U.S. BUREAU OF RECLAMATION

Florence Lake, December 2000

WATER SHORTAGE CONTINGENCY / DROUGHT PLANNING HANDBOOK

United States Department of the Interior
South-Central California Area Office
1243 'N' Street
Fresno, California 93721-1813
April 2003

Guidelines and Worksheets for Preparing Water Shortage Contingency / Drought Plans for USBR SCCAO M&I Water Contractors

United States Bureau of Reclamation Water Shortage Contingency/Drought Planning Handbook

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ACKNOWLEDGEMENTS

This handbook contains a compilation of resources from a variety of sources. Portions of the text was excerpted from the Urban Drought Guidebook published by the California Department of Water Resources and updated in 1991. The majority of worksheets found in this handbook were derived from forms developed by the Department of Water Resources for preparation of urban water management plans and water shortage contingency plans. The American Water Works Association's Drought Management Handbook was also used to help develop this handbook.

Overview

By completing the worksheets provided in packet located in the front pocket of this notebook, water districts will be able to meet the requirements for the USBR's M&I Water Shortage Policy and the requirements for drought financial assistance from the California Department of Water Resources and the Department of Health Services.

This handbook has been prepared to assist USBR South Central California Area Office urban water contractors with the preparation of a drought or water shortage contingency plan. It is a planning and implementation guide that will help agencies define the conditions under which a water shortage exists and will help agencies create a list of specified actions that will be taken in response to a shortage. The forms, sample materials, references, resources, and background information used in this guidebook are compiled from water resource planning assistance documents prepared by the California Department of Water Resources, the Army Corps of Engineers, and the Western Drought Coordination Council to provide a template for preparation of a water shortage contingency plan. The USBR Mid-Pacific Region's M&I Water Shortage Policy, September 2001, can be found on page 3.

*Note: Throughout this handbook the word "district" is typically used to refer to water suppliers. Other terms, such as purveyor and agency, are also used. They all refer to "a supplier of water to urban customers".

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*Most of the tables and worksheets contained in this document are taken from the forms used to complete an Urban Water Management Plan.

I
INTRODUCTION

In this handbook you will examine ways to prepare your district for water shortages, and identify specific actions your district can take to prevent shortages or to respond to them when they occur. The most effective water shortage response effort begins long before a water shortage occurs. In order to respond most effectively, water districts need to consider all options for preparing for and responding to water shortages.

A. Overview of Water Shortage/Drought Planning in California

Much of California enjoys a Mediterranean-like climate with cool, wet winters and warm, dry summers. On average, 75 percent of the State's average annual precipitation of 23 inches falls between November and March, with half of it occurring between December and February. Floods and droughts occur often, sometimes in the same year. Therefore, planning for water shortages is essential.

The U.S. Bureau of Reclamation, the State of California Department of Water Resources and the CALFED Governor's Advisory Drought Planning Panel's Critical Water Shortage Contingency Plan require water purveyors in California to prepare plans for addressing water shortages for state and federal planning purposes and to be eligible to participate in various water shortage relief programs.

The Reclamation States Emergency Drought Relief Act of 1991 Title II: Drought Contingency Planning Section 202 authorizes the Secretary of the Interior, acting pursuant to Federal Reclamation law, utilizing the resources of the Department of the Interior, and in consultation with other appropriate Federal and State officials, Indian tribes, public, private, and local entities, to prepare or participate in the preparation of cooperative water shortage contingency plans for the prevention or mitigation of adverse effects of drought conditions. Section 203 states that elements of the contingency plans prepared pursuant to section 202 may include, but are not limited to, any or all of the following:

1. Water banks.
2. Appropriate water conservation actions.
3. Water transfers to serve users inside or outside authorized Federal Reclamation project service areas in order to mitigate the effects of water shortage.
4. Use of Federal Reclamation project facilities to store and convey non-project water for agricultural, municipal and industrial, fish and wildlife, or other uses both inside and outside an authorized Federal Reclamation project service area.

5. Use of water from dead or inactive reservoir storage or increased use of ground water resources for temporary water supplies.
6. Water supplies for fish and wildlife resources.
7. Minor structural actions.

The State of California's Urban Water Management Planning Act was enacted in 1985 and requires urban water suppliers serving 3,000 acre-feet of municipal/industrial water per year or 3,000 urban customers, to prepare a comprehensive urban water management plan (UWMP) addressing their current and projected water sources/supplies, water uses, supply reliability, comparison of supply and demand, water demand management (conservation) programs, wastewater recycling and water shortage contingency planning.

In addition, the CALFED Drought Contingency Plan (December 2000) prepared by the Governor's Drought Advisory Panel, outlines a Critical Water Shortage Reduction Marketing Plan, which would provide a water market for agencies experiencing critical water shortages. Criteria for participation in the water marketing program include demonstrating that the purchasing agency has taken appropriate steps to prepare for critical water shortages.

These legal requirements, along with the benefits of avoiding impacts associated with water shortage provide ample incentive for local agencies to prepare a water shortage contingency plan. In an effort to provide specific guidelines for completing a plan, the United States Bureau of Reclamation, South Central California Area Office in Fresno, and the Santa Barbara County Water Agency have developed the following handbook. Water districts can develop a water shortage contingency plan for their agency by completing each of the Worksheets and tables provided.

B. Using This Handbook

This handbook is organized as a series of steps that will assist a water purveyor in completing a water shortage plan. The steps include:

1. Outlining water supply and demand
2. Using information from Step 1 to project water supply shortages
3. Planning for Shortages and Mitigating Impacts
4. Developing a Public Outreach Campaign to ensure customers are aware of supply issues
5. Reviewing how shortages could affect revenue and expenditures
6. Finalizing and adopting your water shortage plan.

To facilitate the completion of each step a worksheet or series of worksheets are provided to organize information for water shortage planning. A packet containing each of the necessary tables for completing the water shortage contingency/drought plan is located in the front pocket of this notebook. USBR staff is available to help water districts adapt the plan outline to their specific, unique situation.

