BEFORE THE WELL RUNS DRY -- A WORKSHOP ON HOW TO DESIGN A LOCAL WATER CONSERVATION PLAN

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based on material prepared
in cooperation with the
Missouri River Basin Commission and
the New England River Basins Commission

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ILLUSTRATIONS

Introduction

During the summer of 1981 the U.S. Geological Survey, the Missouri River Basin Commission, and the New England River Basins Commission cooperated in presenting a series of workshops on water conservation. This workbook and accompaning exercise is designed for use in a one-day workshop presenting water conservation options. The options for expanding sources of water supply are not addressed in this exercise.

The workshop is structured around a lecture and group exercise. The lecture is illustrated with slides, and follows the material explained in the text "Before the Well Runs Dry - a handbook for designing a local water conservation plan." The group exercise is designed as an oversized game board with playing cards describing the various water conservation techniques and their impacts.

A sample agenda for the program is as follows:

8:30am Registration and Coffee

9:00am Welcome and Introduction
Program Overview
Introduction of Case Study Community

9:30am	Case Study Exercise -Step One Problem Identification
10:00am	A Seven-Step Procedure for Designing A Local Water Conservation Plan - An Illustrated Lecture (Part I)
10:45am	Case Study Exercise (continued) - Steps Two - Four, Assessing Supply and Demand
12:00	Lunch
1:00pm	Part II of the Illustrated Lecture and Continuation of the Case Study Exercise - Steps Five-Seven, Minimizing Adverse Impacts
2:30pm	Review of the Water Conservation Plan
3:30pm	Wrap-Up and Evaluation
4:00pm	Adjourn

A sample lecture is included in the Appendix

LECTURE NOTES: PRESENTATION OF THE SEVEN-STEP PROCEDURE FOR DESIGNING A LOCAL WATER CONSERVATION PLAN

Water Conservation Lecture Notes

The planning procedure is designed to help you to:

- consider the full range of options
- evaluate the advantages and disadvantages of various options
- assess the potential impacts of each option on your utility, the users and the community

The first step is to analyze the problem and establish a conservation goal. There are three aspects of this first step:

1. Evaluating whether the community has an average demand problem or peak demand problem;
2. Establishing the percent reduction needed; and
3. Deciding whether the problem is long-term or short-term.

The next step requires an analysis of whether your goals can best be met at the supply end--making improvements in the water supply system, or in the demand or consumption side of the system, or a combination of both.

The third step calls for you to analyze the cost effectiveness and impacts of various management options.

On the supply side, analyze 5 management programs:

- Metering and meter maintenance
- Leak detection and repair
- Pressure reduction
- Watershed management
- Evaporation suppression

If you choose to work on the demand side, the third step in the approach calls for analyzing the impacts of one of three tools to reduce water consumption:

- Price - an economic incentive, encouraging users to conserve to save money
- Regulation - a legal incentive which requires users to conserve to comply with the law
- Education - a voluntary incentive which seeks to change behavior or attitude through information and explanation

You may choose to mix price, regulation, and education to develop a successful program. Experience has shown that education plays a crucial role in raising the effectiveness of the other incentives, especially in a crisis situation.

It is important to explain the situation to consumers, describe the action being taken or proposed, and explain what consumers should do and why these actions are necessary.

In Step 4, consider ways to avoid or minimize any adverse impacts evident in the supply and demand management programs you are reviewing.

In Step 5, choose and design the specific supply and/or demand management programs you will use.

For demand management programs, this includes choosing new water rates, water use restrictions, or educational materials.

In Step 6, choose devices -- the actual hardware or techniques -- that physically reduce water use.

For supply management, the hardware/techniques include the five (5) programs already mentioned. For demand management, they include:

- water saving fixtures
- reuse/recycle systems
- user habit changes

Supply devices can be used alone, or in conjunction with a demand program.

In the final step, combine the results of your various analyses and decisions in the form of an implementable water conservation plan.

THE SEVEN STEP APPROACH IN DETAIL

STEP (1),IDENTIFY PROBLEM/ESTABLISH A CONSERVATION GOAL

This is the key to the planning procedure because all decisions are based on whether the various alternatives under consideration can meet the goal.

The goal is defined by 3 factors or needs:

1. peak and/or average use has to be reduced
2. high or low percentage reduction in use is needed, and
3. short or long-term time span

Peak use refers to the summer average daily use caused by outside uses. Average use refers to the annual average use.

When stating percentage reductions, 1-10% is considered a low percentage reduction, and over 10% is considered high.

A short-term time span is approximately one year or less, while long-term is a year or more.

STEP (2), CHOOSE A SUPPLY AND DEMAND MANAGEMENT PROGRAM

This step is conceptually straightforward. Yet it requires considerable analysis and planning.

The goal of supply management is to improve efficiency and reduce waste within the production and delivery system. It is often the best long-term option because conservation goals are met without depending on water users. While this is standard operating procedure for a well-run utility, sometimes a water supply problem can be solved through better management alone.

Supply management is best used for long-term, low percent reduction goals. It may be useful for short-term goals if your system has not been adequately maintained over the years. It may also be useful for peak use reduction if the problem is caused by inadequate storage or pipe capacity.

The advantages of supply management are:

- the program is under your direct control
- revenues can increase
- slack is maintained in system

The disadvantages include:

- large capital expenditures are usually required
- the options are labor intensive
- a long lead time is needed

Your analysis may require much time or little time, depending upon past studies and experience. Supply management yields long-term improvements in the system. Costs are high, though the "crisis mentality" created during a period of water shortages may help to build a potential constituency in favor of long-term changes, even if they prove costly.

If supply management is not adequate to achieve the conservation goal established in Step 1, then consider demand management. Demand, or consumption, management requires water users to modify their behavior and reduce consumption in a home or business setting. It has the potential to achieve any conservation goal.

In general the advantages include:

- Versatility
- Low expense (potential)
- Less labor intensive
- More rapid implementation

The disadvantages include:

- Revenues may drop
- Results dependent on users' cooperation
- Political support required
- Opposition or resistance from users

STEP (3), ANALYZE THE COST EFFECTIVENESS AND THE IMPACTS OF VARIOUS SUPPLY AND DEMAND MANAGEMENT OPTIONS

For supply management, there are five (5) programs:

- Metering and meter maintenance
- Leak detection and repair
- Pressure reduction
- Watershed management, and
- Evaporation suppression

This type of supply side analysis is not unique to water conservation. Many of you do this as a matter of good management practices. What is unique, however, is a recognition of how to use improved supply management as a way to meet water conservation goals.

Metering

Metering itself does not reduce water consumption. It provides an accurate accounting of all the water used throughout the system. This information is needed for planning leak detection and repair programs, pricing programs, and other conservation efforts. If the utility decides to install new meters for all its users, and in conjunction, implements an appropriate water rate, a long-term reduction in water consumption can be realized.

Leak Detection and Repair (LD&R)

LD&R can substantially reduce water waste within the system. LD&R also includes an analysis of unaccounted-for water.

Some categories of unaccounted-for water include abandoned services, inaccurately metered water, illegal hook-ups, and defective hydrants.

There are two basic methods for conducting surveys: if your system is losing water primarily through leaks, a system scan would be most effective; if your system is losing water through illegal hook-ups, or meter under-registration (e.g., unaccounted-for water), a water audit would be most effective.

Leak detection and repair programs are almost always cost-effective. They are best for long-term, low percent reduction goals. If the system has not been well maintained, leak detection might achieve a high percentage reduction goal if used as a conservation technique.

Pressure Reduction

Consider pressure reduction if there are a significant number of areas where pressure is high (80 lb/sq in. or greater).

Pressure-reducing valves installed in street mains or individual services can reduce waste simply by reducing the amount of water passing through the system. Pressure reduction is used for meeting long-term, low percentage reduction, average use goals.

Watershed Management

Watershed management is used primarily to protect or increase water flows to the supply and to protect ground water sources. Techniques include: (1) forestry management (thinning forests in the watershed); (2) zoning ordinances to prohibit inappropriate land uses within the recharge area; (3) purchasing surrounding watershed land to maintain it under your control; and (4) sub-division regulations which allow development to proceed in a manner which does not harm the watershed. Watershed management is most useful for meeting long-term, low percentage reduction, average use goals.

Evaporation Suppression (reservoir covers)

Evaporation suppression is only useful when evaporation is responsible for significant water loss (greater than 10%). It is used in more arid places.

The impact analysis for each supply management program entails a review and analysis of the following impacts:

- Financial and economic
- Technical and environmental, and
- Legal and institutional.

Figure 3.2 in Section Three details a set of impacts that may occur as a result of undertaking the different supply management programs.

Use the list of impacts as a guide, and concentrate only on those that are relevant to your setting.

For demand management programs, analyze the cost effectiveness and the impacts of various demand management options.

In demand (consumption) management programs, you have a choice of three tools to encourage users to reduce their use:

- Pricing
- Regulation, and
- Education

In many cases, you will combine the three tools.

All three programs can be relatively inexpensive to implement.

Pricing - If a pricing program is carefully designed, it can generate excess revenues while it encourages use reductions. Therefore, it should be considered as part of many conservation programs.

Pricing is best used for long-term, low percent reduction goals.

The costs of a pricing program are mostly one time costs. These costs will be for a rate survey, or cost of service study, possibly costs to institute a new billing system, and, if regulated, costs for an attorney or someone to present your new rate before the public utilities commission.

The major disadvantage to pricing is user opposition, especially from industry, local government, and the public utility commission.

Regulation - This program can be used to achieve any conservation goal. It is most effective for short-term, high and low percentage reduction goals and long-term, low percentage reduction, average or peak goals. Regulation can be quickly implemented and can achieve immediate results.

Costs to implement regulation are limited to costs of enforcement. If you do not have the authority and/or manpower for enforcement, you may have to secure the assistance of the police department or the local government.

The major disadvantages to using regulation are that revenues will decrease as consumption drops and some users may oppose limitations on how they can use their water.

Education - Education programs can help any conservation program because education is generally well received by the public and can reduce user opposition to other programs. It is effective for any goal, except long-term, high percentage reduction goals.

The major disadvantages to education are that revenues may decrease as consumption decreases, and results are less reliable than other programs because of its voluntary nature.

Impacts

The types of impacts for demand management programs include:

- What a change in revenues, up or down, will mean to the utility or company;
- How a change in water rates might affect high volume users, including potential impact on employment;
- What the effect of reduced water use, such as reduced wastewater treatment costs, postponing new source development, potential damage to landscaping, and increasing the potential for adding new connections, will have on the utility or company;
- How the public will react to the conservation program, and to the perceived equity of the program;
- What it will cost to implement the program; and
- How laws, regulations, or ordinances create or limit options.

Figures 3.4 - 3.7 in Section Three detail most of the impacts of demand management programs.

STEP (4), IDENTIFY ACTIONS TO MODIFY ADVERSE IMPACTS

In Step 3 you identified the impacts of various supply and demand management approaches. In Step 4 you identify actions which can minimize the adverse impacts associated with each program, and then choose the best program.

Figures 4.1 and 4.2 in Section Three list potential actions you could take to minimize these adverse impacts.

STEP (5), CHOOSE SPECIFIC SUPPLY AND/OR DEMAND MANAGEMENT PROGRAMS

Step (5) is the place to begin detailing the specific elements of a conservation program.

Once you have analyzed the cost-effectiveness, impacts, and modifications of the impacts of supply management programs, you'll be able to select programs most effective for your community. Review each supply management program again to be sure that it has the potential to achieve the conservation goal you have established. After this review, proceed with Step 6 - Evaluate and Select Hardware/Techniques for the supply management programs' specific equipment or plan. This step is much more involved for demand management.

After you've completed the analyses in Steps 3 and 4, choose the programs that are the most cost effective and have most beneficial impacts. Step 5 is the place to begin detailing the specific elements of a conservation program. On the demand side, this includes:

<u>Pricing</u>: establishing a new water rate

<u>Regulation</u>: choosing water use restrictions

<u>Education</u>: choosing education tools/devices/campaign materials

<u>Pricing</u> - There are two aspects of a pricing policy: the price level (price per unit) and price structure (price level variations based on time, quantity and/or type of use).

Price level is more important because only when the price level is high enough -- regardless of structure -- will users consider how they are using water and conserve.

There are six basic steps for designing a new water rate.

A. Determine the goal for percent reduction; for example, 5% or 10%.

B. Estimate the decrease in water use by consumers in response to price increases. This change is termed "price elasticity of demand."

C. Determine the percent change of price necessary to achieve your goal.

D. Calculate the new total revenue, as a result of the new price.

E. Compare the new total revenues to your annual costs (remember, variable costs will drop as water use drops).

- if revenues too high, may need a lower price
- if revenues too low, may need a higher price
- a price structure can change your revenues up or down

F. Select a price structure - price structures are used to modify price levels so that the total water rate (level and structure) can achieve one or more of the following:

- cover the true cost of supplying water
- be equitable to all users

- be easily understood and accepted by consumers
- discourage waste of water and subsidization of consumption of one user group by another
- be politically acceptable.

Twenty common price structures are listed in Figure 5.2 in Section Three. They are grouped by their ability to meet peak or average conservation goals. Like the other charts, use it as a resource to pick a structure that meets your goal.

When using pricing there are several guidelines to keep in mind:

- responses to a price hike generally diminish as users become accustomed to them;
- pricing is most effective in reducing peak use among residential users and average use among large volume users;
- in the Great Plains, the price of water has been traditionally low and responsiveness to price hikes is generally low, especially among residential users;
- changing a water rate often requires a long lead time;
- only propose a water conservation price hike once -- or community opposition may develop.

Regulation - Choose a regulation program from the following methods:

- restricting a specific water use
- restricting the time/season during which a specific use is allowed
- requiring permits for some water users
- restricting the quantity of water which can be used
- requiring appliances and equipment which use a smaller amount of water

Various regulations have different potentials for meeting conservation goals. Figure 5.4 in Section Three summarizes these potentials.

Keep in mind that some regulations may be prohibited in your community. In other cases, regulations may require enforcement you are not able to provide, e.g., limiting a new specific use. Finally, some regulations, such as rationing or plumbing code changes, may not be effective because of user or political opposition.

Practical experience has yielded several recommendations:

- reserve stringent regulations, such as rationing and use bans, to high percentage reduction, short-term goals, and to periods of extreme emergency, such as extended drought.
- use less stringent regulations, such as plumbing code changes and limits on specific uses, for long-term, low percentage goals.
- most regulations that limit outdoor uses are easy to implement and can achieve water use reductions immediately.
- all regulations require some level of enforcement -- make sure enforcement staff is available.

Education - Education can stand on its own, or augment price and regulation programs.

The number of educational tools are many -- it is important to match the right educational tools and techniques to your community setting.

Each available tool is bound by two factors:

- type of community
- budget resources

Figure 5.5 in Section Three presents a partial list of educational methods used to encourage water use reduction. Some are better suited to small communities than large; some are more expensive than others.

When developing educational programs, work with communications professionals. The assistance of a local newspaper editor or public relations practitioner can help yield a better, more focused program.

Past experience has provided some education-related recommendations:

- Educational programs should help users to understand why conservation is needed and should provide specific recommendations on how to conserve.
- Education is most effective during a water crisis when user awareness is high.
- Keep conservation messages short and simple.
- Provide detailed data on how to reduce consumption after getting people's attention.

- Mix the media. Use visuals to strengthen claims or message. People remember pictures better than words.
- Reach as many consumers as possible with as many techniques as possible, budget allowing.
- Users need constant reminders of the need to conserve.
- School programs are sometimes successful when children teach their parents/siblings water-saving habits.

All three of the demand side strategies, pricing, regulation, and education, require the utility to forecast the impact of the selected program on the amount of water conserved. This is particularly difficult for pricing strategy. As indicated before, the response of water consumers to a change in price is measured by the "price elasticity of demand."

Predicting Response to Pricing

Price elasticity of demand is defined as follows:

$$\text{Elasticity Value} = \frac{\text{\% change in water use}}{\text{\% change in price}}$$

The Elasticity Value is the way that economists measure individuals' response to price changes. Every individual and every community will respond differently.

The Elasticity Value can range from zero to $-\infty$. It is negative because the price of water and water use move in opposite directions. For water some typical Elasticity Values are:

	Range
Total residential use	-.05 to - .45
Indoor use	-.07 to - .30
Outdoor use	-.22 to -1.57
Total Commercial/Industrial use	-.56 to -1.33

The more responsive water is to a change in price, the more negative the elasticity. For example, outdoor use is more responsive (more elastic) than indoor use. Conversely, indoor use is less responsive (less elastic) than outdoor use.

There are many factors which influence the price elasticity of demand for water. Some of the important ones are:

Amount of price increase: the larger the increase, the greater the response

Average user income: the higher the income, the less the response

Price level: the higher the income, the less the response on the part of users

Average number of people per household: the larger the number, the less the response

Average rainfall and temperature: the more temperate the climate, the less the response

In the case study, the elasticity values were assumed to be as follows:

Shortfall Elasticities	
Residential	-.40
Commercial & Municipal	-.70
Industrial	-1.30
All Users	-.46
Summer	-.80
Winter	-.13

The elasticity values in your community should be similar to these. As a utility manager you will have to estimate your elasticity values after evaluating the factors which influence price elasticity. For example, if your community had a relatively low user income and an arid climate, you could expect that the demand would be relatively elastic.

The following example demonstrates how to use elasticity to forecast user response in the case study community. Suppose you decided to raise the price of water in the case study community by 10% to residential users. The following formula can be used to determine the decrease in water use:

$$\text{\% change in water use} = \text{Elasticity Value} \times \text{\% change in price}$$

$$= -.40 \times 10\% = -4\%$$

or conversely, suppose that you decided you needed to determine the price necessary to reduce residentidal water use by 10%. The correct formula is:

$$\text{\% change in price} = \frac{\text{\% change in water use}}{\text{Elasticity Value}}$$

$$= \frac{-10\%}{-.40} = 25\%$$

A 25% increase in price is necessary to reduce consumption by 10%.

