservoirs based on a critical dry period having not more than a 5 percent probability of occurrence plus 90 percent of maximum pumping rate for groundwater sources plus water purchased by contract from other suppliers)
 - Comparison of supply vs. demand (existing, 5 years out, and 20 years out)
 - If average daily demand is greater than available supply, identification of measures to improve water use efficiency and, if necessary, the timing and quantity of additional supplies/facilities
3. Supply Management
 - Description of known or potential contamination sources and measures to be undertaken to protect supply
 - Identification of available alternatives and, if necessary, additional sources of supply

4. Demand Management

- Establishment of residential retrofit program that makes water-saving plumbing equipment required by the Act available (includes annual notification of availability, at cost or at no direct cost, low flow faucet aerators, showerheads, toilet tank displacement equipment and includes making available installation of same at cost or at no direct cost)
- Establishment of a program that provides technical assistance to major users (customers using greater than 3 million gallons of water per year are required to be targeted for assistance, and the guidance document states facility audits shall be provided to these customers)
- Education and information

5. System Management

- Universal metering of all customers
- Meter installation, maintenance, and repair with remote reading or automatic reading systems to be installed and operational by July 1, 1996
- Comprehensive and periodic leak detection and repair (must do immediately if unaccounted-for water use greater than 15 percent)
- Preventive maintenance plan

6. Financial Management

- Use of appropriate fees and rates (declining block rates are found by the act “to be no longer conducive to sound water supply management”)

7. Emergency Management (major items)

- Identification of known and potential natural and human caused risks and effect of same on each component of the water supply system
- Identification of demands on the system, including major users and priority users, and evaluation of the level of service to be sustained during each emergency situation
- Specification of water supply emergency responses, which become progressively more stringent depending on the severity of the emergency

Plan updating. Utilities are required to review and update the plan every five years. Water suppliers must also report progress on plan implementation every 2.5 years. These reports include updates on demand and production data.

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 an 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.

- Hybrid approach to target setting

If targets must be set, a hybrid approach based on the UK Leakage targets 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 an at-least-as effective manner 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 partially activity based, partially 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.

REFERENCES

1. "Security of Supply, Leakage, and Water Efficiency 2002–3 Report," Office of Water Services, UK–Environment Agency, 2003.
2. WRC (Water Research Centre), 1994. Managing Leakage, Reports A-J. Engineering and Operations Committee, WRC, Sindon, London.
3. Algre, H., et al., 2000. *Manual of Best Practice: Performance Indicators for Water Supply Services*. IWA Publishing, London.
4. Arizona Department of Water Resources "Third Management Plan for Phoenix Active Management Area, 2000–2010," Phoenix, AZ, December 1999.
5. California Urban Water Conservation Council, "Memorandum of Understanding Regarding Urban Water Conservation in California," Sacramento, CA, December 2002.