In addition, a number of references and resources for further information are included to guide the water purveyor to other entities that may be able to assist in the development of a water shortage plan.

C. Adopting Your Plan

Once you have completed Tables 1 through 17, you will have all of the materials and information necessary for a complete water shortage plan for your district. The next step is to compile the plan in a manner that will be the most useful for you district. Then your district should officially adopt the plan so that the plan can be implemented as soon as it becomes apparent that a water shortage is imminent. The steps listed below provide a guide for adopting your plan.

1. Announce through local media that draft copies of your water shortage plan are available for review.
2. Set Public Meeting dates to provide the public with a forum for providing comments.
3. Incorporate comments into the draft Water Shortage/Drought Plan to create your Final Plan.
4. Adopt the Water Shortage/Drought Plan through an ordinance.
5. Send official copies of your plan to the Bureau of Reclamation, the California Department of Water Resources, and neighboring water districts.
6. Implement your plan through an aggressive public information campaign.
7. Develop administrative procedures to ensure enforcement of the restrictions outlined in your plan.

II
WATER SUPPLY AND WATER DEMAND INFORMATION
(Getting Started)

In this section you will compile information about your district's current and future water supplies and customer demand. For the purposes of this handbook, the base year is 2000 and the projections are for 2005 and 2010 since these dates correspond to the dates when Urban Water Management Plans will need to be updated. To develop future water supply and demand projections you will need to: know how many service connections you have, know the amount and source of water available to your district in the future (you can incorporate information from your district's long range water supply plan), understand past water use trends, and obtain information regarding future population growth in your service area. You will also need to be sure to include all regulatory and legal requirements that affect your supplies including minimum flow rates for streams, species habitat requirements, and reservoir conservation requirements. The data included in these tables will be used in later sections to develop a worst-case water shortage scenario and to understand the financial impacts of reduced water sales on the district. (Note: These tables were adapted from *City of New Albion, California 2000 Urban Water Management Plan,* which is the sample plan for preparing an Urban Water Management Plans developed by the State of California, The Resources Agency, Department of Water Resources. If you have already prepared an Urban Water Management Plan, you can use the information from those tables in this section.)

Worksheet 1 - Complete the following worksheet by inserting information regarding all supplies available to your agency. For projections be sure to include anticipated reductions due to factors such as seawater intrusion, contamination, land subsidence, and siltation.

Worksheet 1

Available Water Supplies* (Shown in Calendar Years)							
SOURCE*	**3 years ago**	**2 years ago**	**Last Year**	**This Year**	**2005**	**2010**	**Drought of Record**
Surface Water							
1.							
2.							
3.							
Groundwater							
Recycled Water							
Imported Water							
1. CVP							
2. SWP							
3.							
Sales to Other Agencies							
Totals							
*Units of Measure: Acre-feet/Year							

**See Glossary for further explanation of categories.*
Adapted from the Sample *Urban Water Management Plan for the City of New Albion, California 2000.* Prepared by the State of California, Department of Water Resources. December 2000.

Worksheet 2 - Complete the following worksheet by filling in the number of service connections by customer class served by your agency. For projections please use the number of additional dwelling units that will be added in the next 5 or 10 years based on local community or land use plans. If you district uses designations for customer classes than those listed, please substitute the customer class types that your district currently uses.

Worksheet 2

Number of Service Connections By Customer Type* (Shown in Calendar Years)			
Customer type	**2000**	**2005**	**2010**
Single Family			
Multi-Family			
Commercial			
Institutional			
Industrial			
Recreation			
Agriculture			
Total			

**See Glossary for further explanation of categories. If you do not use these category titles for distinguishing customer classes, you may substitute meter sizes or alternative categories.*
Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 3 - Complete the following worksheet by filling in the total amount of water sold by customer class for each year listed. For projections, use estimates of new developments from community plans as described for Worksheet 2, and population figures as outlined in Worksheet 4 below. If you district uses designations for customer classes than those listed, please substitute the customer class types that your district currently uses.

Worksheet 3

Past, Current and Projected Water Use (Shown in acre-feet per Calendar Year)					
Customer type	**1990**	**1995**	**2000**	**2005**	**2010**
Single Family					
Multi-Family					
Commercial					
Institutional					
Industrial					
Recreation					
Agriculture					
Unaccounted Loss					
Sales to Other Agencies					
Environmental Water Account					
Total					

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 4 - Complete the following worksheet by entering current and projected population levels. Utilize one of the methods below to project population changes. To determine per-capita demand, determine total water sales to urban customers (in gallons) - including residential, institutional, industrial, commercial, and recreational - and divide this figure by the total population within your service area. Then divide that amount by 365 (days in a year) to determine gallons per person per day - or per-capita demand.

Worksheet 4

Population and Per-Capita Demand			
	2000	**2005**	**2010**
Population			
Per-Capita Demand			

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources, 2000.

Methods for Determining and Projecting Population

It can be difficult to determine a precise number of people living in your service area. There are a number of ways to estimate population within the boundaries of a water district and several sources of information (local planning agency or association of governments, local county assessor's office, California Department of Finance, your district's records of metered accounts) to guide you in developing this information. You will need to determine the best method to use depending on the availability of information in your community and whether or not your district serves a city or an unincorporated area within the local county. The guidelines below provide a method for unincorporated areas and a method for cities.

Method 1 - Unincorporated Areas:

a. Contact your County Assessor's Office to determine the total number of registered voters within the boundaries of your service area. Multiply this number by the ratio of total county population divided by the total number of registered voters within the county. The answer is an estimate of the total population in your service area. If this information is not available, contact the local land-use or demographic planning agency to obtain population figures for your service area. If this information is not available, obtain the data for the number of persons per household, a factor that is available in most areas, and multiply that number by the number of residential meters in your service area to determine an estimated population.

b. If you have used voter registration information to create a base population, then obtain the community's recent historical annual growth rate (a % increase or decrease each year), project the increase in five year increments and add that to the base population derived in the previous step. If your community has an approved land use plan for your area, they may also have population projections. If not, you can use your historical rate of new connections per year and multiply that by the persons per household figure referenced in the previous step.