STEP (6), CHOOSE SPECIFIC HARDWARE AND TECHNIQUES

In this step, you select hardware/techniques that will reduce water use in your community.

For supply management, the specific hardware/techniques will depend on your individual system and preference. For example, for metering, you will have to choose the type of meter for installation and design a meter replacement/maintenance schedule.

For leak detection and repair, you will have to choose a system survey method. For example, you will have to choose between aquaphones, geophones, or electronic surveys for leak detection. For pressure reduction, you will need to select the brand and size of the pressure reducing valves. Operate similarly for the other supply management options.

There are 3 categories of hardware/techniques for Demand Management Programs:

- water saving fixtures
- reuse/recycle systems
- user habit changes

Again, you need to review each technique to determine which is most applicable to your community.

Water Saving Fixtures:

They reduce water use by modifying the design of a conventional plumbing system.

Water-saving fixtures recommended:

- should be approximately equal in cost to conventional fixtures
- should not require excessive maintenance

- should reduce water use significantly
- should gain easy acceptance by consumers

There are many types of water-saving fixtures. Of more than 60 different types, the 20 most cost-effective fixtures are detailed in Section Three.

Reuse/Recycle Systems:

They reduce water use by using the same water more than once. They are best for long-term, high percentage goals.

Reuse: Using the same water for more than one function with little or no treatment prior to discharge.

Recycle: Using the same water repeatedly, usually with some treatment.

They are generally:

- very effective
- very expensive

Figure 6.4 in Section Three details the ten situations in which reuse/recycle systems are used most.

User Habit Changes

User habit changes are designed to reduce water use by changing the user's behavior pattern. They are best for long-term, low percentage, and short-term, high percentage goals.

There are two basic behavior pattern changes:

- use less water to perform the same function
- perform the function less often

Developing a long-term or short-term education program is the key to affecting user habit changes:

- users need information before they change their routine behavior
- users need constant reminders and reinforcement if user habit changes are to continue.

Figure 6.5 in Section Three matches some habit changes with conservation goals.

STEP (7), SUMMARIZE CONSERVATION PLAN

To summarize your conservation plan, draw together the results of the prior steps.

GOALS:

SUPPLY MANAGEMENT: HARDWARE AND TECHNIQUES

DEMAND MANAGEMENT: HARDWARE AND TECHNIQUES

CASE STUDY COMMUNITY AND INSTRUCTIONS FOR EXERCISE

CASE STUDY: SHORTFALL, MONEKOTA

Shortfall is a small city of 7,500 people, located next to an intermittent stream, Corn Creek, in cental Monekota. The population has been relatively stable for quite some time, and significant new growth is not expected. All of the people are served by a central water supply system that was built in the 1930's. Ninety percent (90%) of the services are metered; the major exception being the older central part of the city. This part of the service area is a mix of residential, commercial, and municipal users. Water pressure is fairly even throughout the city, at about 60 pounds per square inch. The water utility has maintained the system consistency over the years, and it is in generally fair condition. However, in the past few years, the budget has been very tight and some programs such as regular leak detection and repair, main relining, and valve checks and maintenance have had to be dropped.

The source of supply is a series of five wells in the northwest corner of town. These wells all draw water from the same aquifer. The combined safe yield of these wells (safe yield is defined for this case study as the amount of water which can be annually withdrawn without permanent or long term depletion of the source) is 432 million gallons per year (mgy), or an annual average of 1.2 million gallons per day (mgd). The supply just meets the annual average demand of 1.2 mgd of the city. The wells are designed to be pumped at higher than average rates during peak use periods. In the summer, when peak use is highest, the utility pumps water from the wells to the storage tank on off-peak hours. The stored water is then used during peak hours. With this pumping schedule, the utility can meet the average summer daily demand of 1.7 mgd (212 mgy). The average winter daily demand of .9 mgd (220 mgy) is easily met without special pumping schedules.

The major water use categories are as follows:

Residential (1875 connections)	--	342 mgy (.95 mgd)	79%
Commercial (and some municipal, 60 connections)	--	18 mgy (.05 mgd)	4%
Industrial (1 connection)	--	20 mgy (.05 mgd)	4%
Unaccounted-for water	--	52 mgy (.15 mgd)	13%
TOTAL	--	432 mgy (1.2 mgd)	

The city serves as the agricultural supply and trade center for the area. The one industrial connection in town is a long established cheese processing plant that employs a significant portion of Shortfall's residents.

Over the past few years, agricultural users outside the city limits have significantly increased their withdrawal of water from the same aquifer that the city wells tap. This large increase in use has caused a slow decline in ground water levels, reducing reliable safe yields, and increasing water quality problems. A new treatment plant is now needed in Shortfall to treat the well water so that it remains usable. The city has not been able to convince large agricultural users to reduce their water use to slow the rate of ground water level decline.

The water utility is municipally owned, but it operates as a separate entity. The city council oversees the entire operation: the council must approve the budget, major projects, and rate increases. As a separate entity, the utility must meet all its own expenses through the sale of water. Traditionally, it has not been subsidized by the city, except under very extreme conditions. However, it also cannot make large profits because it ultimately has to answer to the city council which does not believe that large profits are in the public interest. Recently, the council reluctantly approved a rate increase to meet the expenses of the construction of the new treatment plant. The rate is now a uniform unit rate of $.75 per 1000 gallons. This rate generates enough revenue to meet the annual costs of $285,000 to run the utility. (The $285,000 budget includes the new debt on the bond issues floated to pay for the treatment plant). The annual costs are broken down as follows:

FIXED COSTS	--	$190,000
VARIABLE COSTS	--	$ 95,000 (or $.25/1000 gallons produced)
TOTAL	--	$285,000

For the past few years, the entire region has suffered from a severe drought. This shortage of rainfall has made the utility's problems worse. Peak use during the summer has been higher than usual as people have used more water to compensate for the lack of rain. Recharge to the ground water has been reduced and ground water levels are declining faster than "normal" as a result. The utility expects the ground water levels to drop even further since the recovery of ground water from the effects of a drought is very slow. Even if rainfall is normal this year, water levels will probably not recover sufficiently, nor be high enough to meet demand.

The water superintendent presented the current supply situation to the city council. They were concerned about the economic effects of the drought and authorized the superintendent to look for a new source of water. The initial search was disappointing. No other aquifer in the area is large enough to tap for public use; the aquifer that is currently tapped cannot withstand another well or deeper wells because it is already being over used. Purchasing water from adjacent users is not likely because they too are experiencing drought conditions and declining ground water levels. In addition, distances are great, making water connections prohibitively expensive. Developing a reservoir at Corn Creek is a possibility. However, the initial analysis showed that the yield would be small, less than .25 mgd, and it would not be dependable during a severe drought because of the intermittent nature of the river flow. The cost of developing a reservoir would be in the millions of dollars. An additional rate hike of 100% would be necessary to pay for reservoir construction. This option is politically unacceptable to the city council because they just approved a rate hike to pay for the water treatment plant.

The water superintendent feels that something must be done immediately to cope with the drought situation and the long-term projected decrease in yields from the wells. The superintendent estimates that the reliable safe yield of the wells, given that they are overpumped and that the rainfall/recharge estimates are lower now than when the system was designed, is really only 1.0 mgd, or 15% (65 mgy) short of the average annual demand.

Note: The following pages should be color coded to match colors selected for each step in the group exercise. The cards should be reproduced on matching color sheets.

STEP ONE: IDENTIFY PROBLEM/ ESTABLISH GOAL

Read the case study describing conditions in Shortfall, Monekota, a community of 7500 in the northern Great Plains.

A. Is there an average or peak demand problem?

B. Is there a long-term or short-term problem?

On the card marked "PROBLEM", write down the problem that your group has just identified.

THEN, define the conservation goal in terms of the problem you just described.

A. What is the percent reduction required to solve the problem? On the card marked "GOAL - percent reduction", write down the NUMERICAL PERCENT REDUCTION. If it is from one to ten percent, write it down next to "LOW"; if it is above ten percent, write it down next to "HIGH".

B. Which general use category, average or peak, must be reduced? On the card marked "GOAL - average or peak", check the appropriate category.

C. How long must this reduction be maintained to solve the problem? If it is less than one year, check off short-term on the card marked "GOAL - long or short-term". If use reduction is required for more than one year, check off long-term on the card marked "GOAL- long or short-term".

REMEMBER, your goal may change as you progress through the procedure.

STEP TWO: ASSESS POTENTIAL OF SUPPLY MANAGEMENT

As a group, discuss Shortfall's supply system and options to determine if the potential to use supply management to solve the problem completely or in part is high. If the potential for supply management is high, then move to Step Three and evaluate supply management programs in detail. If the potential for supply management is low, move to Step Three and evaluate how the problem can be solved with demand management programs.

Review the existing conditions of the water supply system. Generally, if a system has excessively high leakage (over fifteen percent of total water delivered), then supply management will have high potential. Next, consider whether the utility can afford the program. If the utility cannot afford the program, can it obtain extra money to pay for the program? If supply management were implemented, would there be any opposition from the users or other local interest groups? Would there be enough time to carry out the programs to meet the conservation goal within a reasonable time?

STEP THREE: ANALYZE COST-EFFECTIVENESS OF MANAGEMENT PROGRAMS

Two stacks of cards marked "SUPPLY MANAGEMENT" and "DEMAND MANAGEMENT" detail a variety of conservation programs that could be used in Shortfall. For each conservation program, the cards contain information on the following:

A. The amount of water saved; and

B. Program impact on net revenues to the utility.

Review all the program options for "SUPPLY MANAGEMENT" if supply management was determined to have high potential. Review all the program options for "DEMAND MANAGEMENT" if supply management has low potential. Place on the exercise sheet the cards that describe the programs capable of meeting the conservation goal and revenue constraints. REMEMBER, you can combine programs from SUPPLY MANAGEMENT and DEMAND MANAGEMENT as well as combine individual programs within SUPPLY and DEMAND; just add together water saved and net revenues to determine what the total impact would be on the utility. The only exceptions to the simple addition are the combination of the Pricing and Regulation programs (DEMAND MANAGEMENT). These combination programs are described separately on cards in the stack for DEMAND MANAGEMENT. Combinations of pricing and regulatory programs complement and support one another. Their combined effects cannot be simply added together. The figures on the combination cards for the amount of water saved and revenues demonstrate this synergistic effect. At times the combination of programs will bring about only a marginal increase in conservation.

NOTE: You can choose only one option within a single management program. For instance, you can choose only one Leak Detection and Repair program, only one Pricing program, only one Education program. The only exception is watershed management.

If there are any other programs you feel are more appropriate than those described, use the blank cards at the bottom of the stacks to design your own program, including estimated water saved and effect on revenues.

STEP FOUR: ANALYZE IMPACTS AND MODIFICATIONS TO ADVERSE IMPACTS OF MANAGEMENT PROGRAMS

After selecting a preliminary set of management programs that are cost effective, analyze the social, political, and legal-institutional impacts of these programs.

From the two stacks of cards marked "SUPPLY MANAGEMENT" and "DEMAND MANAGEMENT", choose those cards that match the programs you selected in Step Three and place them on the exercise sheets.

Review the impacts and modifications to the adverse impacts that are listed on each card. Discuss the impacts and modifications with the group and determine whether the preliminary set of programs is still acceptable. If so, make any appropriate modifications to the preliminary set of programs suggested by the modifications - or any other modifications you may feel are important. Put a check by those modifications you are willing to make, or that apply.

If the preliminary programs are unacceptable, return to Step Three and re-analyze the options.

NOTE: if there are any impacts that you feel must be considered that are not listed on the cards, write them in the blank spaces on each card. Or, if you designed your own programs, use the blank impact cards at the bottom of the stacks to describe their expected impacts and necessary modifications.

STEP FIVE: CHOOSE MANAGEMENT PROGRAMS

Choose management programs which can meet the goal most effectively and which have the fewest adverse impacts. TAKE THE APPROPRIATE CARDS FROM STEP THREE AND PLACE THEM IN STEP FIVE.

Review the programs to make sure the conservation goal is met and the revenue constraints are not violated. If either of these conditions are not met, return to Step Three.

The management programs you select are one part of your draft conservation plan.

STEP SIX: CHOOSE SPECIFIC HARDWARE/TECHNIQUE

For SUPPLY MANAGEMENT, you would have to select the specific brand name of equipment you need or determine exactly who will be carrying out the work. This will NOT be done for this exercise.

For DEMAND MANAGEMENT, there are three groups of hardware/techniques that reduce water use in homes and businesses:

A. Water saving fixtures
B. Reuse/recycle systems
C. User habit changes

Even though the purchase and installation of hardware/techniques is up to the users, you may want to assist them in selection, purchase, and/or installation of hardware/techniques. Permanent use reductions are more likely to result if the utility takes an active role in this phase of the conservation program. Frequently, users do not purchase the best equipment, or do not take the appropriate actions that will best achieve the conservation goal. Therefore, use reductions may diminish over time unless the utility provides guidance on the implementation of hardware/techniques.

Review the cards marked "HARDWARE/TECHNIQUES" and discuss with the group if the utility should take an active role in assisting users in the implementation of hardware/techniques. Choose the role that you feel is most appropriate and place the card on the exercise sheet. REMEMBER, if the chosen program has costs associated with it, make sure the utility has enough money to pay for it (see Step Five, net revenues). If not, you may want to revise your management programs.

The hardware/technique you select is the second part of your draft conservation plan.

STEP SEVEN: SUMMARIZE CONSERVATION PLAN

As a group, review the draft conservation plan you designed in STEPS 5 and 6. Make sure that: 1) the program can effectively meet the conservation goal, 2) the adverse impacts associated with each program will not make the program unacceptable, and 3) the plan does not violate the revenue constraints.

If all these conditions are met, then your draft plan will be your final plan.

If any of these conditions are not met, review your draft plan and return to STEP 3 (or STEP 6 if hardware/technique is the only problem) and modify the plan.

What part of your conservation plan is most likely to run into political difficulty? Do some contingency planning. As a group, identify the most vulnerable part of your program, and develop an option should the city council reject this program element. Be prepared to discuss this topic, and all of the decisions your group made in developing its plan, in the next part of the workshop.

BIBLIOGRAPHY
FIGURES, FROM BEFORE THE WELL RUNS DRY, A HAND-BOOK ON DESIGNING A LOCAL WATER CONSERVATION PLAN

BIBLIOGRAPHY

WATER USE

Bender, Norman and Kaye, Henry, (undated), "Two Separate Recirculation Systems Cut Plant's Water Usage in Half." Water Supply and Conservation, edited by Richard A. Young (reprint from Plant Engineering).

Boland, J. J., (undated), Forecasting the Demand for Urban Water in Municipal Water Systems, edited by D. Holtz and S. Sebastian, Bloomington IN: Indiana University Press.

Brauer, D., and others, 1976, A Study of Water Use and Its Conservation in Northern Colorado. Unpublished Report.

Bruner, J. M., 1969, An Analysis of Municipal Water Demand in the Phoenix Metropolitan Area.

Camp, R. C., 1978, "The Inelastic Demand for Residential Water: New Findings." Journal American Water Works Association, Vol. 70, No. 8.

Danielson, L. E., 1977, Estimation of Residential Water Demand. Economics Research Report No. 39, Raleigh: North Carolina State University.

Gottlieb, Manuel, 1963, "Urban Domestic Demand for Water: A Kansas Case Study." Land Economics, Vol. 39, No. 2.

McCuen, R. H., Sutherland, R. C. and Kim, J. R., 1975, "Forecasting Urban Water Use: Commercial Establishment." Journal American Water Works Association, Vol. 67, No. 5.

Russell, C. S., Arey, D. G.; and Kates, R. W., 1970, Drought and Water Supply -Implications of the Massachusetts Experience for Municipal Planning. Baltimore, Maryland: Johns Hopkins Press.

Wiley, R. D., 1979, "Denver - Import and Reuse Conservation Lesson." Water Conservation Needs and Implementing Strategies, American Society of Civil Engineers, New York, New York.

Young, R. A., 1973, "Price Elasticity of Demand for Municipal Water: A Case Study of Tucson, Arizona." Water Resources Research, Vol. 9, No. 4.

WATER CONSERVATION PLANNING

American Water Works Association, 1980, "Water Conservation Strategies," AWWA Management Resource Book, ISBN 0-89867-240-6.

Baumann, D. D., and Boland, J. J., 1980, "Urban Water Supply Planning," Water Spectrum, U.S. Army Corps of Engineers.

Baumann, D. D., Dworkin, D., Sebastian, S., Andrews, B., and Holtz, D., 1976, Planning Alternatives for Municipal Water Systems, Indianapolis, IN: Holcomb Research Institute, Butler University.

Boland, J. J., Carver, P. H., and Slynn, C. R., 1980, "How Much Water Supply Capacity is Enough," Journal American Water Works Association, Vol. 72, No. 7.

Flack, E. J., 1979, Urban Water Conservation, Boulder, CO: University of Colorado.

Flack, E. J., Weakley, W. P., Hill, D. W., 1977, Achieving Urban Water Conservation - A Handbook, Fort Collins, CO: Colorado Water Resources Research Institute, Colorado State University.

Hass, J. E., 1978, "Strategies in the Event of Drought," North American Droughts, edited by Rosenberg, Institute of Behavioral Science, New Jersey; Boulder, CO: University of Colorado.

Klein, Ed, 1978, "Industrial Conservation Programs and Techniques." Industrial Water Allocation and Conservation in California, California Department of Water Resources.

Miller, W. H., 1978, "Mandatory Water Conservation and Tap Allocations in Denver, Colorado," Journal American Water Works Association, Vol. 70, No. 2.