Method 2 - Incorporated Cities:

a. Visit the California Department of Finance website at www.dof.ca.gov. Choose the link for demographic information, and then follow the link for their Catalog of Publications. The link for Report E-1 outlines population estimates for City and County populations with annual percent change. Use the population estimates provided for your city for the current year. ***(See Resource Section 1, Part A for a copy of the 1999 population figures for each city in California from Report E-1).***

b. To project future population, check the city planning agency to see if they have projections. If not, see step "b" in the previous method.

Worksheet 5 – Use the following Worksheet to compare supply (Worksheet 1) and demand (Worksheet 3) totals to determine if anticipated supplies will meet projected demands for the next 20 years.

Worksheet 5

Projected Supply and Demand Comparison (Acre-feet/Year)			
	2000	**2005**	**2010**
Supply totals (From Worksheet 1)			
Demand totals (From Worksheet 3)			
Difference			

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 6 -Complete the following Worksheet by filling in the number of acre-feet of supply available during each of the listed scenarios. (You may want to check historical records to determine the largest cut that was ordered during the last water shortage event).

Worksheet 6

Supply Reliability				
		Multiple Dry Years		
Average/ Normal Year	Single Dry Year 20% reduction in supply	Year 2 10% reduction in supply	Year 3 15% reduction in supply	Year 4 20% reduction in supply

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 7 – Use Worksheet 7 to list the cost of producing and delivering each of the available water supplies for your district. This information will be utilized later to determine potential financial impacts during a water shortage.

Worksheet 7

Water Production and Delivery Costs ($ Per Acre-Foot)	
Surface Water	
1.	
2.	
3.	
Groundwater	
Imported Water	
1. CVP	
2. State Water	
3.	
Recycled Wastewater	

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 8 – Complete the following Worksheet by filling in the current rates for each customer class. For the purposes of this table, it is assumed that you use hundred cubic feet (HCF) as units of water sold. If your district uses a block rate structure, be sure to include rate information for each block. If your district uses a *uniform* rate, fill in the rate next to the row marked Block 1. This information will be utilized later to determine potential financial impacts during a water shortage. If you district uses designations for customer classes than those listed, please substitute the customer class types that your district currently uses.

Worksheet 8

Water Rates to Customers ($ Per Hundred Cubic Feet)		
Customer type		**Rate**
Single Family	Block 1	
	Block 2	
	Block 3	
Multi-Family	Block 1	
	Block 2	
	Block 3	
Commercial	Block 1	
	Block 2	
	Block 3	
Industrial		
Recreation	Block 1	
	Block 2	
	Block 3	
Landscape	Block 1	
	Block 2	
Institutional / Public	Block 1	
	Block 2	
	Block 3	
Agriculture	Block 1	
	Block 2	

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

III
PROJECTING AND DEFINING WATER SUPPLY SHORTAGES THAT TRIGGER MITIGATION ACTIONS
(Understand the Risks)

Options to Address Shortages in Worst Case Supply Scenario

Before you can develop a strategy for addressing water shortages, you will need to consider possible shortage scenarios and how they might impact your district. Developing possible water shortage scenarios will help you understand the possible risks a water shortage would pose to your district and will allow you to develop an effective plan for addressing possible shortages. In this section you will develop a hypothetical worst-case supply scenario using consecutive, increasingly dry, water years. Once you have created the worst-case scenario, you will consider alternative ways to address the resulting shortages. The three types of alternatives included in this section are: 1) supply augmentation; 2) demand reduction; and 3) a combination of supply augmentation and demand reduction.

How to Use Worksheets 9 – 9C

Worksheet 9 will help you determine how a multi-year water shortage would affect your district. Worksheets 9A, 9B, and 9C are provided to demonstrate alternative approaches to addressing the hypothetical shortfalls outlined in Worksheet 9.

Worksheet 9A will help you demonstrate how supply augmentation or enhancement would offset water shortages during multiple dry years. Alternative supply augmentation methods are described in detail in Resource Section 1. Some steps to augment water supplies may need to be taken *before* a water shortage, such as importing water for local storage to be available during a water shortage. Other steps, such as conjunctive use of groundwater and surface water supplies, can be taken during the water shortage.

Worksheet 9B will help you illustrate how demand reduction can reduce supply shortfalls. Some demand management strategies (water use efficiency) should be implemented all the time, regardless of water shortages. The California Urban Water Conservation Council's (CUWCC) statewide Urban Water Conservation Memorandum of Understanding contains examples of long-term efficiency measures, called best management practices (BMPs) (For further information check the CUWCC website at www.cuwcc.org or call (916) 552-5885). Short-term demand reduction during water shortage periods can be accomplished using water conservation strategies such as those listed in Worksheet 11.

Worksheet 9C will help you illustrate how both demand reduction and supply augmentation methods can be used together to minimize shortages during multiple dry years.

Worksheet 9 – Use the following Worksheet to project the hypothetical shortages that would be experienced by your district if a multi-year water shortage were to occur. For total supply sources use the information on Worksheet #1 (Total). For total demand use the information developed in Worksheet #3. For planning purposes, the multiple dry water years assume shortages of 10%, 20%, 30%, 40% and 50% respectively (also see Worksheet #6). You may change these percentages or use fewer than five years to more closely match your district's unique situation. However, this scenario is hypothetical and meant to provide an extreme worst- case example to help you plan.

Worksheet 9

Hypothetical Worst-Case Planning Scenario (statewide and local water shortage)						
Source of Supply	**Normal Water Supply** (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total Supply Sources						
Percent Supply Shortage		10%	20%	30%	40%	50%
Total Demand (assume average year demand levels)						
Difference						

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheets 9A Supply Augmentation Option, 9B Demand Reduction Option and 9C Simultaneous Supply Augmentation and Demand Reduction Option, will help you illustrate three alternative approaches to addressing the water supply shortages resulting from the hypothetical scenario contained in Worksheet 9.

Worksheet 9A - Use this worksheet to project how supply augmentation methods could be implemented in your district to minimize or eliminate projected shortages.

Worksheet 9A

Hypothetical Worst-Case Planning Scenario (statewide and local water shortage) **Supply Augmentation Option**						
Source of Supply	**Normal Water Supply** (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total Supply Sources						
Percent Supply Reduction		10%	20%	30%	40%	50%
New Supplies 1. 2.						
Total Demand (assume average demand)						
Difference						

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 9B – Use this worksheet to project how **demand reduction** methods could be implemented in your district to minimize or eliminate projected shortages. Adjust demand levels using the percentages on the demand reduction line, or you can develop you own demand reduction estimates.

Worksheet 9B

Hypothetical Worst-Case Planning Scenario (statewide and local water shortage) **Demand Reduction Option**						
Source of Supply	**Normal year supply** (acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total Supply Sources						
Percent Supply Shortage		10%	20%	30%	40%	50%
Percent Demand Reduction		5%	10%	15%	20%	25%
Total Demand						
Difference						

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 9C - Use this worksheet to project how a **combination of water supply augmentation and demand reduction** methods could be implemented in your district to minimize or eliminate projected shortages.

Worksheet 9C

Hypothetical Worst-Case Planning Scenario (statewide and local water shortage) **Simultaneous Supply Augmentation and Demand Reduction Option**						
Source of Supply	**Normal year supply** (acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total Supply Sources						
Percent Supply Shortage		10%	20%	30%	40%	50%
New Supplies 1. 2.						
Percent Demand Reduction		5%	10%	15%	20%	25%
Total Demand						
Difference						

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

IV
PREPARING FOR, MINIMIZING, AND RESPONDING TO WATER SHORTAGES
(Develop a Strategy)

A. Introduction

In this section you will examine ways to prepare your district for water shortages, and identify specific actions your district can take to prevent shortages or to respond to them when they occur. The most effective water shortage response effort begins long before a water shortage occurs. In order to respond most effectively, water districts need to consider all options for preparing for and responding to water shortages. There are generally four types of actions to consider: demand reductions, supply alternatives, operational changes and environmental/water quality changes. The following list includes these categories and the associated specific alternatives for districts to evaluate.

List of potential actions to address water shortages

	Demand Reductions
	Voluntary and mandatory use restrictions
	Pricing changes
	Public awareness
	Changes in plumbing codes
	Conservation credits
	Changes in irrigation methods
	Industrial conservation techniques
	Alternatives to water consuming activities
	Supply Alternatives
	New storage
	Reallocation of supplies
	New system interconnections
	Desalination, importation by barge, reuse
	Operational Changes
	Conjunctive use management
	Water banking
	Long-term changes in reservoir release rules
	Conditional reservoir operation and in-stream flows
	Water marketing
	Institutional changes
	Legal changes
	Operational coordination between systems
	Environmental and Water Quality Changes
	Reductions in required low flows
	Alternative means of achieving water quality

Source: U.S. Army Corps of Engineers, *Managing Water for Drought*, September 1994.

In this section you will develop a strategy for responding to water shortages. The worksheets in this section will focus on **demand reduction strategies** and **supply alternatives** in the development of a water shortage strategy. The worksheets will allow you to match specific supply augmentation and demand reduction options with water shortage triggering stages to meet the reduced availability of water supplies during a water shortage in your district.

You may want to investigate options for operational changes or environmental and water quality changes. However, due to the variability in the feasibility of these options from water district to water district, these subjects are not addressed here.

B. Preparing for a Water Shortage

In the previous sections you have analyzed your district's water supply and demand figures and have developed hypothetical worst-case water shortage projections for planning purposes. In this section you will use these hypothetical situations to establish triggers for your water shortage response plan and the actions you will take before and during a water shortage. You will need to consider a number of factors when developing your action plan and choosing water shortage mitigation measures. These considerations include:

- Potential water savings
- Timing required to implement measures
- Direct and indirect costs
- Quality of supplies
- Environmental impacts
- Legal or procedural requirements for implementation
- Community support
- Adequacy of treatment facilities to use supplemental sources
- Staffing requirements

When planning for a water shortage, it is essential to balance supply and demand. The impacts of water shortage hit hardest when agencies place unrealistic expectations on the amount of water supply available and do not include a realistic estimate of the potential for reductions in demand.

A few challenges you will face in preparing for a water shortage include:

- Water shortages are unpredictable events. The duration and severity of water shortages vary and no two water shortage events will have the same impact on a

water district. Water districts must be flexible and prepared in order to minimize the effects of a water shortage on customers.

- Water shortages can impact even adjacent districts very differently depending on the source of water supplies used by the districts, the amount of water in held in reserve (water shortage buffer), the type of customers and the types of water efficiency measures practiced in typical, non-drought years.
- It is difficult to invest the time to plan for a water shortage when water supplies are plentiful. We automatically swing into action when crisis strikes, freely funneling time and money into alleviating suffering and property damage. This is crisis management. But once the crisis is over, it seems like too much trouble to invest the time and resources in planning that could ease the effects of the next water shortage.
- The responsibility for responding to water shortages is divided among many governmental jurisdictions including planning departments, water purveyors, public health departments, etc. These entities must coordinate efforts in order to effectively respond to a water shortage event.

There are good reasons to plan for water shortage -- that is, to practice risk management rather than crisis management:

- Droughts are low-profile natural disasters, but analysis shows that they can be as expensive as floods and hurricanes.
- Planning ahead gives decision-makers the opportunity to implement the most cost effective and equitable programs during a water shortage.