Minton, G. D., Williams, R., and Murdock, T., 1979, "Developing A Conservation Program Tailored to Area Needs," Journal American Water Works Association, Vol. 71, No. 9.

Morgan, W. D., 1979, "The Economics of Water Conservation." Water Conservation Needs and Implementing Strategies, American Society of Civil Engineers, New York, New York.

Nelson, J. O., 1977, "Moving from Water Conservation to Water Management." Community Water Management for the Drought and Beyond: A Handbook for Local Government, California Govenor's Office of Emergency Service, Sacramento, California,p.70-77.

Nelson, J. O., 1975, "Water Conservation in New Residential Development." Proceedings -2nd Annual Conference of Water-care on Water Reclamation and Domestic Water Conservation.

New England River Basins Commission, 1980, Before the Well Runs Dry, Vol. 1: Supporting Research, Vol. 11: A Seven Step Procedure for Designing a Local Water Conservation Plan.

New England River Basins Commission, 1980, Before the Well Runs Dry: a handbook for designing a local water conservation plan.

New England River Basins Commission, 1981, Before the Well Runs Dry: a handbook drought management.

Palmer, N., 1980, "Emergency Planning for Water Supply Protection, Opflow", Journal American Water Works Association, Vol. 72, No. 7.

Rice, I. M., and Shaw, L.G., 1978, "Water Conservation - A Practical Approach." Journal American Water Works Association, Vol. 70, No. 9.

Robie, R. B., 1978, "California's Program for Dealing with Drought," Journal American Water Works Association, Vol. 70, No. 2.

Shelton, T. B., and Sharpe, W. E., 1981, A Guide to Designing a Community Water Conservation Program, Cooperative Extension Services of the Northeast States.

South Florida Water Management Division, 1979, Guidelines for the Development of a Water Shortage Conservation Program-Draft.

U.S. Army Corps of Engineers, 1979, An Annotated Bibliography on Water Conservation, Contract Report No. 78-3, prepared by Planning and Management Consultants, Ltd., Carbondale, IL.

U.S. Army Corps of Engineers, Institute for Water Resources, 1979, The Role of Conservation in Water Supply Planning. Contract Report No. 78-2. Prepared by Duane D. Baumann et al, Southern Illinois University.

U.S. Army Corps of Engineers, 1980, The Evaluation of Water Conservation for Municipal and Industrial Water Supply: Procedures Manual, Contract Report No. 80-1, prepared by Duane D. Baumann et al.

U.S. Economic Development Administration, (undated), A Study Design for the High Plains Development Project, Resources for the Future, Inc., Office of Economic Research, Washington, D.C.

U.S. Environmental Protection Agency, 1981, Flow Reduction: Methods, Analysis Procedures, Examples, Facility Requirements Division.

U.S. Environmental Protection Agency, 1980, Residential Water Conservation: An Annotated Bibliography FRD-16.

U.S. Environmental Protection Agency, 1979, Decision-Maker's Guide in Water Supply Management. Prepared by Culp, Wesner, Culp - Clean Water Consultants. Washington, D.C.

U.S. General Accounting Office, 1978, Better Water Management and Conservation Possible--But Constraints Need to be Overcome, Community and Economic Development Division, Washington, D.C.

U.S. Water Resource Council, 1980, State Water Conservation Planning Guide.

Western Governors' Policy Office, 1978, Managing Resource Scarcity: Lessons from the Mid-Seventies Drought, Denver, Institute for Policy Research.

Westminster, Colorado, 1978, Vision of Balance.

White, Mike, 1978, "Industrial Conservation Programs and Techniques." Industrial Water Allocation and Conservation, California Department of Water Resources.

Wiley, R. D., 1979, "Denver - Import and Reuse Conservation Lesson," Water Conservation Needs and Implementing Strategies, American Society of Civil Engineers, New York, New York.

Aurora, Colorado, 1981, Landscaping for Water Conservation.

WATER CONSERVATION PRACTICES

Barnes, J., Borrelli, J. and Pochop, L., 1979, "Optimum Lawn Watering Rates for Esthetics and Conservation," Journal American Water Works Association, Vol. 71, No. 4.

California Department of Water Resources, 1978, A Pilot Water Conservation Program. Bulletin 191.

"California Drought Changes Consumption Pattern." 1979, Public Works, p. 86.

Campbell, F. C., 1970, "Distribution System Leakage Survey." Journal American Water Works Association, Vol. 62, No. 7.

City of Los Angeles, 1977, Water Conservation Plan, Emergency Water Conservation Plans, Department of Water and Power, Los Angeles, California.

Deibert, L. E., 1978, "Fiscal Planning and Water Conservation in Madison, Wisconsin." Journal American Water Works Association, Vol. 70, No. 1.

Eckenfelder, 1979, W. W., "Industrial Water Conservation." Southeast Water Conservation and Alternative Water Supplies. Water Resources Research Institute, University of North Carolina, Vol. 1, No. 2.

Gros, W. F. H., 1978, Water Conservation Through Leak Detection, Pitometer Association, presented at the EPA Water Conservation and Municipal Wastewater Flow Reduction National Conference, Chicago, Illinois.

Hudson, W. D., 1978, Increasing Water System Efficiency in Municipal Water Systems, edited by D. Holtz and S. Sebastian, Bloomington, IN: Indiana University Press.

Hudson, W. D., 1978, "Reduction of Unaccounted-for Water," Journal American Water Works Association, Vol. 68, No. 1.

Meyer, L., Clemens, R., and Whithill, D., 1979, Water Conservation in Municipally-Supplied Demand with Respect to the Design of Water Rates. Boston, Massachusetts.

Orr, L. E., Enna, V. A., and Miller, M. C., 1978, "Analysis of a Water-Meter Replacement Program." Journal American Water Works Association, Vol. 69, No. 2.

Phillips, R. V., 1977, "Tomorrow's Rate Structures Today." Journal American Water Works Association, Vol. 69, No. 2.

Schmued, R., 1978, "Industrial Conservation Programs and Techniques." Industrial Water Association and Conservation. California Department of Water Resources.

Sharpe, W. E., 1978, "Residential Water Conservation with Water Conservation Devices, _The Water Conservation Challenge_, The Upper Mississippi River Basin Commission, Bloomington, Minnesota.

Siegrist, R. L., Boyle, W. C., Damann, L. A., _A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications_, Water Resources Center, University of Wisconsin, Madison, 1981.

U.S. Army Corps of Engineers, 1979, _Metropolitan Washington (D.C.) Area Water Supply Study - Conservation and Demand Reduction Specialty Appendix - Draft Interim Report_. Baltimore, Maryland.

Weiss, W. H., (undated), "Design Changes Update Industrial Water Conservation System." _Water Supply and Conservation_, edited by R. A. Young (reprint from _Plant Engineering_).

PRICING AND REVENUE PLANNING

Bailey, E. E., 1972, "Peak-Load Pricing Under Regulatory Constraint." _Journal of Political Economy_, Vol. 80, No. 4.

Burns, D. R. J., Gerstle, J. H., Roussos, G. J., Whitaker, M. K., and Wemple, R., 1975, "The Effect of Price on Residential Water Demand." _Economics_, Boulder, CO: University of Colorado.

Coffin and Richardson, Inc., 1979, _Preliminary Report on the Price Elasticity of Water Demand with Repect to the Design of Water Rates_. Boston, Massachusetts.

Cross, J. G., 1970, "Incentive Pricing and Utility Regulation," _Quarterly Journal of Economics_, Vol. 84, No. 2.

DeRooy, J., 1974, "Price Responsiveness of the Industrial Demand for Water." _Water Resources Research_, Vol. 10, No. e.

Feldman, S. L., 1975, "Peak-Load Pricing through Demand Metering." _Journal American Water Works Association_, Vol. 67, No. 9.

Flack, E. J., and Roussos, G. J., 1978, "Water Consumption under Peak-Responsibility Pricing." _Journal American Water Works Association_, Vol. 70, No. 3.

Fonda, S. H., 1979, "Financing a Capital Improvement Program: Revenue Requirements, Cost of Service Analysis, and Rate Design." Journal American Water Works Association. Vol. 71, No. 4.

Graeser, H. J., 1978, "The Art of Rate Making." Journal American Water Works Association. Vol, 70, No. 5.

Graerer, H. J., 1978, "Financing System Changes." Journal American Water Works Association. Vol. 70, No. 9.

Graeser, H. J., and Banker, R. F., 1979, "Allocation of Cost Based on Water Use Patterns." Journal of the New England Water Works Association. Vol. 93, No. 4.

Larkin, D. G., 1978, "The Economics of Water Conservation." Journal American Water Works Association, Vol. 70, No. 9.

Lynne, G. D., Luppold, W. G., and Kiker, C., 1978, "Water Price Responsiveness of Commercial Establishments." Water Resources Bulletin, Vol. 14, No. 3.

McGarry, R. S., 1978, Water and Sewer Conservation Oriented Rate Structure. Washington Suburban Sanitary Commission, Hyattsville, Maryland.

Russel, J. D., 1979, "Rate Design for Equity Among Customers." Journal American Water Works Association, Vol. 71, No. 4.

Williamson, O. E., 1966, "Peak-Load Pricing and Optimal Capacity under Indivisibility Constraints." American Economic Review, Vol.56, No. 4.

PUBLIC PARTICIPATION AND EDUCATION

Harwood, G.D., 1979, "Water Conservation, Conflicting Interests, and Public Education," Water International, Vol. 4, No. 4.

Lattie, J., 1977, "Public Education for Water Conservation," Drought and Beyond, A Handbook for Local Government, California Office of Emergency Services, Sacramento, California.

Milne, M., 1976, Residential Water Conservation. Report #35, California Water Resources Center, University of California, Davis.

National Science Foundation, 1978, Urban Drought in the San Francisco Bay Area: A Study of Institutional and Social Resiliency, prepared by Teknekron, Inc. and Resource Analysis, Inc.

Smith, L. K., 1977, _40 Ways to Save Water in Your Yard and Garden_. Environmental Design Consultants - International, Newberry Park, California.

Snodgrass, R. W., and Hill, D. W., 1977, "Achieving Urban Water Conservation: Testing Community Acceptance," Completion Report No. 81, Fort Collins, CO: Colorado Water Resources, Research Institute, and Colorado State University.

Washington Suburban Sanitary Commission, 1978, _Final and Comprehensive Report: Cabin John Drainage Basin Water Customer Education and Appliance Test Program_. Hyattsville, Maryland.

Washington Suburban Sanitary Commission, 1974, _Final and Comprehensive Report -WSSC's Water Conservation/Wastewater Reduction Customer Education and Behavioral Change Program_. Hyattsville, Maryland.

WATER CONSERVATION IMPACTS

Bennett, E. R., (undated), "Impact Of Flow Reduction on On-lot Sewage Systems," Department of Civil and Environmental Engineering, Boulder, CO: University of Colorado.

Davis, J. A., and Bursztynsky, T. A., 1980, "Effects of Water Conservation on Municipal Wastewater Treatment Facilities," _Journal Water Pollution Control Federation_, Vol. 52, No. 4.

Primeaux, W. J., and Hollman, K. W., 1974, "Factors Affecting Residential Water Consumption: The Managerial Viewpoint." _Water and Sewage Works_, R-138.

FIGURE 1. SEVEN STEP PROCEDURE FOR DESIGNING A WATER CONSERVATION PLAN

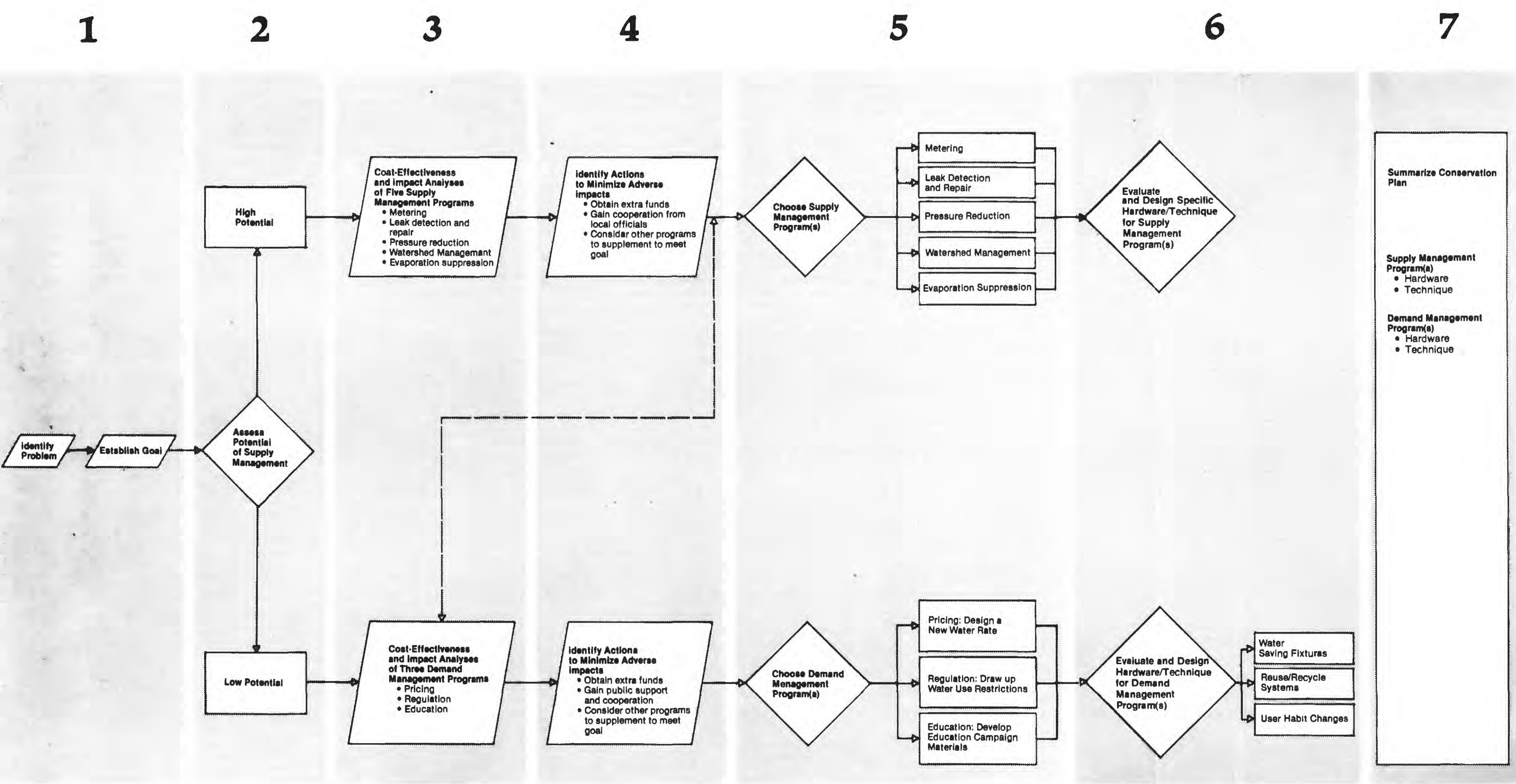


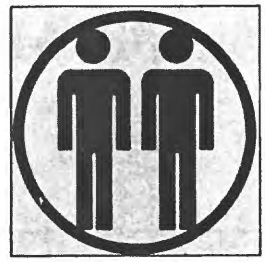
FIGURE 2.1

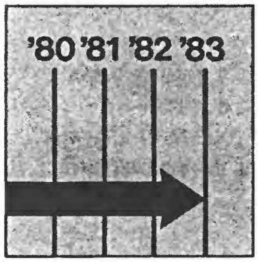
Comparing Supply and Demand Management Programs

SUPPLY MANAGEMENT PROGRAMS	DEMAND MANAGEMENT PROGRAMS

Not dependent on consumer cooperation.

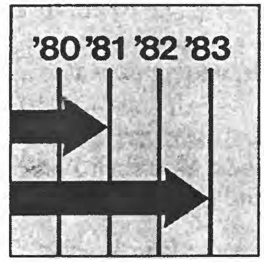
Dependent on consumer cooperation.

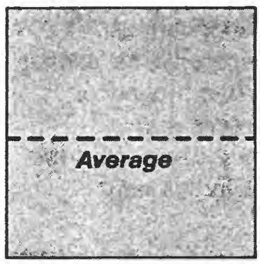




Meets long term goals effectively.

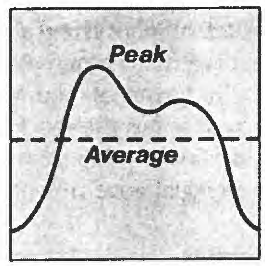
Can meet any conservation goal, long or short term.

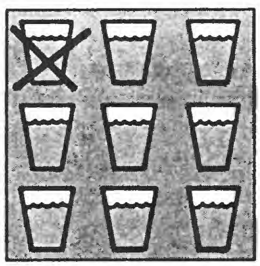




Suitable for average demand problems or peak demand problems due to inadequate system capacity.

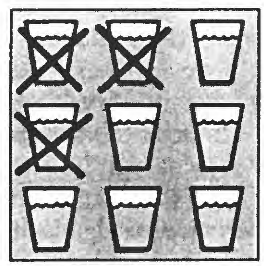
Solves average and peak demand problems.





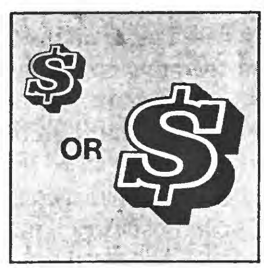
Best for low % reduction goal.

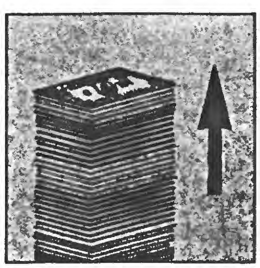
Can achieve either low or high % reduction goal.



Sometimes requires large expenditures of funds.