C. Develop a Water Shortage Strategy with Stages

In this section, you will develop a specific plan for augmenting supplies during a shortage and reducing demand to a level that can be sustained by the water supply available during a shortage. The types of customers served and the statutory authority of the utility are some of the considerations that need to be taken into account. A good public information program is extremely important for a successful water shortage strategy. Communicating to customers those measures which are necessary at a given level of shortage will determine how well the public accepts the program.

Step 1: **Developing Water Shortage Strategy Stages:**

The best approach to managing water during a water shortage is to use a staged approach, with increasing levels of supply augmentation and demand reduction in each successive stage. A typical water shortage contingency program will have four stages.

Worksheet 10 outlines when each stage of the District's water shortage plan would be enacted. The percentages have been adopted from the California Department of Water Resources *Example Urban Water Management Plan, 2000* (Drought Contingency Plan Chapter) and may be adjusted to more appropriately reflect the percentage reductions that would create threats to human health and the environment in your district. You should review how a shortage in supply of each percentage level (15% to 50%) could affect your district. If normal year supplies are well above current use, then the listed percentages may be fine for your district. If normal year supplies are only slightly more than current demand, you may want to enact the stages of your water shortage plan at smaller percentage levels than those indicated in Worksheet 10.

The stages are designed to be somewhat flexible and it is not intended that an agency would move through each stage in every circumstance. It is more likely that a voluntary program (Stage 1) would be tried at the first sign of a water shortage and then, if conditions worsened, Stage 2 or 3 would be implemented. In the event of an earthquake or other sudden event that severely reduces supply availability, an agency may need to begin Stage 4 actions immediately. The triggers selected by your district for Worksheet 10 will help determine which stage is in effect at any time during a water shortage.

Worksheet 10

Triggers for Implementing Water Shortage Plan	
Stage 1 – Minimal	**15%** Total Supply Reduction
Stage 2 – Moderate	**15-25%** Total Supply Reduction
Stage 3 – Severe	**25-35%** Total Supply Reduction
Stage 4 – Critical	**35-50%** Total Supply Reduction

Adapted from the *Sample Urban Water Management Plan* - Drought Contingency Plan Section. Prepared by the. State of California, Department of Water Resources. 2000.

Step 2 – How to Select Appropriate Drought Mitigation Measures*:

Now that you have defined the Water Shortage Strategy stages, you will need to select the actions that will be taken during each stage. A valuable tool for assessing potential actions for water shortage mitigation is a decision matrix. Water shortage mitigation actions can be aligned along one axis with assessment criteria along the other. You should use the actions listed in Worksheet 11 and the criteria listed below to create this matrix. A point system or a simple plus/minus system can be established to aid in

selecting measures. Such a matrix could prove valuable in gaining consensus from water users or other water districts. As the district gains experience implementing various measures, the assessment criteria should be updated or re-evaluated.

The following criteria should be used when preparing a drought mitigation strategy.

Anticipated water savings: The size of the target use group and anticipated savings are key factors for assessing measures.

Consumer acceptance: Any measures must meet with some level of consumer acceptance. Without proper public education and involvement, no measure will meet with a high level of public acceptance. The message must be clear and concise when the drought program is implemented.

Equity: The measures selected must be perceived as equitable to all customer classes. This will enhance the acceptance of the measures selected. If there is a real or perceived inequity between various consumer groups, then the measures may not achieve the desired results. However, since some water uses are assigned a higher priority than others, by law, parity must sometimes be sacrificed.

Sustainability: Another element of assessment is the calculation of a particular measure's sustainability over time. In other words, will the measure provide only a short-term reduction or is it also a viable long-term measure? Each has its place depending on the particular drought event, its anticipated duration, and the long-term water supply situation.

Cost: Careful consideration needs to be given to the cost of implementing mitigation measures. These costs include the cash outlay to promote, coordinate, and enforce a given measure, as well as the costs in lost revenues (See Section VII for more information about rates and revenue stabilization during a drought). In recent droughts some water districts have discovered that their drought measures were so effective in reducing demand, that revenues declined dramatically causing a cash flow crisis for the district. Therefore, both the cost of implementing a measure and the resultant impact on revenue flow must be taken into account so that the intensity of the measures taken can coincide with the severity of the crisis.

Legal and contractual issues: Districts must assess measures from a legal and contractual standpoint. Some existing codes, regulations, ordinances and contracts may need to be revised in order to implement specific drought measures. In particular, the

need to make these revisions may affect the timing of when a measure can be implemented.

Policy compatibility: Drought measures should be, the extent possible, compatible with existing long-term policy objectives such as conservation programs.

Reliability history: The measures presented in this handbook have been proven effective and reliable in many areas and under a variety of circumstances. Each district is unique, and must consider its own past experiences or those of similar agencies when assessing the potential of each measure.

Ease of implementation: Some measures may offer substantial mitigation but will prove very difficult to actually implement. The means of implementing each measure should be carefully analyzed to determine if it warrants further consideration.

**(Excerpted from the Drought Management Handbook, American Water Works Association, 2002)*

Step 3: Matching Water Shortage Mitigation Actions to Strategy Stages

A description of the specific supply augmentation and demand reduction measures in each stage should be prepared as shown in Worksheet 11. This list serves as a general guide which you can use to assess each potential action and select from the actions ranked the highest in your decision matrix to determine which actions you will take during each stage. The actual plan developed by your agency should be based on local circumstances so it may not include each action listed.

Supply Augmentation Methods

One way to minimize shortages to customers is to increase supplies **before the** water shortage and/or provide a "water shortage buffer" to serve as a reserve when rainfall is low or other conditions cause reductions in the level of normal supplies available to the district. Methods of supply augmentation can be classified into 5 groups: 1) methods to increase existing supplies or develop new supplies; 2) drawing from reserve supplies; 3) methods to increase efficiency (demand reductions); 4) modifications to operations; and 5) cooperative efforts with other agencies. Worksheet 11 contains several examples of these methods. Resource Section 1, Part B includes information on specific supply augmentation measures.

Implementation of supply augmentation is often difficult because few of these actions can be undertaken quickly. Also, many of these methods involve balancing environmental and jurisdictional considerations. Finally, if reserves are used, these resources must eventually be replenished. Despite the inherent difficulties with using supply augmentation options, even minimal supply augmentation programs have been helpful in water shortage situations. Developing extra supply increases utility credibility with customers by demonstrating that the utility is maximizing its efforts to deal with the water shortage, even before it begins. Also, supply augmentation can provide a water shortage buffer in case of multi-year shortages or can be used to minimize the amount of demand reduction needed to meet temporary supply deficits.

Demand Reduction Methods

Demand reduction is the most straightforward way to address drought-induced water supply deficits. Efforts to help customers reduce demand should first be directed at the customer uses, which are inefficient, wasteful or able to be temporarily reduced or suspended without significant hardship. Since certain conservation actions on the part of the customer may be mandated, enforcement mechanisms are needed for maximum implementation of demand reduction.

The typical demand reduction goals for staged plans normally range from 5-10 percent in the first stage, to as much as 50% in the last stage. Stage 1 relies primarily on voluntary demand reduction actions taken by the water customers. These actions are taken in anticipation of a future water shortage creating a modest water shortage. Subsequent stages are in response to increasingly severe water shortage conditions. Stage 2 utilizes some mandatory measures and Stages 3 and 4 involve water rationing. Stage 4 includes extensive restrictions on water use and would be initiated only in very extreme circumstances. Each stage incorporates and builds on the actions taken in the previous stages.

There are many ways that water districts can request and encourage water conservation from their customers. The success of these efforts depends largely on how well the district communicates with customers and with the media. The level of savings achieved will depend, in part, on how efficiently customers use water before the water shortage begins. On the one hand, if customers use water efficiently before a water shortage begins, the impact of the water shortage is minimized because shortages are less likely to occur (unless the district has not set aside a buffer for shortages). On the other hand, if customers are already efficient in their water use, there is less excess water use to be cut during a water shortage. District managers need to consider current levels of water

use when preparing a water shortage action plan in order to understand what level of conservation may be possible during a water shortage.

This section addresses both pre-drought and drought actions. Pre-drought demand reduction measures include implementation of the fourteen best management practices (BMPs) identified in the statewide Memorandum of Understanding (MOU) for Urban Water Conservation in California. These measures are listed in Worksheet 11. These measures are long-term, cost-effective programs that are appropriate for implementation by all urban water districts. Implementation of these measures results in more efficient water use in urban communities. (For more information about these BMPs or a copy of the statewide MOU, visit the California Urban Water Conservation Council's web site at: www.cuwcc.org or call (916) 552-5885.)

Resources Section 1 C contains a key with estimates and ranges of potential demand reduction, timing to realize water savings, and costs to water districts that are based on previous results of similar programs implemented in Santa Barbara County during the 1986-1992 drought.

Worksheet 11: Actions for Your Water Shortage Strategy – Highlight or circle the options your district will use to augment supplies and reduce demand during the next water shortage. You will need to determine the relative costs of, and quantities available from, the potential supplemental supplies for your district. This should be included as part of your district's long-term water supply planning process. You will also need to determine which demand reduction measures will meet your district's needs for potential demand reduction, timing to realize water savings, and cost. Please write the stage in which you will implement each action in the space provided.

Worksheet 11

ACTIONS FOR YOUR WATER SHORTAGE STRATEGY	STAGE
Methods to Increase Existing Supplies	
Increase use of recycled wastewater	
Increase use of nonpotable water for nonpotable uses	
Construct emergency dams	
Re-activate abandoned dams	
Drawing From Reserve Supplies	
Use reservoir dead storage	
Add wells	
Deepen wells	
Re-activate abandoned wells	
Rehabilitate operating wells	
Renegotiate contractually controlled supplies	

Methods to Increase Efficiency	
Suppress reservoir evaporation	
Reduce dam leakage	
Minimize reservoir spills	
Reduce distribution system pressure	
Conduct distribution system water audit	
Conduct distribution system leak detection and repair	
Surge and clean wells	
Modifications to Operations	
Re-circulate wash water	
Blend primary supply with water of lesser quality	
Transfer surplus water to areas of deficit	
Change pattern of water storage and release operations	
Cooperative Efforts with Other Agencies	
Exchanges	
Transfers or interconnections	
Mutual aid agreements	
Best Management Practices	
1. Residential Water Surveys	
2. Residential Plumbing Retrofit	
3. System Water Audits, Leak Detection And Repair	
4. Metering with Commodity Rates	
5. Large Landscape Conservation Programs And Incentives	
6. High-Efficiency Washing Machine Rebate Programs	
7. Public Information Programs	
8. School Education Programs	
9. Conservation Programs For Commercial, Industrial, and Institutional	
10. Wholesale Agency Assistance Programs	
11. Conservation Pricing	
12. Conservation Coordinator	
13. Water Waste Prohibition	
14. Residential Ultra Low Flow Toilet Replacement Programs	
Additional Demand Reduction Actions	
Implement all applicable pre-stage 1 measures	
Provide technical assistance to customers	
Begin public information campaign– water shortage message	
Ask customers for voluntary reductions in use	
Provide incentives to customers to reduce water consumption (rebates, free devices)	
Prohibit wasteful use of water	
Limit number of building permits issued	
Implement water shortage rate structure (Change the water rate structure from a uniform rate to an inclining block rate)	
Plumbing fixture replacement	
Request increased reduction by customers	