Can require large or small expenditures of funds.





Lost revenues can be recovered.

Some programs cause revenues to drop.

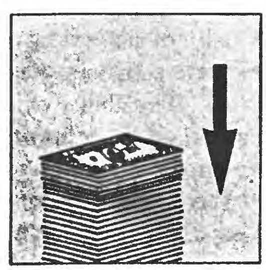
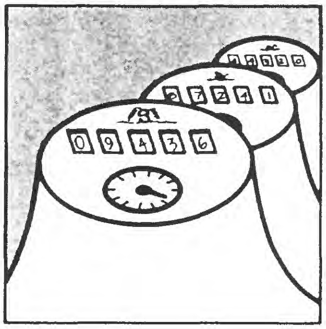


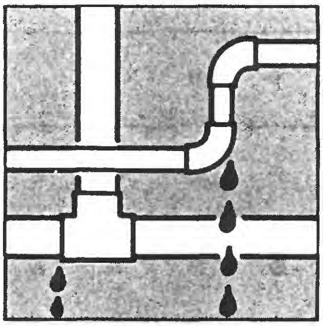
FIGURE 3.1

The Five
Supply Management Programs



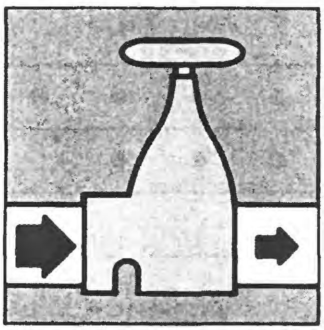
Metering:

- Accurately accounts for all water used to insure system efficiency
- Can be expensive



Leak Detection and Repair

- Reductions can be substantial
- Improves system efficiency
- Repairs can be expensive

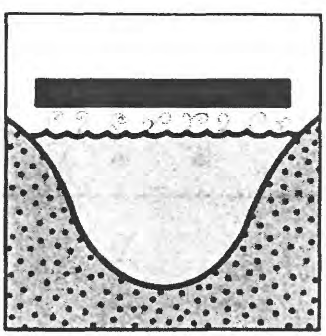


Pressure Reduction

- Useful only in areas with excessively high pressure (over 80 psi)
- Can be expensive

Watershed Management

- Can protect water supply from contamination
- Can maintain or increase recharge flows to source
- Can generate income for utility



Evaporation Suppression

- Useful only if evaporation is significant (over 10%)
- Expensive

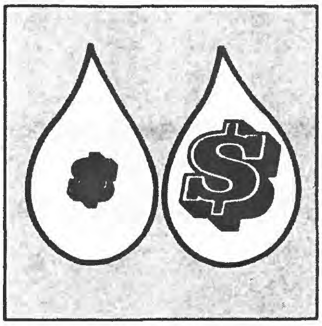
FIGURE 3.2

Impacts of
Supply Management Programs

IMPACTS	Metering	Leak Detection & Repair	Pressure Reduction	Watershed Management	Evaporation Suppression
FINANCIAL / ECONOMIC					
Profits may increase	●	●	●		
Costs for program may be high	●	●	●	●	●
Expenditures may result in temporary operating deficit	●	●	●		
Program costs may not be covered by existing revenues	●	●	●	●	●
New water rate may be necessary to generate more revenues for program	●	●	●	●	●
Subsidy or grant from local, state or federal government may be available	●	●			
New personnel may be needed	●	●	●	●	●
Variable costs decrease, including energy	●	●	●	●	
Revenues may increase	●	●			
TECHNICAL / ENVIRONMENTAL					
New source development may be postponed, scaled down, or eliminated	●	●	●	●	●
System efficiency improves	●	●	●	●	●
Energy consumption decreases	●	●	●		
LEGAL / INSTITUTIONAL					
Utility may not be able to accept or obtain grant for program	●	●			
Lack of cooperation from local government may complicate program implementation	●	●	●	●	●
Community opposition			●	●	

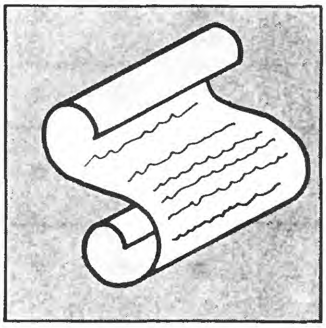
FIGURE 3.3

The Three
Demand Management Programs



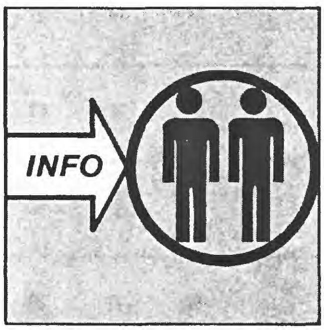
Pricing

- Higher costs for consumers encourage conservation



Regulation

- Users required by law to comply with certain restrictions



Education

- Conservation by voluntary response from consumers
- Desirable to use in conjunction with other conservation programs

FIGURE 3.4

Impacts of Demand Management Programs for a Municipal-Metered Utility

IMPACTS	Pricing	Regulation	Education
FINANCIAL / ECONOMIC			
Variable costs (energy, chemicals) decreased within utility	●	●	●
Variable costs decreased for sewage treatment plant/septic tank operations	●	●	●
Decrease in user's energy and/or sewer use bills	●	●	●
Investment for new source postponed, reduced or eliminated	●	●	●
Investment for new waste water treatment facilities postponed, reduced, or eliminated	●	●	●
Fire protection, public health and lifestyle maintained, when shortage is avoided	●	●	●
If additional connections become available, tax base increased	●	●	●
Utility system improvements result in lower community fire insurance rates	●	●	●
Users' expenditure to buy water saving fixtures or reuse/recycle systems	●	●	●
Revenues usually increase	●		
User's water bills increase	●		
Revenue increase results in system re-investment, improved customer service	●		
Revenue increase may be diverted by community to other community programs, budgets	●		
Revenue increase may be diverted to general budget allowing a tax cut	●		
Large volume users may develop own source with subsequent loss of their revenues to utility	●	●	
Increased price or restriction to large volume users may result in production cutbacks, employee layoff, increases in product prices	●	●	
Utility expenditure to do rate study	●		
User's water bill decreases, at least temporarily		●	●

FIGURE 3.4

continued

FINANCIAL / ECONOMIC (continued)	Pricing	Regulation	Education
Revenue loss necessitating rate hike, subsidy from local government	●	●	●
If revenue loss is made up by using community general funds, other community program budgets will be cut or property tax may be increased	●	●	●
Revenue loss may result in cutback in utility's operation and/or maintenance	●	●	●
Utility expenditure to pay for enforcement		●	
New industry may not be attracted to community	●	●	
Utility expenditure to pay for education materials			●
TECHNICAL / ENVIRONMENTAL			
New source development postponed, reduced or eliminated	●	●	●
Additional connections possible	●	●	●
Reduced operation and maintenance at utility	●	●	●
Reduced waste water volume	●	●	●
Reduced operation and maintenance at sewage treatment plant or septic tank systems	●	●	●
Increase capacity and life of sewage treatment plant or septic tank systems	●	●	●
Reduced energy consumption	●	●	●
Maintain water supply source level and/or flow	●	●	●
Stream flows may vary (higher if less water extracted; lower if less waste water discharged)	●	●	●
Waste water pollutant concentration increases	●	●	●
In marginally low grade sewers; waste water transportation efficiency may decrease	●	●	●
Damage to lawns and gardens if outdoor watering not possible	●	●	●
Industrial or large volume users may develop own source or relocate	●	●	

FIGURE 3.4
continued

TECHNICAL / ENVIRONMENTAL (continued)	Pricing	Regulation	Education
System improvement because of re-investment (revenue increase)	●		
System degradation if operation and maintenance reduced (revenue loss)	●	●	●
SOCIAL / POLITICAL			
Community lifestyle maintained	●	●	●
Community water related recreation may be jeopardized	●	●	●
If revenue loss results in other community programs being cut to divert their funds to utility, political opposition		●	●
If revenue loss results in community services cutback to divert those funds to support utility, user opposition		●	●
Revenue gain may increase other community programs, services	●		
Peer pressure to comply with program		●	●
User and special interest group opposition to program	●	●	
Political opposition to program	●	●	
Fairness of program must be carefully considered	●	●	
Program may affect politics of community growth and development	●	●	
User and political cooperation with program and understanding of utility operations increased			●
Cooperation with enforcement authority to implement program may be difficult		●	
Cooperation with school department and other community departments to incorporate program may be difficult			●
Well received by users and local government			●

FIGURE 3.4

continued

LEGAL / INSTITUTIONAL	Pricing	Regulation	Education
Bond and debt obligations must be maintained	●	●	●
Local laws and voter preference may determine where excess revenues can be spent	●		
Local, state, and federal laws may limit options to users on how to conserve, particularly health and safety regulations	●	●	●
Contradictions between surface and ground water laws may inhibit comprehensive supply management	●	●	●
Cooperation among community departments may improve or complicate implementation	●	●	●
Local laws and voter preference may determine how and if utility gets subsidized in case of revenue loss	●	●	●
Cooperation with enforcement agency may improve or complicate implementation		●	
Local, state, and federal laws may limit use of some programs	●	●	
Coordination with school departments and media may be necessary			●
May improve coordination of government bodies involved with program			●
If water supply and waste water operations are independent, coordination of program with each other may be difficult	●	●	●

FIGURE 3.5

Impacts of
Demand Management Programs
for a
Municipal-Unmetered Utility

IMPACTS	Pricing	Regulation	Education
FINANCIAL / ECONOMIC			
Variable costs (energy, chemicals) decreased within utility		●	●
Variable costs decreased for sewage treatment plant/septic tank operations		●	●
Decrease in user's energy and/or sewer use bills		●	●

FIGURE 3.5
continued

	Pricing	Regulation	Education
FINANCIAL / ECONOMIC (continued)			
Investment for new source postponed, reduced or eliminated		●	●
Investment for new waste water treatment facilities postponed, reduced, or eliminated		●	●
Fire protection, public health and lifestyle maintained, when shortage is avoided		●	●
If additional connections become available, tax base increased		●	●
Utility system improvements result in lower community fire insurance rates		●	●
Users' expenditure to buy water saving fixtures or reuse/recycle systems		●	●
Large volume users may develop own source with subsequent loss of their revenues to utility		●	
Utility expenditure to pay for enforcement		●	
New industry may not be attracted to community		●	
Utility expenditure to pay for education materials			●
Restriction on large volume users may result in production cutback, employee layoff		●	
TECHNICAL / ENVIRONMENTAL			
New source development postponed, reduced or eliminated		●	●
Additional connections possible		●	●
Reduced operation and maintenance at utility		●	●
Reduced waste water volume		●	●
Reduced operation and maintenance at sewage treatment plant or septic tank systems		●	●
Increase capacity and life of sewage treatment plant or septic tank systems		●	●
Reduced energy consumption		●	●
Maintain water supply source level and/or flow		●	●

FIGURE 3.5

continued

TECHNICAL / ENVIRONMENTAL (continued)	Pricing	Regulation	Education
Stream flows may vary (higher if less water extracted; lower if less waste water discharged)		●	●
Waste water pollutant concentration increases		●	●
In marginally low grade sewers; waste water transportation efficiency may decrease		●	●
Damage to lawns and gardens if outdoor watering not possible		●	●
Industrial or large volume users may develop own source or relocate		●	
SOCIAL / POLITICAL			
Community lifestyle maintained		●	●
Community water related recreation may be jeopardized		●	
Peer pressure to comply with program		●	●
User and special interest group opposition to program		●	
Political opposition to program		●	
Fairness of program must be carefully considered		●	
Program may affect politics of community growth and development		●	
User and political cooperation with program and understanding of utility operations increased			●
Cooperation with enforcement authority to implement program may be difficult		●	
Cooperation with school department and other community departments to incorporate program may be difficult			●
Well received by users and local government			●
LEGAL / INSTITUTIONAL			
Bond and debt obligations must be maintained		●	●
Local, state, and federal laws may limit options to users on how to conserve, particularly health and safety regulations		●	●

FIGURE 3.5
continued

LEGAL / INSTITUTIONAL (continued)	Pricing	Regulation	Education
Contradictions between surface and ground water laws may inhibit comprehensive supply management		●	●
Cooperation among community departments may improve or complicate implementation		●	
Local, state, and federal laws may limit use of some programs		●	
Coordination with school departments and media may be necessary			●
May improve coordination of government bodies involved with program			●
If water supply and waste water operations are independent, coordination of program with each other may be difficult		●	●

FIGURE 3.6
Impacts of Demand Management Programs for a Municipal-Regulated Utility

IMPACTS	Pricing	Regulation	Education
FINANCIAL / ECONOMIC			
Variable costs (energy, chemicals) decreased within utility	●	●	●
Variable costs decreased for sewage treatment plant/septic tank operations	●	●	●
Decrease in user's energy and/or sewer use bills	●	●	●
Investment for new source postponed, reduced or eliminated	●	●	●
Investment for new waste water treatment facilities postponed, reduced, or eliminated	●	●	●
Fire protection, public health and lifestyle maintained, when shortage is avoided	●	●	●
If additional connections become available, tax base increased	●	●	●
Utility system improvements result in lower community fire insurance rates	●	●	●

FIGURE 3.6
continued

TECHNICAL / ENVIRONMENTAL	Pricing	Regulation	Education
New source development postponed, reduced or eliminated	●	●	●
Additional connections possible	●	●	●
Reduced operation and maintenance at utility	●	●	●
Reduced waste water volume	●	●	●
Reduced operation and maintenance at sewage treatment plant or septic tank system	●	●	●
Increase capacity and life of sewage treatment plant or septic tank system	●	●	●
Reduced energy consumption	●	●	●
Maintain water supply source level and/or flow	●	●	●
Stream flows may vary (higher if less water extracted; lower if less waste water discharged)	●	●	●
Waste water pollutant concentration increases	●	●	●
In marginally low grade sewers; waste water transportation efficiency may decrease	●	●	●
Damage to lawns and gardens if outdoor watering not possible	●	●	●
Industrial or large volume users may develop own source or relocate	●	●	
System improvement because of re-investment (revenue increase)	●		
System degradation if operation and maintenance reduced (revenue loss)	●	●	●
SOCIAL / POLITICAL			
Community lifestyle maintained	●	●	●
Community water related recreation may be jeopardized	●	●	
If revenue loss results in other community programs being cut to divert their funds to utility, political opposition		●	●
Revenue gain may increase other community programs, services	●		

FIGURE 3.6
continued

FINANCIAL / ECONOMIC (continued)	Pricing	Regulation	Education
Users' expenditure to buy water saving fixtures or reuse/recycle systems	●	●	●
Revenues usually increase	●		
User's water bills increase	●		
Revenue increase results in system re-investment, improved customer service	●		
Revenue increase may be diverted by community to other community programs, budgets	●		
Revenue increase may be diverted to general budget allowing a tax cut	●		
Large volume users may develop own source with subsequent loss of their revenues to utility	●	●	
Increased price or restriction to large volume users may result in production cutbacks, employee layoff, increases in product prices	●	●	
Utility expenditure to do rate study	●		
User's water bill decreases, at least temporarily		●	●
Revenue loss necessitating rate hike, subsidy from local government	●	●	●
If revenue loss is made up by using community general funds, other community program budgets will be cut or property tax may be increased	●	●	●
Revenue loss may result in cutback in utility's operation and/or maintenance		●	●
Utility expenditure to pay for enforcement		●	
New industry may not be attracted to community	●	●	
Utility expenditure to pay for education materials			●
Regulatory board limits rate of return and flexibility in rate setting	●		
9 to 12 month approval process by regulatory board may complicate conservation program and supply problem	●		
If there is a revenue loss, a rate hike to make up for it may not be permitted by regulatory board	●	●	●

FIGURE 3.6
continued

SOCIAL / POLITICAL (continued)	Pricing	Regulation	Education
Peer pressure to comply with program		●	●
Regulatory board opposition to program	●		
User and special interest group opposition to program	●	●	
Political opposition to program	●	●	
Fairness of program must be carefully considered	●	●	
Program may affect politics of community growth and development	●	●	
User and political cooperation with program and understanding of utility operations increased			●
Cooperation with enforcement authority to implement program may be difficult		●	
Cooperation with school department and other community departments to incorporate program may be difficult			●
Well received by users and local government			●
LEGAL / INSTITUTIONAL			
Bond and debt obligations must be maintained	●	●	●
Local laws, voter preference, and regulatory board may determine where excess revenues can be spent	●		
Local, state, and federal laws may limit options to users on how to conserve, particularly health and safety regulations	●	●	●
Contradictions between surface and ground water laws may inhibit comprehensive supply management	●	●	●
Cooperation among community departments may improve or complicate implementation	●	●	●
Local laws and voter preference may determine how and if utility gets subsidized in case of revenue loss	●	●	●
Cooperation with enforcement agency may improve or complicate implementation		●	
Local, state, regulatory board, and federal laws may limit use of some programs	●	●	

FIGURE 3.6
continued

LEGAL / INSTITUTIONAL (continued)	Pricing	Regulation	Education
Coordination with school departments and media may be necessary			●
May improve coordination of government bodies involved with program			●
If water supply and waste water operations are independent, coordination of program with each other may be difficult	●	●	●
Regulatory board may not allow pricing for conservation	●		

FIGURE 3.7
Impacts of
Demand Management Programs
for an
Investor-Owned Utility

IMPACTS	Pricing	Regulation	Education
FINANCIAL / ECONOMIC			
Variable costs (energy, chemicals) decreased within utility	●	●	●
Decrease in user's energy and/or sewer use bills	●	●	●
Investment for new source postponed, reduced or eliminated	●	●	●
Fire protection, public health and lifestyle maintained, when shortage is avoided	●	●	●
Users' expenditure to buy water saving fixtures or reuse/recycle systems	●	●	●
Revenues usually increase	●		
User's water bills increase	●		
Revenue increase results in system re-investment, improved customer service	●		
Large volume users may develop own source with subsequent loss of their revenues to utility	●	●	
Increased price or restriction to large volume users may result in production cutbacks, employee layoff, increases in product prices	●	●	