Require that eating establishments serve water only when specifically requested by customers	
Prohibit use of running water for cleaning hard surfaces such as sidewalks, driveways, and parking	
Require lodging hotels/motels to post notice of water shortage condition with tips in each guest room	
Provide weekly updates on supply conditions to media and public	
Prohibit some uses of water – i.e., lawn watering using sprinklers	
Institute rationing programs through fixed allotments or percentage cutbacks	
Reduce pressure in water lines	
Prohibit use of ornamental fountains and ponds, except when water is re-circulated (include a sign adjacent to the fountain stating that the water in the fountain is being re-circulated)	
Prohibit filling swimming pools and spas unless the pool or spa is equipped with a pool cover	
Prohibit the use of potable water for cleaning, irrigation and construction purposes, including but not limited to dust control, settling of backfill, flushing of plumbing lines, and washing of equipment, buildings and vehicles	
Vehicles and boats can only be washed at a car wash that recycles water or uses 10 gallons or less of water per cycle or with a bucket and hose equipped with a automatic shut-off nozzle	
Intensify implementation of all measures in previous stages	
Implement mandatory water rationing including per-capita water use allocations for residential customers	
Restrict water use only to priority uses (no lawn watering, car washing)	

Adapted from the *Water Conservation Guidebook No. 7; Urban Drought Guidebook*, Department of Water Resources, 1988.

How to Use Your Strategy When a Shortage is Imminent

Once you have completed Worksheet 11, you have developed an important piece of your strategy for dealing with a water shortage. The following information describes how to implement this portion of your water shortage plan when a shortage is imminent.

Step 1: Evaluate Water Saved by Staged Reductions:

The water savings realized by the demand reduction methods in any stage will vary from month to month. Many methods included in Worksheet 11 emphasize outside water use reduction. Therefore, their effectiveness will be higher in the warmer months. Not only will the percentage of total demand reduction be higher, but the total quantity of water saved will also be larger because of the higher water demand during those months. For example, if a Stage 3 water rationing plan is expected to save 25 percent of the total demand on an annual average basis, savings may be as much as 35 percent in the summer months. There would be a correspondingly lower rate of savings, perhaps 15 percent, during the winter.

Exactly how much water savings can be achieved in any given month is difficult to predict. A service area where most of the water use is residential with a large proportion used for landscape irrigation can expect high summer savings relative to the annual average; whereas a service area with low summer irrigation demands would experience much less variation from the predicted annual average savings. One way to account for this variation is to assume that the savings can be scaled to the normal year demand curve.

Step 2: Select Stage

The estimated water savings from the four-stage plan can be used to decide which stage to select to reduce demand to match available supply at any time before or during a water shortage. The following procedure is recommended.

1. Graph projected water supply. Include the analysis of supplemental sources in determining the available water supply for the coming year.

2. Estimate dry year water demand. Apply the percent savings anticipated for each stage to the projected dry year demand curve. Graph the results as a series of three adjusted demand curves together with the projected dry year demand.

3. Compare supply and demand curves to determine which water shortage stage will reduce demand to match the available supply. Select the appropriate stage and publicize which stage of the water shortage strategy you must enter to sustain use through the shortage. (See Section VI for information on Public Outreach Methods).

Lag Time Problem:

Water agencies frequently assume that they will immediately achieve the levels of water use reduction they are asking for. Especially for areas that have not experienced rationing before, this is unlikely. This is because adjacent water suppliers in the region may have differing messages and it can be difficult to achieve high water use reductions. This is compounded by the fact that customers on a bi-monthly billing cycle do not know how much water they are using until they receive their water bill as long as two months from the start of the program. Also, with the unseasonably mild winter weather usually associated with droughts, water use can actually be higher.

By the time water suppliers realize that they are not achieving the savings they were expecting, or that the response is lagging, less water is available for the rest of the year. The likely result of this lag time effect is that water suppliers will have to leapfrog over Stages 2 and 3 rationing levels all the way to severe levels in order to have sufficient water supplies available to meet demand.

Another effect of the lag time is that suppliers will draw down terminal reservoirs and emergency storage, and overdraft groundwater to make it through later months of the year. That can reduce the supply of water for emergencies and water to meet the next year's needs.

To avoid some of these lag time effects, it is better to ration earlier at levels that are uncomfortable but manageable rather than to wait and later have to live with much more extreme rationing.

V
MONITORING PROCEDURES
(Watch Closely)

Implementation of a water shortage plan includes ongoing monitoring of the effectiveness of the individual conservation measures, monitoring supply availability and monitoring actual water use.

A. Water Production and Use Monitoring

Normal Monitoring Procedure

In normal water supply conditions, production figures are recorded daily. Totals are reported weekly to the Water Treatment Facility Supervisor. Totals are reported monthly to the Water Department Manager and incorporated into the water supply report.

State 1 and 2 Water Shortages

During a Stage 1 or 2 water shortage, daily production figures are reported to the Supervisor. The Supervisor compares the weekly production to the target weekly production to verify that the reduction goal is being met. Weekly reports are forwarded to the Water Department Manager and the Water Shortage Response Team. Monthly reports are sent to the City Council or Board of Directors. If reduction goals are not met, the Manager will notify the governing board so that corrective action can be taken.

Stage 3 and 4 Water Shortages

During a Stage 3 or 4 water shortage, the procedure listed above will be followed, with the addition of a daily production report to the Manager.

Disaster Shortage

During a disaster shortage, production figures will be reported to the Supervisor hourly, and to the Manager and the Water Shortage Response Team daily. Reports will also be provided to the governing board and the local Office of Emergency Services.

B. Supply and Demand Comparison Tracking

It is critical to track available supply and actual use on a regular basis and assure that demand levels do not substantially exceed targets set in Section IV. Compare actual demand and supply with projected demand and supply to determine if stage adjustments are needed. Prior to altering the demand reduction stage, consider any program adjustments such as raising the level of expenditure on public outreach or increasing enforcement efforts. If these actions do not achieve the required stabilization, then adjust the stage. It is best to avoid going up and down in stages because this can hurt public confidence and acceptance. Try to avoid going down until the water shortage is over or the shortage emergency has passed. Using these techniques, you can stay on top of the situation and make informed decisions throughout the duration of the water shortage.