FIGURE 3.7
continued

FINANCIAL / ECONOMIC (continued)	Pricing	Regulation	Education
Utility expenditure to do rate study	●		
User's water bill decreases, at least temporarily		●	●
Revenue loss necessitating rate hike	●	●	●
Revenue loss may result in cutback in utility's operation and/or maintenance	●	●	●
Utility expenditure to pay for enforcement		●	
New industry may not be attracted to community	●	●	
Utility expenditure to pay for education materials			●
Regulatory board limits rate of return and flexibility in rate setting	●		
9 to 12 month approval process by regulatory board may complicate conservation program and supply problem	●		
If there is a revenue loss, a rate hike may not be permitted by regulatory board	●	●	●
TECHNICAL / ENVIRONMENTAL			
New source development postponed, reduced or eliminated	●	●	●
Additional connections possible	●	●	●
Reduced operation and maintenance at utility	●	●	●
Reduced waste water volume	●	●	●
Reduced operation and maintenance at sewage treatment plant or septic tank system	●	●	●
Increase capacity and life of sewage treatment plant or septic tank system	●	●	●
Reduced energy consumption	●	●	●
Maintain water supply source level and/or flow	●	●	●
Stream flows may vary (higher if less water extracted; lower if less waste water discharged)	●	●	●
Waste water pollutant concentration increases	●	●	●

FIGURE 3.7
continued

TECHNICAL / ENVIRONMENTAL (continued)	Pricing	Regulation	Education
In marginally low grade sewers; waste water transportation efficiency may decrease	●	●	●
Damage to lawns and gardens if outdoor watering not possible	●	●	●
Industrial or large volume users may develop own source or relocate	●	●	
System improvement because of re-investment (revenue increase)	●		
System degradation if operation and maintenance reduced (revenue loss)		●	●
SOCIAL / POLITICAL			
Community lifestyle maintained	●	●	●
Community water related recreation may be jeopardized	●	●	●
Peer pressure to comply with program		●	●
Regulatory board opposition to program	●		
User and special interest group opposition to program	●	●	
Political opposition to program	●	●	
Fairness of plan must be carefully considered	●	●	
Program may affect politics of community growth and development	●	●	
User and political cooperation with program and understanding of utility operations increased			●
Cooperation with enforcement authority to implement program may be difficult		●	
Cooperation with school department and other community departments to incorporate program may be difficult			●
Well received by users and local government			●

FIGURE 3.7
continued

LEGAL / INSTITUTIONAL	Pricing	Regulation	Education
Bond and debt obligations must be maintained	●	●	●
Regulatory board may determine where excess revenues can be spent	●		
Local, state, and federal laws may limit options to users on how to conserve, particularly health and safety regulations	●	●	●
Contradictions between surface and ground water laws may inhibit comprehensive supply management	●	●	●
Cooperation among community departments may improve or complicate implementation	●	●	●
Cooperation with enforcement agency may improve or complicate implementation		●	
Local, state, regulatory board, and federal laws may limit use of some programs	●	●	
Coordination with school departments and media may be necessary			●
May improve coordination of government bodies involved with program			●
If water supply and waste water operations are independent, coordination of program with each other may be difficult	●	●	●
Regulatory board may not allow pricing for conservation	●		

FIGURE 4.1

Actions to Minimize Adverse Impacts From Supply Management Programs

ADVERSE IMPACTS / ACTIONS	Metering	Leak Detection & Repair	Pressure Reduction	Watershed Management	Evaporation Suppression
IMPACT: Costs of program may result in temporary operating deficit					
ACTION: Short-term loans; temporary subsidy from local government; use emergency funds; borrow from another budget	●	●	●		
IMPACT: Costs of program can not be covered by existing revenues					
ACTION: Implement new water rate ; seek subsidy from local government (see discussion for PRICING under demand management programs – step 3)	●	●	●	●	●
IMPACT: Lack of cooperation from local government may complicate implementation					
ACTION: Develop education program to explain need for program, increase cooperation (see discussion of EDUCATION under demand management programs – step 3)	●	●	●	●	●
IMPACT: Community opposition					
ACTION: Develop education program to inform community of need for program (see discussion of EDUCATION under demand management programs – step 3)		●	●		

FIGURE 4.2

Actions to Minimize Adverse Impacts for Demand Management Programs

ADVERSE IMPACTS / ACTIONS	Municipal Metered	Municipal Unmetered	Municipal Regulated	Investor Owned
FINANCIAL / ECONOMIC				
IMPACT: Revenue decrease				
ACTIONS:				
Raise water rate	●		●	●
Obtain government subsidy	●		●	
Increase taxes to subsidize utility	●		●	
IMPACT: Additional expenditures needed to pay for program				
ACTIONS:				
Minimize cost of program	●	●	●	●
Raise water rate	●		●	●
Obtain government subsidy	●	●	●	
Increase taxes to subsidize utility	●	●	●	
IMPACT: Regulatory board limits				
ACTION:				
Lobby for change in policy			●	●
IMPACT: User expenditures required for water saving devices				
ACTIONS:				
Provide devices free or at low cost	●	●	●	●
Establish customer assistance program	●	●	●	●
IMPACT: User's water bill increase				
ACTION:				
Provide users with information on how to reduce use (i.e., education)	●		●	●
IMPACT: Large volume users may develop own source, relocate, lay off employees; new industry not attracted				
ACTION:				
Modify price structure or regulation to minimize effects on these users, to maintain community economic livelihood	●	●	●	●

FIGURE 4.2
continued

TECHNICAL / ENVIRONMENTAL	Municipal Metered	Municipal Unmetered	Municipal Regulated	Investor Owned
IMPACT: Reduced sewer transportation efficiency				
ACTIONS:				
Replace sewer at greater slope	●	●	●	
Exempt area from conservation program	●	●	●	●
IMPACT: Damage to landscape				
ACTIONS:				
Inform users on how to irrigate most efficiently	●	●	●	●
Design program so that irrigation limited, but still allowed	●	●	●	●
Reuse grey or treated waste water for irrigation	●	●	●	
SOCIAL / POLITICAL				
IMPACT: Public and political opposition				
ACTION:				
Implement education program to improve users' understanding of need for programs	●	●	●	●
IMPACT: Community water related recreation may be jeopardized				
ACTIONS:				
Design program to limit use, but still allow use	●	●	●	●
Exempt community use from program	●	●	●	●
IMPACT: Equity of program				
ACTION:				
Design program very carefully to assure equity among users	●	●	●	●

FIGURE 4.2
continued

LEGAL / INSTITUTIONAL	Municipal Metered	Municipal Unmetered	Municipal Regulated	Investor Owned
IMPACT: Lack of cooperation of community departments may complicate implementation				
ACTION:				
Implement education program to improve their understanding of need for cooperation	●	●	●	●
IMPACT: Limits of regulatory board				
ACTION:				
Lobby for policy change			●	●
IMPACT: Limits of local, state or federal laws				
ACTIONS:				
Lobby for change	●	●	●	●
Obtain exemption	●	●	●	●
IMPACT: Voter preference limits use of revenues				
ACTION:				
Implement education program to inform voters of need for funds	●	●	●	

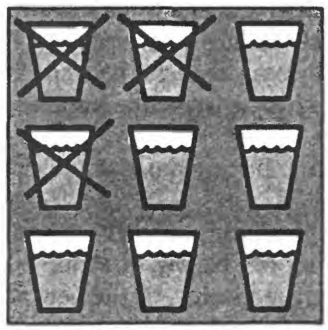
Guidelines

57

FIGURE 5.1

Using Pricing to Design a New Water Rate

A



Express % reduction goal numerically

$$\% \text{ Reduction} = \frac{\text{Goal (Units Water Used)}}{\text{Current Use (Units Water Used)}} \times 100$$

B

Estimate the Elasticity Value (E Value) for your community, or how much water use will drop after the price goes up

Factors to consider when estimating elasticity:

- New Price Level
  (Higher price → Higher E value)
- Average User Income
  (Higher income → Lower E value)
- Average Number of People Per Household
  (Larger number → Lower E value)
- Average Rainfall and Temperature
  (More temperate → Lower E value)

C

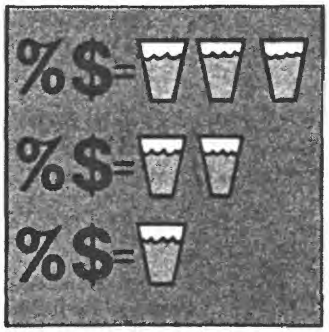


FIGURE 5.1
Continued

Determine % change in price necessary to achieve goal; then calculate new price level

Using the elasticity equation:

$$\text{Elasticity Value} = \frac{\text{\% Change in Water Use (i.e. \% Reduction Goal)}}{\text{\% Change in Price}}$$

You can calculate the % change in price needed by rearranging the equation:

$$\text{\% Change in Price} = \frac{\text{\% Reduction Goal (From Step A)}}{\text{Estimated Elasticity (From Step B)}}$$

If you are using more than one elasticity value for your users, use the % Change in Price equation below:

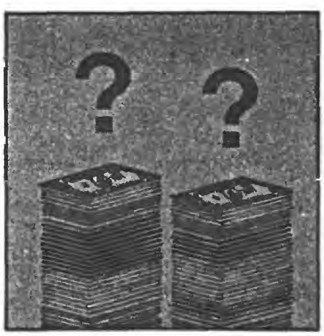
$$\text{\% Change in Price} = \frac{\text{\% Reduction Goal (From Step A)}}{\dfrac{\left(\text{Annual Use of User Group 1} \times \text{E Value for User Group 1}\right) + \left(\text{Annual Use of User Group 2} \times \text{E Value for User Group 2}\right)}{\left(\text{Annual Use of User Group 1} + \text{Annual Use of User Group 2}\right)}}$$

Note: There can be more than two different user groups for your community. If so, just add on their use and elasticity value as user group 3.

Now calculate the new price level:

$$\text{New Price Level} = \left(\text{\% Change in price} \times \text{Existing Price}\right) + \text{Existing Price}$$

D



Calculate what the new revenues will be as a result of the new rate

First calculate the change in use:

$$\text{Change in Use} = \text{\% Change in Price (From Step C)} \times \text{Elasticity Value}$$

Then calculate the difference between existing use and new use:

$$\text{Difference} = \text{Annual Water Use} \times \text{\% Change in Use}$$

FIGURE 5.1 continued

D cont.

If you are using different elasticity values for different user groups, use the equation below:

$$\text{Difference} = \left(\begin{array}{c}\text{Annual Water}\\ \text{Use for}\\ \text{User Group 1}\end{array} \times \begin{array}{c}\text{\% Change}\\ \text{in Use for}\\ \text{User Group 1}\end{array}\right) + \left(\begin{array}{c}\text{Annual Water}\\ \text{Use for}\\ \text{User Group 2}\end{array} \times \begin{array}{c}\text{\% Change}\\ \text{in Use for}\\ \text{User Group 2}\end{array}\right)$$

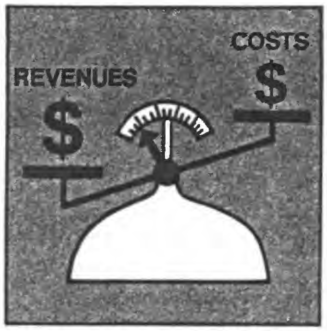
Now calculate the new annual use:

$$\text{New Annual Use} = \text{Current Annual Use} - \begin{array}{c}\text{Difference Between}\\ \text{Existing Use and New Use}\end{array}$$

Finally, use the following equation to determine the new revenues:

$$\text{New Revenues} = \text{New Annual Use} \times \text{New Price (From Step C)}$$

E

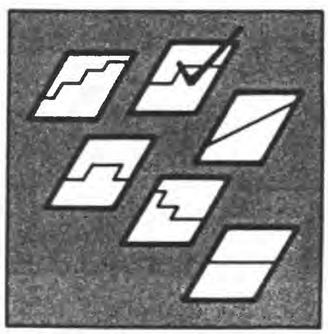


Compare the new revenues to new annual costs

Points to consider:

- As consumption drops, variable costs decrease
- If revenues exceed new annual costs, decrease price level
- If revenues are less than new annual costs, increase price level . . . . or consider using new price structure to adjust revenues

F



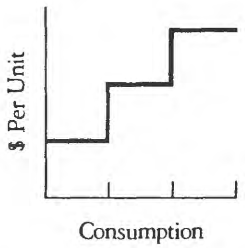
Select a price structure

See figure 5.2 for a summary of the most commonly used price structures.

Review the most common structures listed in Figure 5.2. They are grouped according to whether they would be more appropriate for an average or peak conservation goal. (**Note:** Most structures could be used to achieve either peak or average goals if the price levels are high enough. These groupings are general guidelines only.) A new price structure can modify adverse impacts associated with a new price level. For example, if you have many large-volume water users in your community, consider using a price structure that your large-volume users will feel is fair (excess use structure, uniform unit block structure, seasonal structure). Figure 5.2 lists where each price structure will be most appropriate under **Considerations.**

Figure 5.2

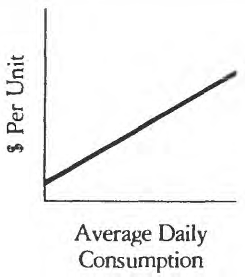
Common Price Structures



Structure: Increasing block
Price per block increases as consumption increases

Best Used For: Reducing average (and sometimes peak) use

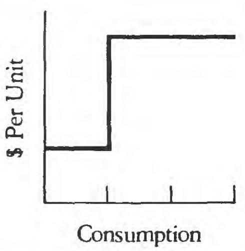
Considerations: Large volume users consider inequitable



Structure: Sliding scale
Price level per unit for all water used increases based on average daily consumption

Best Used For: Reducing average (and sometimes peak) use

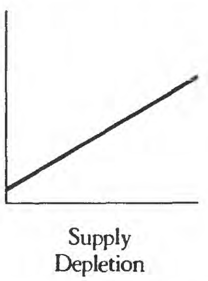
Considerations: Large volume users consider inequitable



Structure: Lifeline pricing
Price for "necessary" water use kept low

Best Used For: Reducing average use

Considerations: Usually used to insure that low income users not unduly burdened by high prices

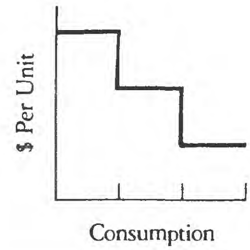


Structure: Scarcity Pricing
Cost of developing new supply attached to existing use

Best Used For: Reducing average use

Considerations: Used where supplies are diminishing (i.e. a finite supply) so that costs for developing new supplies paid for by current users

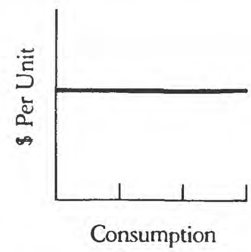
Figure 5.2 continued



Structure: Decreasing block rate
Price per unit decreases as consumption increases

Best Used For: Reducing either peak or average use

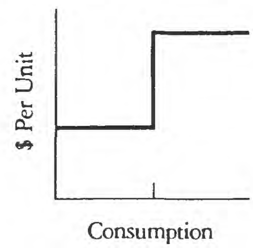
Considerations: Large volume users prefer this structure. When there is sufficient supply, costs of supplying water will probably decrease as consumption increases



Structure: Uniform block rate
Price per unit is constant as consumption increases

Best Used For: May be somewhat effective in reducing average use

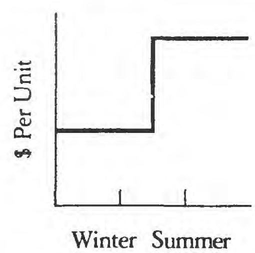
Considerations: Large volume users consider this structure equitable



Structure: Excess use
Price level significantly higher for all water used above average, usually determined by winter use

Best Used For: Reducing peak use

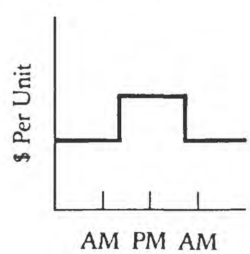
Considerations: Large volume users consider equitable



Structure: Seasonal
Price level during season at peak use (summer) higher than level during winter

Best Used For: Reducing peak use

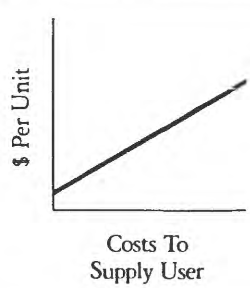
Considerations: Large volume users consider equitable. Effective for summer tourist community



Structure: Daily peak load
Price level higher during hours of peak use

Best Used For: Reducing peak use

Considerations: Expensive to implement since sophisticated meter reading system would be necessary



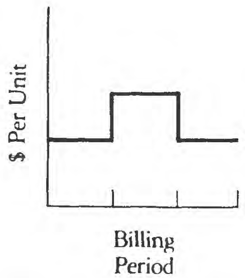
Structure: Spatial pricing
User pays for actual costs of supplying water to his establishment

Best Used For: Discouraging new or difficult to serve connections

Considerations: Used in areas where distribution system is being expanded rapidly and being expanded in difficult to serve areas (long mains, pumps, etc.)

Figure 5.2

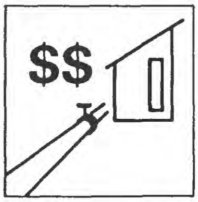
continued



Structure: Average variable
Price per unit varies according to actual expenditures during billing period

Best Used For: Does not affect use

Considerations: Should be used *only* where costs vary significantly between billing periods



Structure: Hook up fees
Charge at time of connection

Best Used For: Discouraging new connections

Considerations: Usually used to recover connection costs or if system nearing capacity, to discourage new hook-ups

Structure: Tax incentives
Community gives tax credits, reductions, when users have implemented other conservation devices

Best Used For: Reducing either peak or average use

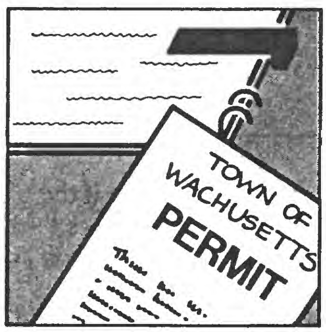
Considerations: Allows for voluntary user choice to use conservation devices

FIGURE 5.3

Methods of Regulation

Restricting a specific water use

Restricting the time during which a specific use is allowed



Requiring permits for some water uses

Restricting the quantity of water which can be used

Requiring the installation of appliances and equipment which use a minimum of water

Review Figure 5.4 which lists the most commonly used regulations for the conservation goal each has the most potential to achieve. Next, from the group of regulations most effective for your conservation goal, choose the one (or combination) that could best be used in your community. Remember, regulations may not be allowed in your community because local laws prohibit them. Some regulations (such as limiting specific uses) may not be useful because they require enforcement and you may not have the capability to enforce. Some regulations (such as rationing, plumbing code changes and appliance retrofit) may not be effective because of user and political opposition.

FIGURE 5.4

Regulations According to Conservation Goal

	Short or Long Term Goal	% Reduction in Water Use (LOW — HIGH)
FOR AVERAGE DEMAND PROBLEMS		
Restricting Quantity: Rationing*	S,L	
Restricting Quantity: Moratorium on new hook-ups	S	
Restricting Use: Restaurants serve water only on request	S	
Requiring Special Equipment: Plumbing code changes	L	
Requiring Special Equipment: Appliance Retro Fit	L	
FOR PEAK DEMAND PROBLEMS		
Restricting Use: Ban car washing, irrigation, etc.*	S,L	
Restricting Time: Limit car washing, landscape irrigation by months, days	S	
Requiring Special Equipment: Landscape irrigation with hand held hose only	S	
Requiring Permit: Pool filling	L	
Restricting Time: Limit hours for car washing, irrigation, etc.	L	

*Probably not well accepted on long term basis.

FIGURE 5.5

Education Campaign Methods According to Cost and Community Size

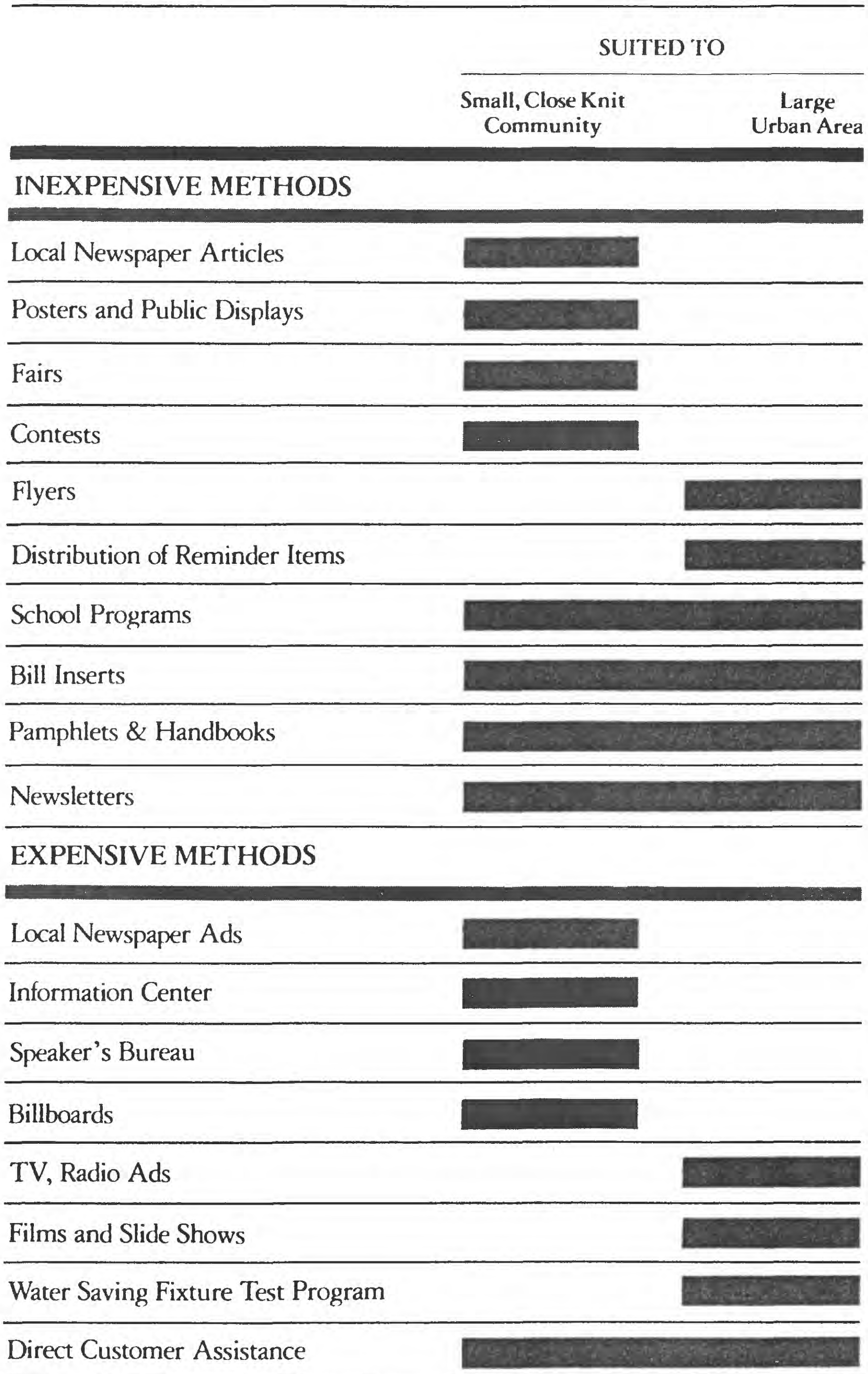
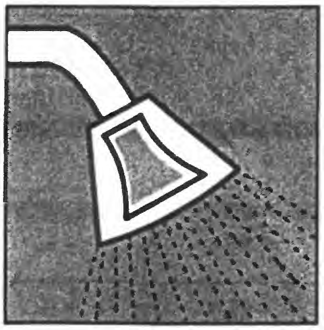


FIGURE 6.1

Hardware/Software for Demand Management Programs



Use Water Saving Fixtures

- Cost should be approximately equal to conventional fixtures
- Should be easily maintained
- Should reduce water use significantly
- Should gain easy consumer acceptance
- See Figures 6.2, 6.3

Institute Reuse/Recycle Systems

- Very Expensive
- Very effective (up to 99% reduction in water use)
- See Figure 6.4

Promote User Habit Changes

- Education Programs are key to success
- See Figure 6.5

Water-saving fixtures: Water-saving fixtures reduce water use by modifying the design of a conventional plumbing system. There are about 60 different types of fixtures, all capable of reducing water use. Of these 60 types, about 20 are versatile enough to be used widely. Figure 6.2 lists the 20 fixtures which are likely to be of most interest to you. If you have an unusual situation, such as your system is in a remote area, see Figure 6.3 which lists the other fixtures.

FIGURE 6.2

Commonly Used Water Saving Fixtures According to Conservation Goal

	Short or Long Term Goal	COST: Capital	COST: Compared to Conventional Fixtures
FOR AVERAGE DEMAND PROBLEMS			
Shallow Trap Toilet	L	$75	=
Dual Flush Toilet	L	$85	=
Toilet Tank Inserts	S,L	$.90-4.00	
Shower Flow Restrictors	S,L	$.75-25.00	=
Faucet Aerators	L	$1-5	=
Hot Water Pipe Insulation	L	$.50/ft.	↑
Fog and Spray Nozzles (IND./COM. ONLY)	S,L	$150	
Vacuum Flush Toilet	L	Expensive	↑
Pressurized Flush Toilet	L	$360	↑
Multiple Rinse Tanks (IND./COM. ONLY)	L	Expensive	
Counter-Flow Rinse (IND./COM. ONLY)	L	Expensive	↑
Automatic Flow Regulators (IND./COM. ONLY)	L	$190	
FOR PEAK DEMAND PROBLEMS			
Drip Irrigation Systems	L	$7-30	=
Time Controlled Sprinkler	L	$70 and up	↑
Moisture Indicators	S	$.05-25.00	=
Hose Attachments	L	$1-40	=
Swimming Pool Covers	L	$220-4,800	↑
Tensiometers	L	$15-30	↑

FIGURE 6.2

Commonly Used Water Saving Fixtures According to Conservation Goal

% Reduction in Water Use (0% – 50% – 100%)	Use Pattern Similar ?	Comments
	✓	Very well accepted by users.
	✓	Minor change in use pattern required.
	✓	Retro-fit to conventional fixtures.
	✓	Some retro-fit to conventional fixtures.
	✓	Well accepted by consumers.
	✓	Saves up to 8 gals. per capita per day.
Variable	✓	Retro-fit to conventional fixtures.
	✓	Mixed acceptance by consumers.
	✓	Requires electricity.
		Change in process required.
		Change in process required.
	✓	Retro-fit to conventional plumbing.
Variable	✓	For gardens, trees, shrubs only.
Variable	✓	Needs electricity.
Variable	NO	Mixed acceptance by consumers.
Variable	✓	Well accepted by consumers.
	NO	Mixed acceptance by consumers.
Variable	NO	Mixed acceptance by consumers.

FIGURE 6.3

Water Saving Fixtures to Consider Under Special Conditions

	Cost
DOMESTIC INDOOR FIXTURES	
Chemical Toilets: Self-contained	$100
Fresh Water Flushing: Self-contained	$60
Fresh Water Recirculating: Self-contained	$250
Waste Water Recycling Toilet	$1400-1650 (capital) $100-300 (installation)
Pressurized Tank Toilet	$40 (Retrofit costs to conventional unit)
Controlled Volume Flush Toilet	—
Oil Flush Toilet	$2500 (Not installed)
Composter Toilet	$950 (Not installed or delivered)
Packaging Toilet	—
Incinerator Toilet	$395 (Capital) $75 (Installation)
Freeze Toilet	$320 (Not installed)
Leak Signaling Ballcock for Toilet	$6-10
Tank Flushing Valve for Toilet	Insignificant
Variable Flush	$5 (Retrofit)
Air Assisted Shower Head	$275
Self Closing Mixing Valves	Same as conventional (Knee/ft. operated are $75-120 or more)
Thermostatically Controlled Mixing Valve	$60
Pressure Balancing Mixing Valve	$45
Instant Hot Water	$100 (Not installed)

FIGURE 6.3
continued

	Cost
DOMESTIC INDOOR FIXTURES (continued)	
Electrically Controlled Plumbing	New installation not much more than conventional plumbing
Hot Water Recirculation	Hundreds of dollars
Automatic Dishwasher	$175-350
Automatic Clothes Washers–Suds Saver	$15-20 more than conventional
Functionally Designed Sinks/Tubs	Not significantly more than conventional
Bidets	$70
Bottled Water	$.50/gal.
Solar Stills	$500
Chilled Water Dispenser	$200 more than conventional luxury model refrigerator
INDUSTRIAL / COMMERCIAL FIXTURES	
Cascading Rinse	Varies
Air Blown Rinse	Varies
Wetting Agents	Varies
Improved Tank Design	Varies
Improved Racking	Varies
Improved Air/Water Contact in Cooling Towers	$650,000 (For a 420,000 gpm tower)

Water Reduction, Compared to Conventional Use	Comments
100%	Mostly for recreation areas/vehicles.
99%	Mostly for recreation areas/vehicles.
98%	Mostly for recreation areas/vehicles.
45%	Mostly for remote areas.
50-60%	35-120 psi needed in supply line. Possible for small development.
—	Mostly for marine use not adaptable to home.
99%	Suitable for areas with waste water disposal problems
100%	Suitable for areas with waste water disposal problems
100%	Needs electricity. Difficult to dispose of waste. Use in remote areas.
100%	Needs power, regular maintenance for incinerator. Use in remote areas.
100%	Difficult to dispose of wastes; needs power. Use in remote areas.
Potential savings is high	Loud noise when there is a leak.
Potential savings	More efficient flapper type.
50%	User depresses valve for as long as necessary. Not as acceptable as dual flush.
83-95%	Needs power. Too expensive for wide scale use.
Potential savings more in public lavatories	Most suitable for use in public lavatories.
Reduces waste water while waiting for correct temperature	"Luxury" item.
Potential savings	Mostly for showers (avoid thermal shock). "Luxury" item.
Eliminates waste while waiting for hot water	Heater near tap. Cost effective for new developments only.

Water Reduction, Compared to Conventional Use	Comments
75%	Reductions not documented. Probably cost-effective for new developments only.
Eliminates waste while waiting for hot water	Cost effective for new developments only.
Could save, if properly used	Widely used.
20-26%	Not now generally used.
Potential savings	Reduces volume in tub/sink to minimum necessary. Limits aesthetics of fixtures.
Potential savings	Not culturally acceptable in America.
Users generally do not waste	Usually cooking and drinking only.
—	Mostly for use where water is brackish.
Saves by eliminating running water	"Luxury" item.
75% – in combination with baffles, agitation	Adaptation to existing plant design limited.
Varies	Adaptation to existing plant design limited.
Varies	Use in existing process limited.
Varies	Could be expensive to replace existing tanks.
10-95%	Use limited.
—	Mostly for energy conservation.

FIGURE 6.4

Reuse/Recycle Systems According to Conservation Goal

	Short or Long Term Goal	% Reduction in Water Use (LOW — HIGH)
FOR AVERAGE DEMAND PROBLEMS		
Direct reuse of process or cooling water within industrial/commercial establishments	S,L	
Treatment and reuse of process or cooling water within industrial/commercial establishments	L	
Direct recycle of process or cooling water within industrial/commercial establishments	L	
Treatment and recycle of process or cooling water within industrial/commercial establishments	L	
Air cooling of cooling water within industrial/commercial establishments	L	
Cooling towers for cooling water within industrial/commercial establishments	L	
Treatment and reuse of waste water by municipality	S,L	
Treatment and recycle of waste water by municipality	L	
Treatment and recycle of grey water within residential homes	L	
Treatment and reuse of waste water within residential homes	L	
FOR PEAK DEMAND PROBLEMS		
Treatment and reuse of waste water by municipality	S,L	
Direct reuse of grey water within residential homes	S,L	

FIGURE 6.5

User Habit Changes According to Conservation Goal

	Habit Change	% Reduction in Water Use (LOW – HIGH)
FOR AVERAGE DEMAND PROBLEMS		
Toilet	Do not use as wastebasket.	
Shower	Use only for rinsing. Shower for only 5 minutes.	
Tub/Sink	Turn off water while shaving, brushing teeth. Fill tub 1/4 full for bath.	
Dishwashing	Rinse dishes in ponded water or with spray attachment.	
Food Preparation	Wash vegetables in ponded water. Refrigerate water for drinking.	
Automatic Washers	Use only with full load.	
FOR PEAK DEMAND PROBLEMS		
Landscape Irrigation	Measure water when irrigating. Irrigate only in early morning or late evening, and only when necessary.	
Car Washing	Use bucket and spray attachment on hose. Wash car only when necessary.	
Pool Filling	Fill to level which minimizes splashing. Drain only for necessary repairs.	

APPENDIX A

Sample lecture

Water Conservation Lecture

During the summer of 1980, the community of SEWARD, NEBRASKA lost the use of one well entirely, and had to drastically reduce the use of two others. This left Seward with only six wells. The sources of the problem were many -- a summer with unusually high temperatures and low rainfall, an increase in outdoor and agricultural irrigation uses, and steadily increasing population.

What were the town's options in the near term, as well as the long term?

- Reducing the consumption through education, regulation or pricing?

- Improving the supply system through leak detection and repair, or metering or meter maintenance?

How should various options be evaluated, and the soundest techniques and devices chosen?

What is the logical sequence for making decisions leading up to choosing hardware and techniques that solve problems, are acceptable to the community, and meet the town's goals?

The answers to these questions are the basis of the water conservation project.

Whether the problem is long term or short term, peak or average, in Kansas City, MO. or elsewhere, the 7-step planning approach applies.

Based upon interviews conducted with water supply managers and planners and a literature search, the project represents the first effort to develop a mechanism specifically to achieve water conservation.

For some of you, the entire methodology will prove useful. Others of you will find value in just several of the steps. Take from it what you can use. Our basic assumption is that you have a shortage of water, and water conservation is one viable option to solve your problem.

The planning approach is designed to help you to:

- consider the full range of options
- evaluate the advantages and disadvantages of various options
- assess the potential impacts of each option on your utility, the users and the community

As in any planning methodology, terminology is important, and we will spend some time describing the use of various terms.

Also, public participation can play a major role in the successful development and implementation of a water conservation program. While we won't spend much time on public involvement techniques, remember that public participation should begin with the problem identification stage.

The first slide contains an outline of the planning steps. Let me run through it quickly to give you a sense of the approach, then we will go through the seven steps in detail.

The first step is to analyze the problem and establish a conservation goal. There are three aspects of this first step:

1. Evaluating whether the community has an average demand problem or peak demand problem;

2. Establishing the percent reduction needed; and

3. Deciding whether the problem is long-term or short-term.

The next step requires an analysis of whether your goals can best be met at the supply end--making improvements in the water supply system -- or in the demand or consumption side of the system, or a combination of both.

The third step calls for you to analyze the cost effectiveness and impacts of various management options.

On the supply side, you analyze 5 management programs:

- Metering and meter maintenance
- Leak detection and repair
- Pressure reduction
- Watershed management
- Evaporation supression

If you choose to work on the demand side, the third step in the approach calls for analyzing the impacts of one of three tools to reduce water consumption:

- Price - an economic incentive, encouraging users to conserve to save money

- Regulation - a legal incentive which requires users to conserve to comply with the law
- Education - a voluntary incentive which seeks to change behavior or attitude through information and explanation

You may choose to mix price, regulation, and education to develop a successful program. Experience has shown that education plays a crucial role in raising the effectiveness of the other incentives, especially in a crisis situation.

It is important to explain the situation to consumers, describe the action being taken or proposed, and explain what consumers should do and why these actions are necessary.

In Step 4, you consider ways to avoid or minimize any adverse impacts evident in the supply and demand management programs you are reviewing.

In Step 5, you choose and design the specific supply and/or demand management programs you will use.

For demand management programs, this includes choosing new water rates, water use restrictions, or educational materials.

In Step 6, you choose devices -- the actual hardware or techniques -- that physically reduce water use.

For supply management, the hardware/techniques include the five (5) programs already mentioned. For demand management, they include:

- water saving fixtures
- reuse/recycle systems
- user habit changes

Supply devices can be used alone, or in conjunction with a demand program.

In the final step, you combine the results of your various analyses and decisions in the form of an implementable water conservation plan.

Let's look at the seven step approach in depth. I will present steps 1 - 4 now, and 5 - 7 after lunch.

STEP (1), IDENTIFY PROBLEM/ESTABLISHING A CONSERVATION GOAL. This is the key to the planning procedure because all decisions are based on whether the various alternatives under consideration can meet the goal.

The goal is defined by 3 factors or needs:

1. peak and/or average use has to be reduced
2. high or low percentage reduction in use is needed, and
3. short or long-term time span

Peak use refers to the summer average daily use caused by outside uses. Average use refers to the annual average use.

When stating percentage reductions, 1-10% is considered a low percentage reduction, over 10% is considered high.

A short-term time span is approximately one year or less, while long-term is a year or more.

STEP (2), CHOOSING A SUPPLY AND DEMAND MANAGEMENT PROGRAM. This step is conceptually straightforward. Yet it requires considerable analysis and planning.

The goal of supply management is to improve efficiency and reduce waste within the production and delivery system. It is often the best long-term option because conservation goals are met without depending on water users. While this is standard operating procedure for a well-run utility, sometimes a water supply problem can be solved through better management alone.

Supply management is best used for long-term, low percent reduction goals. It may be useful for short-term goals if your system has not been adequately maintained over the years. It may also be useful for peak use reduction if the problem is caused by inadequate storage or pipe capacity.

Some of the advantages of supply management include:

- the program is under your direct control
- revenues can increase
- slack is maintained in system

Some of the disadvantages of supply management include:

- large capital expenditures
- the options are labor intensiveness
- a long lead time

Your analysis may require much time or little time, depending upon past studies and experience. Supply management yields long-term improvements in the system. Costs are high, though the "crisis mentality" created during a period of water shortages may help to build a potential constituency in favor of long-term changes, even if they prove costly.

If supply management is not adequate to achieve your conservation goal established in Step 1, then consider demand management. Demand or consumption management requires water users to modify their behavior and reduce consumption in a home or business setting. It has the potential to achieve any conservation goal.

In general, the advantages include:

- Versatility
- Low expense (potential)
- Less labor intensive
- More rapid implementation

The disadvantages include the possibilities that:

- Revenues may drop
- Results dependent on users' cooperation
- Political support required
- Opposition or resistance from users

STEP (3), ANALYZE THE COST EFFECTIVENESS AND THE IMPACTS OF VARIOUS SUPPLY AND DEMAND MANAGEMENT OPTIONS

For supply management, there are five (5) programs:

- Metering and meter maintenance
- Leak detection and repair
- Pressure reduction
- Watershed management, and
- Evaporation supression

This type of supply side analysis is not unique to water conservation. Many of you do this as a matter of good management practices. What is unique, however, is a recognition of how to use improved supply management as a way to meet water conservation goals.

Metering

Metering itself does not reduce water consumption. It provides an accurate accounting of all the water used throughout the system, This information is needed for planning leak detection and repair programs, pricing programs, and other conservation efforts. If the utility decides to install new meters for all its users, and in conjunction, implements an appropriate water rate, a long-term reduction in water consumption can be realized.

Leak Detection and Repair (LD&R)

LD&R can substantially reduce water waste within the system. LD&R also includes unaccounted-for water analysis.

Some categories of unaccounted-for water include abandoned services, inaccurately metered water, illegal hook-ups, and defective hydrants.

There are two basic methods of conducting surveys: if your system is losing water primarily through leaks, a system scan would be most effective; if your system is losing water through illegal hook-ups, or meter under-registration (e.g., unaccounted-for water), a water audit would be most effective.

Leak detection and repair programs are almost always cost-effective. They are best for long-term, low percent reduction goals. If the system has not been well maintained, leak detection might achieve a high percentage reduction goal if used as a conservation technique.

Pressure Reduction

Consider pressure reduction if there are a significant number of areas where pressure is high (80 lb/sq in. or greater).

Pressure-reducing valves installed in street mains or individual services can reduce waste simply by reducing the amount of water passing through the system. Pressure reduction is used for meeting long-term, low percentage reduction, average use goals.

Watershed Management

Watershed management is used primarily to protect or increase water flows to the supply and to protect ground water sources. Techniques include: (1) forestry management (thinning forests in the watershed); (2) zoning ordinances to prohibit inappropriate land uses within the recharge area; (3) purchasing surrounding watershed land to maintain it under your control; and (4) sub-division regulations which allow development to proceed in a manner which does not harm the watershed. Watershed management is most useful for meeting long-term, low percentage reduction, average use goals.

Evaporation Suppression (reservoir covers)

Evaporation suppression is only useful when evaporation is responsible for significant water loss (greater than 10%). It is used in more arid places.

The impact analysis for each supply management program entails a review and analysis of the following impacts:

- Financial and economic,
- Technical and environmental, and
- Legal and institutional

In your handbooks, Figure 3.2 details a set of impacts that may occur as a result of undertaking the different supply management programs. The kind of information you'll see is shown on this slide. (Point out how info is presented then read example).

Use the list of impacts as a guide, and concentrate only on those that are relevant to your setting.

Now let's turn to demand management programs. Here, you analyze the cost effectiveness and the impacts of various demand management options.

In demand (consumption) management programs, you have a choice of three tools to encourage users to reduce their use:

- Pricing
- Regulation, and
- Education

In many cases, you will combine the three tools.

All three programs can be relatively inexpensive to implement.

Pricing - If a pricing program is carefully designed, it can generate excess revenues while it encourages use reductions. Therefore, it should be considered as part of many conservation programs.

Pricing is best used for long-term, low percent reduction goals.

The costs of a pricing program are mostly one time costs. These costs will be for a rate survey, or cost of service study, possibly costs to institute a new billing system, and, if regulated, costs for an attorney or someone to present your new rate before the public utilities commission.

The major disadvantage to pricing is user opposition, especially from industry, local government, and the public utility commission.

Regulation - This program can be used to achieve any conservation goal. It is most effective for short-term, high and low percentage reduction goals, and long-term, low percentage reduction, average or peak goals. Regulation can be quickly implemented and can achieve immediate results.

Costs to implement regulation are limited to costs of enforcement. If you do not have the authority and/or manpower for enforcement, you may have to secure the assistance of the police department or the local government.

The major disadvantages to using regulation are that revenues will decrease as consumption drops and some users may oppose limitations on how they can use their water.

Education - Education programs can help any conservation program because education is generally well received by the public and can reduce user opposition to other programs. It is effective for any goal, except long-term, high percentage reduction goals.

The major disadvantages to education are that revenues may decrease as consumption decreases, and results are less reliable than other programs because of its voluntary nature.

Impacts - The types of impacts for demand management programs include:

- What a change in revenues, up or down, will mean to the utility or company;

- How a change in water rates might affect high volume users, including potential impact on employment;
- What the effect of reduced water use, such as reduced wastewater treatment costs, postponing new source development, potential damage to landscaping, and increasing the potential for adding new connections, will have on the utility or company;
- How the public will react to the conservation program, and to the perceived equity of the program;
- What it will cost to implement the program; and
- How laws, regulations, or ordinances create or limit options.

In your handbooks, we have included tables (figures 3.4 - 3.7) that list most of the impacts for demand management. Let's look for a moment at a sample impact table for demand management programs. (Read info on slide).

STEP (4), IDENTIFY ACTIONS TO MODIFY ADVERSE IMPACTS

In Step 3 you identified the impacts of various supply and demand management approaches. In Step 4 you identify actions which can minimize the adverse impacts associated with each program, and then choose the best program.

Figures 4.1 and 4.2 in your handbooks list potential actions you could take to minimize these adverse impacts.

Let's look at samples of the charts on ways to modify impacts to see how they are structured.

(Show chart page as examples; point out several examples.)

(Supply, i.e., inadequate funds -- need more revenues -- increase price, i.e., cannot meet goal -- consider demand management.)

(Demand i.e., community opposition -- develop education program, revenue loss due to conservation, increase price).

We have now looked at steps 1 - 4 in some detail. Between now and lunch, work as a group on steps 1 - 4. The instructions are in your workshop materials. (The bright green book with the plastic binding.) The workshop faculty will be stopping by your tables periodically to answer questions. You may not complete step 4 before lunch, but don't worry about finishing. After lunch, I will present steps 5 - 7 in detail. You will then have time to pick up where your group has left off.

STEP (5), CHOOSE SPECIFIC SUPPLY AND/OR DEMAND MANAGEMENT PROGRAMS

Step (5) is the place to begin detailing the specific elements of a conservation program.

Let's start with the supply side.

Once you have analyzed the cost-effectiveness, impacts, and modifications of the impacts of supply management programs, you'll be able to select programs most effective for your community. Review each supply management program again to be sure that it has the potential to achieve the conservation goal you have established. After this review, proceed with Step 6 - Evaluate and Select Hardware/Techniques for the supply management programs' specific equipment or plan. This step is much more involved for demand management.

After you have completed the analyses in Steps 3 and 4, choose the programs that are the most cost effective and have most beneficial impacts. Step 5 is the place to begin detailing the specific elements of a conservation program. On the demand side, this includes:

Pricing: establishing a new water rate

Regulation: choosing water use restrictions

Education: choosing education tools/devices/campaign materials

Now, I will address each program in detail.

Pricing - There are two aspects of a pricing policy: the price level (price per unit) and price structure (price level variations based on time, quantity and/or type of use).

Price level is more important because only when the price level is high enough -- regardless of structure -- will users consider how they are using water and conserve.

There are six basic steps for designing a new water rate.

A. The first step is to determine the goal for percent reduction; for example, 5% or 10%.

B. Estimate the decrease in water use by consumers in response to price increases. This change is termed "price elasticity of demand". We will discuss this concept in more detail later.

C. Determine the percent change of price necessary to achieve your goal.

D. Calculate the new total revenue, as a result of the new price.

E. Compare the new total revenues to your annual costs (remember, variable costs will drop as water use drops).

   - if revenues too high, may need a lower price
   - if revenues too low, may need a higher price
   - a price structure can change your revenues up or down

F. Select a price structure - price structures are used to modify price levels so that the total water rate (level and structure) can achieve one or more of the following:

- cover the true cost of supplying water
- be equitable to all users
- be easily understood and accepted by consumers
- discourage waste of water and subsidization of consumption of one user group by another
- be politically acceptable.

Twenty common price structures are listed in Figure 5.2 in your notebook. They are grouped by their applicability to meeting peak or average conservation goals. Like the other charts, use them as a resource to pick a structure that meets your goal.

When using pricing there are several guidelines to keep in mind:

- responses to a price hike generally diminish as users become accustomed to paying more;
- pricing is most effective in reducing peak use among residential users and average use among large volume users;
- in the Great Plains, the price of water has been traditionally low and responsiveness to price hikes is generally low, especially among residential users;

- changing a water rate often requires a long lead time
- only propose a water conservation price hike once -- or community opposition may develop.

Regulation - Choose a regulation program from the following methods:

- restricting a specific water use
- restricting the time/season during which a specific use is allowed
- requiring permits for some water users
- restricting the quantity of water which can be used
- requiring appliances and equipment which use a smaller amount of water

Various regulations have different potentials for meeting conservation goals.

Another chart (figure 5.4) in your workshop materials summarizes these potentials.

Keep in mind that some regulations may be prohibited in your community. In other cases, regulations may require enforcement you are not able to provide, e.g., limiting a new specific use. Finally, some regulations, such as rationing or plumbing code changes, may not be effective because of user or political opposition.

Practical experience has yielded several recommendations:

- reserve stringent regulations, such as rationing and use bans, to high percentage reduction, short-term goals, and to periods of extreme emergency, such as extended drought;
- use less stringent regulations, such as plumbing code changes and limits on specific uses, for long-term, low percentage goals;
- most regulations that limit outdoor uses are easy to implement and can achieve water use reductions immediately;
- all regulations require some level of enforcement -- make sure enforcement staff is available.

Education - Education can stand on its own, or augment price and regulation programs.

The number of educational tools are many -- it is important to match the right educational tools and techniques to your community setting.

Each available tool is bound by two factors:

- type of community
- budget resources

A chart in your workshop handbook (figure 5.5) presents a partial list of educational methods used to encourage water use reduction.

Some are better suited to small communities than large; some are more expensive than others.

When developing educational programs, work with communications professionals. The assistance of a local newspaper editor or public relations practitioner can help yield a better, more focused program.

Past experience has provided some education-related recommendations:

- Educational programs should help users to understand why conservation is needed and should provide specific recommendations on how to conserve.
- Education is most effective during a water crisis when user awareness is high.
- Keep conservation messages short and simple.
- Provide detailed data on how to reduce consumption after getting people's attention.

- Mix the media. Use visuals to strengthen claims or message. People remember pictures better than words.
- Reach as many consumers as possible with as many techniques as possible, budget allowing.
- Users need constant reminders of the need to conserve.
- School programs are sometimes successful when children teach their parents/siblings water-saving habits.

All three of the demand side strategies, pricing, regulation, and education, require the utility to forecast the impact of the selected program on the amount of water conserved. This is particularly difficult for pricing strategy. As indicated before, the response of water consumers to a change in price is measured by the "price elasticity of demand."

PREDICTING RESPONSE TO PRICING

It will be useful at this point to elaborate on this concept. Price elasticity of demand is defined as follows:

$$\text{Elasticity Value} = \frac{\%\ \text{change in water use}}{\%\ \text{change in price}}$$

The Elasticity Value is the way that economists measure individuals' response to price changes. Every individual and every community will respond differently.

The Elasticity Value can range from zero to -00. It is negative because the price of water and water use move in opposite directions. For water, some typical Elasticity Values are:

	Range
Total residential use	-.05 to - .45
Indoor use	-.07 to - .30
Outdoor use	-.22 to -1.57
Total Commercial/Industrial use	-.56 to -1.33

The more responsive water is to a change in price, the more negative the elasticity. For example, outdoor use is more responsive (more elastic) than indoor use. Conversely, indoor use is less responsive (less elastic) than outdoor use.

There are many factors which influence the price elasticity of demand for water. Some of the important ones are:

Amount of price increase: the larger the increase, the greater the response

Average user income: the higher the income, the less the response

Price level: the higher the income, the less the response on the part of users

<u>Average number of people per household</u>: the larger the number, the less the response

<u>Average rainfall and temperature</u>: the more temperate the climate, the less the response

In the case study, the elasticity values were assumed to be as follows:

<u>Shortfall Elasticities</u>

Residential	-.40
Commercial & Municipal	-.70
Industrial	-1.30
All Users	-.46
Summer	-.80
Winter	-.13

The elasticity values in your community will be within these same ranges. As a utility manager you will have to estimate your elasticity values after evaluating the factors which influence price elasticity. For example, if your community had a relatively low user income and an arid climate, you could expect that the demand would be relatively elastic.

Let's consider briefly how you would use elasticity to forecast user response in Shortfall. Suppose you decided to raise the price of water in Shortfall by 10% to residential users. The following formula can be used to determine the decrease in water use:

$$\%\text{ change in water use} = \text{Elasticity Value} \times \%\text{ change in price}$$
$$= -.40 \times 10\% = -4\%$$

or conversely, suppose that you decided you needed to determine the price necessary to reduce residential water use by 10%. The correct formula is:

$$\%\text{ change in price} = \frac{\%\text{ change in water use}}{\text{Elasticity Value}}$$
$$= \frac{-10\%}{-.40} = 25\%$$

A 25% increase in price is necessary to reduce consumption by 10%. A detailed discussion of these calculations is available in the handbook.

STEP (6), CHOOSE SPECIFIC HARDWARE AND TECHNIQUES

In this step, you select techniques that will reduce water use in your community.

For supply management the specific hardware/techniques will depend on your individual system and preference. For example, for metering, you will have to choose the type of meter for installation and design a meter replacement/maintenance schedule.

For leak detection and repair, you will have to choose a system survey method. For example, you will have to choose between aquaphones, geophones, or electronic surveys for leak detection. For pressure reduction, you will need to select the brand and size of the pressure reducing valves. Continue this exercise for the other supply management options.

Now let's return to the analysis of demand management programs.

There are 3 categories of hardware/techniques for Demand Management Programs:

- water saving fixtures
- reuse/recycle systems
- user habit changes

Again, you need to review each technique to determine which is most applicable to your community.

Water Saving Fixtures:

They reduce water use by modifying the design of a conventional plumbing system.

Water-saving fixtures, recommended:

- should be approximately equal to conventional fixtures
- should not require excessive maintenance
- should reduce water use significantly
- should gain easy acceptance by consumers

There are many types of water-saving fixtures. Of more than 60 different types, the 20 most cost-effective fixtures are detailed in a Figure 6.2 in your handbook. Here is a sample page -- (choose 1 or 2, and describe. Show how to use the chart).

Reuse/Recycle Systems:

They reduce water use by using the same water more than once. They are best for long-term, high percentage goals.

Reuse: Using the same water for more than one function with little or no treatment prior to discharge.

Recycle: Using the same water repeatedly, usually with some treatment.

They are generally:

- very effective
- very expensive

Figure 6.4 in your handbook details the eight situations in which reuse/recycle systems are used most.

User Habit Changes

User habit changes are designed to reduce water use by changing the user's behavior pattern. They are best for long-term, low percentage, and short-term, high percentage goals.

There are two basic behavior pattern changes:

- use less water to perform the same function
- perform the function less often

Developing a long-term or short-term education program is the key to affecting user habit changes

- users need information before they change their routine behavior
- users need constant reminders and reinforcement if user habit changes are to continue.

Figure 6.5 in your handbook matches some habit changes with conservation goals. (Point out how to use this slide.)

STEP (7), SUMMARIZE CONSERVATION PLAN

To summarize your conservation plan, draw together the results of the prior steps.

GOALS:

SUPPLY MANAGEMENT: HARDWARE AND TECHNIQUES

DEMAND MANAGEMENT: HARDWARE AND TECHNIQUES

This concludes the formal presentation of the seven-step water conservation planning approach. Are there any questions?

Please continue with steps 5 - 7 of your exercise. The workshop faculty will once again visit each table to answer your questions.

APPENDIX B

Workshop Evaluation Forms

EVALUATION
WATER CONSERVATION WORKSHOP

1. How similar is the 7-step approach to the way you would have analyzed and planned for a water conservation problem before you attended this workshop?

1	2	3	4	5
/	/	/	/	/
basically the same		somewhat similar		very different

2. How helpful will the 7-step approach be to you in analyzing and planning for water conservation needs in your community?

1	2	3	4	5
/	/	/	/	/
not helpful at all		helpful		very helpful

3. a. Do you forsee developing a water conservation strategy for your community in the near future?

( ) yes
( ) no

b. If yes, do you plan to follow the 7-step approach?

1	2	3	4	5
/	/	/	/	/
no		will use the approach as a guide		will follow approach exactly

4. Apart from the 7-step approach itself, how useful was the information presented at the workshop:

a. In general?

1	2	3	4	5
/	/	/	/	/
not useful at all		useful		very useful

b. Information on impacts and mitigation measures?

1	2	3	4	5
/	/	/	/	/
not useful at all		useful		very useful

c. Information on pricing, price elasticity, and pricing structures?

1	2	3	4	5
/	/	/	/	/
not useful at all		useful		very useful

d. Other: ____________________

1	2	3	4	5
/	/	/	/	/
not useful at all		useful		very useful

5. How could the 7-step approach be changed to make it more relevant to your needs?

____

____

____

6. Please list any areas not covered in the workshop about which you feel it would be useful to receive information:

____

____

____

7. Please rate each of the workshop sessions on the value of the content and the method of presentation:

(a) Presentation of 7-step approach (lecture)

Content:

1	2	3	4	5
/	/	/	/	/
poor		adequate		excellent

Method of Presentation:

1	2	3	4	5
/	/	/	/	/
poor		adequate		excellent

(b) Group Exercise: designing a water conservation plan

Content:

1	2	3	4	5
/	/	/	/	/
poor		adequate		excellent

Method of Presentation:

1	2	3	4	5
/	/	/	/	/
poor		adequate		excellent

(c) Wrap-up and Exercise Evaluation

Content:

1	2	3	4	5
/	/	/	/	/
poor		adequate		excellent

8. (a) What type of water system does your community/region have?

( ) Publicly owned, revenue from water charges, not regulated
( ) Publicly owned, revenue from water charges, regulated
( ) Publicly owned, revenue from other sources, not regulated
( ) Privately owned, revenue from water charges, regulated
( ) Other ________________________________

(b) What type of community does your system serve?

( ) Rural
( ) Suburban
( ) Urban

(c) How many users does your system serve?

( ) 1 - 2500
( ) 2500 - 5000
( ) 5000 - 10,000
( ) 10,000 - 20,000
( ) 20,000 - 50,000
( ) 50,000 - 100,000
( ) 100,000 - 200,000
( ) over 200,000

(d) Have you ever developed a water conservation plan for a water system?

( ) Yes
( ) No

(e) Are you most concerned with (check as many as necessary):

( ) Short-term drought
( ) Annual peak load demand
( ) Shortage due to supply contamination
( ) Future demand exceeding supply
( ) Frequent droughts
( ) Augmentation not possible
( ) Other ______________________________
____

APPENDIX C

Sample Cards and Group Exercise Board

PROBLEM

GOAL - Long or Short Term

Long Term ______________________________.

Short Term _____________________________.

GOAL - Average or Peak

Average use must be reduced ________________.

Peak use must be reduced ___________________.

GOAL - Percent Reduction

High percent reduction - _______________%

Low percent reduction - ________________%

SUPPLY MANAGEMENT

PROGRAM: LEAK DETECTION AND REPAIR #1
Water audit; perform major repairs

WATER SAVED (per year): 3% or 13 mgy

NET REVENUE (per year): -$22,000

SUPPLY MANAGEMENT

PROGRAM:

WATER SAVED (per year):

NET REVENUE (per year):

SUPPLY MANAGEMENT

PROGRAM: LEAK DETECTION AND REPAIR #2
System audit; perform major and minor repairs

WATER SAVED (per year): 7% or 30 mgy

NET REVENUE (per year): -$52,000

SUPPLY MANAGEMENT

PROGRAM: METERING #1
Install new meters in unmetered services; replace old meters with more accurate meters

WATER SAVED (per year): - 0 -

NET REVENUE (per year): -$15,000

DEMAND MANAGEMENT

PROGRAM: PRICING #1
Raise uniform unit rate to $.99 per 1000 gallons

WATER SAVED (per year): 13% or 57 mgy

NET REVENUE (per year): + $48,000

DEMAND MANAGEMENT

PROGRAM: PRICING #2
Excess use rate for res and com users:
$.75/1000 gal. for first 33,000 gal.; $1.10/1000 gal. for all use above. For ind. users:
$.75/1000 gal. for first 4,000,000 gal.; $1.10 for all use above.

WATER SAVED: 10% or 43 mgy

NET REVENUES: +$1,000

DEMAND MANAGEMENT

PROGRAM: PRICING #3
Increase summer rate to $1.03 per 1000 gallons; increase winter rate to $.80 per 1000 gallons

WATER SAVED (per year): 13% or 57 mgy

NET REVENUE (per year): +$23,000

DEMAND MANAGEMENT

PROGRAM: REGULATION #1
Alternate day/time of day outdoor use restrictions; pool filling by permit only; plumbing code changes; restaurants serve water by request only

WATER SAVED (per year): 7% or 30 mgy

NET REVENUE (per year): -$15,000

DEMAND MANAGEMENT

PROGRAM: REGULATION #2
Total outdoor use ban (including municipal use); reduce municipal use (no street sweeping, sewer or main flushing); recycle for large A-C units required; no fountain displays; car wash water recycling required

WATER SAVED (per year): 20% or 90 mgy

NET REVENUE (per year): -$60,000

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #1
Uniform unit rate of $.99/1000 gals.

Alternate day/time of day outdoor use restrictions; pool filling by permit only; plumbing code changes; restaurants serve water by request only

WATER SAVED (per year): 15% or 64 mgy

NET REVENUE (per year): +$43,000

DEMAND MANAGEMENT

PROGRAM: EDUCATION #1
Bill inserts; pamphlets; posters around town; billboards; school programs; newspaper articles; radio ads.; reminder items; speaker's bureau; customer assistance

WATER SAVED (per year): 5% or 23 mgy

NET REVENUE (per year): -$12,000

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #2
Uniform unit rate of $.99/1000 gals.

Total outdoor use ban (including municipal use); reduce municipal use (no street sweeping, sewer or main flushing); recycle for large A-C units required; car wash water recycling required

WATER SAVED (per year): 23% or 100 mgy

NET REVENUE (per year): +$17,000

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #1
Excess use rate

Partial outdoor use ban

WATER SAVED (per year): 11% or 47 mgy

NET REVENUE (per year): -$12,000

DEMAND MANAGEMENT

PROGRAM: PRICING #3/ REGULATION #1
Summer rate

Partial outdoor use ban

WATER SAVED (per year): 15% or 64 mgy

NET REVENUES (per year): +$20,000

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #2
Excess use rate

Total outdoor use ban

WATER SAVED (per year): 22% or 95 mgy

NET REVENUE (per year): -$43,000

DEMAND MANAGEMENT

PROGRAM: PRICING #3/REGULATION #2
Summer $1.03/1000 gals

Winter $.80/1000 gals

Total outdoor use ban (including municipal use); reduce municipal use flushing ; recycle of large A-C units required; carwash water recycling required

WATER SAVED (per year): 23% or 98 mgy

NET REVENUES (per year): -$18,000

DEMAND MANAGEMENT

PROGRAM:

WATER SAVED (per year):

NET REVENUE (per year):

DEMAND MANAGEMENT

PROGRAM:

WATER SAVED (per year):

NET REVENUE (per year):

DEMAND MANAGEMENT

PROGRAM:

WATER SAVED (per year):

NET REVENUE (per year):

DEMAND MANAGEMENT

PROGRAM: EDUCATION (IN COMBINATION WITH ANY OTHER DEMAND MANAGEMENT PROGRAM) Bill inserts; pamphlets; posters around town; billboards; school programs; newspaper articles; radio ads.; reminder items; speaker's bureau; customer assistance

WATER SAVED (per year): 2% or 8 mgy

NET REVENUES (per year): -$6,000

DEMAND MANAGEMENT

PROGRAM: EDUCATION #1 (ALONE OR IN COMBINATION) Bill inserts; pamphlets; posters around town; billboards; school programs; newspaper articles; radio ads; reminder items; flyers; speaker's bureau; customer assistance

IMPACTS	MODIFICATIONS
1. Well received by community	1. N/A
2. Revenue decrease	2. Raise water rate

DEMAND MANAGEMENT

PROGRAM: REGULATION #2 - Total outdoor use ban; reduce municipal use (no street sweeping, sewer or main flushing); recycle for large a-c units required; no fountain displays; car wash water recycle required

IMPACTS	MODIFICATIONS
1. Damage to landscape will result	1. Education may ease some opposition; exempt public areas
2. Revenue decrease	2. Raise water rate; borrow from other budget

DEMAND MANAGEMENT

PROGRAM: REGULATION #2 - continued

IMPACTS	MODIFICATIONS
3. Lack of cooperation with local enforcement agency may reduce effectiveness of program	3. Offer compensation to enforcement agency

DEMAND MANAGEMENT

PROGRAM: PRICING #3/REGULATION #2

Summer rate

Complete outdoor use ban

IMPACTS	MODIFICATIONS
1. Residents, industry, and City Council bitterly oppose this program	1. Attempt to highlight benefits versus consequences to change public opinion
2. Revenue deficit	2. Raise rate for winter

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #2

Uniform unit rate of $.99/1000 gals

Total outdoor use ban; reduce municipal use (no street sweeping, sewer or main flushing); recycle for large a-c units required; car wash water recycle required

IMPACTS	MODIFICATIONS
1. City Council opposes; threaten to take over utility	1. Generate support from other sectors

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #2 continued

IMPACTS	MODIFICATIONS
2. Residential users oppose watering ban	2. Education program may ease some opposition
3. Community aesthetics suffer	3. Exempt public parks areas
4. Lack of cooperation from enforcement authority may reduce program results	4. Offer compensation to enforcement authority

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #1

Uniform unit rate of $.99/1000 gals.

Alternate day/time of day outdoor use restrictions; pool filling by permit only; plumbing code changes; restaurants serve water on request only

IMPACTS	MODIFICATIONS
1. User opposition-pay more must use less	1. Education program ease some opposition

DEMAND MANAGEMENT

PROGRAM: PRICING #1/REGULATION #1 continued

IMPACTS	MODIFICATIONS
2. Possible damage to landscape	2. Education program to explain how to irrigate efficiently
3. City Council may not approve rate	3. Special program for City Council to explain need for program

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #1

Excess use rate

Partial use bans

IMPACTS	MODIFICATIONS
1. Industry feels program is fair	1. N/A
2. Residents feel program is unfair; will organize fight against it	2. Education program may help; but unlikely

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #1 continued

IMPACTS	MODIFICATIONS
3. City Council may not approve	3. Publicize industrial support; exempt public areas from use ban
4. Revenue deficit not significant	4. N/A

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #2

Excessive rate

Total outdoor use ban; reduce municipal use (no street sweeping, sewer or main flushing);recycle for large A-C units required; car wash water recycle required

IMPACTS	MODIFICATIONS
1. Damage to landscape	1. Exempt public parks areas

DEMAND MANAGEMENT

PROGRAM: PRICING #2/REGULATION #2 continued

IMPACTS	MODIFICATIONS
2. Opposition from residential sector, will boycott by refusing to pay bills	2. Education program may ease some opposition temporarily, but unlikely
3. Opposition from city council to use ban	3. Exempt public parks
4. Industry supports	4. Publicize industrial support
5. Revenue deficit	5. Raise rate on first block

DEMAND MANAGEMENT

PROGRAM: PRICING #3/REGULATION #1

Summer rate

Partial use ban

IMPACTS	MODIFICATIONS
1. Residents don't like it; but not bitterly opposed	1. Assist residents through education program to educate them how to irrigate efficiently
2. Industry threatens to leave town	2. Offer technical assistance

DEMAND MANAGEMENT

PROGRAM PRICING #3/REGULATION #1 continued

IMPACTS	MODIFICATIONS
3. City Council does not like the use ban	3. Exempt public parks
4. Revenue surplus may be diverted	4. Reinvest in system or other conserva-tion program

DEMAND MANAGEMENT

PROGRAM: PRICING #1 - Uniform unit rate of $.99 per 1000 gallons

IMPACTS	MODIFICATIONS
1. Extreme opposition from City Council approval may not be granted	1. Special program for City Council to explain need for program
2. Revenue surplus may be diverted	2. Reinvest in system or other conservation program

DEMAND MANAGEMENT

PROGRAM: PRICING #3 - Increase summer rate to $1.03 per 1000 gallons and winter rate to $.80 per 1000 gallons.

IMPACTS	MODIFICATIONS
1. Residents do not like, but can live with it	1. Education program
2. Industry threatens to leave town, feels program inequitable	2. Offer technical assistance to industry
3. Revenue surplus may be diverted	3. Reinvest in system or other conservation program

DEMAND MANAGEMENT

PROGRAM: PRICING #2 Excess use rate

IMPACTS	MODIFICATIONS
1. Industry feels program is equitable	1. N/A
2. Residents feel program is unfair; organizing fight against program	2. Education program may help; but unlikely
3. City Council quietly supports	3. Attempt to make Council and industry support more vocal
4. Revenue deficit not significant	4. N/A

DEMAND MANAGEMENT

PROGRAM: REGULATION #1 - Alternate day/time of day outdoor use restrictions; pool filling by permit only; plumbing code changes; restaurants serve water on request

IMPACTS	MODIFICATIONS
1. Revenues decrease	1. Raise water rate; borrow from other budget
2. Community aesthetics	2. Inform users on how to irrigate most efficiently

SUPPLY MANAGEMENT

PROGRAM:

SUPPLY MANAGEMENT

PROGRAM: LEAK DETECTION AND REPAIR #2
System audit; major and minor repairs performed

IMPACTS	MODIFICATIONS
1. System efficiency improves	1. N/A
2. Cost exceed available funds significantly	2. Raise rate
3. Opposition from commercial users; construction will disrupt business	3. Work out acceptable plan; build support from others

SUPPLY MANAGEMENT

PROGRAM: LEAK DETECTION AND REPAIR #1
Scan to detect major leaks; perform major repairs

IMPACTS	MODIFICATIONS
1. System efficiency improves	1. N/A
2. Costs exceed available funds; not allowed to operate in deficit	2. Raise water rate; borrow from other budgets

SUPPLY MANAGEMENT

PROGRAM: METERING #1
Install new meters in unmetered services; replace old meters with more accurate meters

IMPACTS	MODIFICATIONS
1. Will improve system efficiency significantly	1. N/A
2. May recover lost revenues	2. N/A
3. May cause temporary revenue deficit	3. Borrow from other budgets

DEMAND MANAGEMENT

PROGRAM:

DEMAND MANAGEMENT

PROGRAM:

DEMAND MANAGEMENT

PROGRAM:

HARDWARE/TECHNIQUE

PROGRAM: Utility takes NO ROLE

COST: 0

HARDWARE/TECHNIQUE

PROGRAM: Utility offers industry only technical assistance

COST: $2,500 per year for first two years; $1,000 per year thereafter

HARDWARE/TECHNIQUE

PROGRAM: Utility takes SLIGHTLY ACTIVE role - provides tips on water conservation

COST: Cost of EDUCATION PROGRAM - see Step 3

HARDWARE/TECHNIQUE

PROGRAM: Utility takes MODERATELY ACTIVE role - provides water-saving fixtures at cost; provides industry with technical assistance

COST: Approximately $5,000 per year

HARDWARE/TECHNIQUE

PROGRAM: Utility takes ACTIVE role - purchases and distributes water-saving fixtures for retro-fit; provides industry with technical assistance

COST: Approximately $35,000 per year for first two years; $5,000 per year thereafter

HARDWARE/TECHNIQUE

PROGRAM: Utility takes AGGRESSIVE role - purchases, distributes, and installs water-saving fixtures for retro-fit; provides industry with technical assistance

COST: Approximately $60,000 per year for first two years; $15,000 per year thereafter