VI
PUBLIC OUTREACH
(Keeping Your Customers Informed)

This section outlines the methods that a water district can use to provide information to the public and the media during a water shortage. It includes a menu of options for informing the public about the water shortage and actions they can take to reduce their water use, and a checklist for keeping the media involved. There is also a Worksheet for identifying media contacts. Sample public information materials such as press releases, bill inserts, advertisements, and workshop topics, along with guidelines for writing a press release are included in the Resources Section 4.

General Public Outreach

The public will be affected by water shortages, and should be involved in water shortage preparedness efforts. During a water shortage, the effectiveness of water shortage responses is often a function of the trust, knowledge, and commitment of the public. Many water managers believe they practice good "public involvement" because they conduct regular meetings at which agency policies are explained and questions from the public answered. But this approach may not be effective in developing trust, knowledge and commitment to agency decisions, nor in inducing changes in water users behavior that can reduce water shortage impacts. The agency needs to develop a comprehensive outreach program that reaches all customers with messages regarding the water situation and specific steps they can take to use water efficiently.

Public participation may help to increase administrative accountability; to supply pertinent information; to evaluate methodological approaches and use priorities; to raise broad but related value questions; to call planners' attentions to immediate problems; and to make plans more politically acceptable. Generally, effective public involvement has the following characteristics: two-way communication; involvement early and through the entire process; deliberation involving informal and personal processes; and representation of all interests.

There are many methods you can use to inform your customers about the water shortage, and inform them of the steps you would like them to take to conserve. Worksheet 12 presents a list of options for you to use in your outreach efforts.

Worksheet 12 - Place a checkmark by the options that you will consider including in your public awareness campaign during a water shortage.

Worksheet 12

Menu of Options for Public Outreach	
Bill Inserts for water bills	
Public service advertising – run for free by local media	
Paid Advertising – Newspaper	
Paid Advertising – Radio	
Paid Advertising – Television	
Paid Advertising – Movie Slides for local movie theaters	
Paid Advertising – Chamber of Commerce Newsletter	
District newsletter	
Classroom Presentations	
Water Shortage Pamphlet – mass distribution to all customers	
Water Shortage Website	
Public Workshops – Drought Survival – Water conservation	
Water Shortage Information Center	
Public Advisory Committee	
Displays in District Office	
Low flow fixture rebates	
Low flow fixture distribution	
Promote use of Greywater	
Drought Tolerant Plant Tagging Program at local nurseries	
Promoting CIMIS information	
Water Shortage Hotline	
Water Audits	
Displays in Public Libraries, at local schools, shopping malls, etc.	
Bus ads	
Billboards	
Promotional Items with a conservation message (mugs, rulers, stickers, pens)	

Source: Santa Barbara County Water Agency, 2001.

Involving the Media

The local media (newspapers, radio and television stations) in any community is an essential partner in helping a water district increase public awareness regarding a water shortage situation. The media can reach most, if not all, of your customers with information and tips that will help keep water use levels down to the targeted levels. On the other hand, the media can hurt your efforts by distorting the effects that rationing and conservation were having on the community, overly dramatizing situations that are not representative of the community as a whole, or simply presenting a much bleaker picture of the situation than actually exists. For instance, news reporter might only interview customers whose landscapes had died or those who had retrofitted their toilets and were

dissatisfied, rather than featuring those who were able to comply with reductions with a minimum of hardship. During water shortages, the majority of the residents are able to successfully cope with water shortage restrictions, at least in the short-run. This fact may not be considered as newsworthy as the stories about people who were unhappy or experiencing hardship.

Some sensationalizing media tactics, such as printing photos of dry, cracked mud from the bottom of a local reservoir, may also have a positive affect. After seeing such photos in the newspaper, local residents will better understand the magnitude of the problem and may be more inspired to conserve. However, when these same pictures are viewed by residents in communities in other parts of the state or country, it may have the negative affect of decreasing tourism if travelers avoid visiting places they perceive as a disaster area.

One recommendation for successfully working with the local media, to use them as allies, is to encourage them to present the positive, everyday efforts of residents as well covering the sensational stories. It is difficult to achieve a 100% accurate representation, but keeping the media informed through press releases or press conferences will help to mitigate the negative affects of dramatized or one-sided reporting.

It is important that the public hear consistent messages from water suppliers in the area, particularly when they are in the same media market. There can be significant differences in the supplies available to adjacent water districts. However, if customers in one district are asked to reduce their water use as much as 30% while their neighbors served by another district are only asked to conserve 10 or 15%, they will question the equity of the program, or become confused. This can lead some of them not to meet their reduction goals.

Analysts drew three conclusions about the media from the 1986-1992 California drought.

1. **The role of the media is not well understood by water managers**.
   The media are governed by their own rules of objective reporting, newsworthiness, and perceptions of what the public wants to know. They cannot be managed by water agencies. If they were, they would not be able to sell news. The questions like, “Are we in a drought?” or “Is the water shortage over?” are not silly questions from the media’s point of view. Reporters understand the thinking modes and perceptions of the general-public much better than water professionals. For them, once the water supply situation is called a water shortage, it automatically implies that behavior has to be changed from normal behavior to crisis behavior. Such a change is newsworthy.

2. **The media cannot improve on imprecise and ambiguous messages**.
   Most likely, the statements will become even more confusing after they are reported in the press. Only unambiguous and complete answers to questions that are asked by the press can be communicated clearly to the public.

3. **Media cannot explain complex water management issues**.
   What is very interesting to water professionals is usually "too dry" for newspapers, radio, and television. Long feature articles on water issues do not sell newspapers, but timely, well-written articles during a water shortage emergency will be read by concerned people.

Checklist for Keeping the Media Involved

____ 1. Create a media list to ensure that all available local media are used – select an official representative at each radio station, newspaper, and television station to serve as a point of contact for water shortage information released from your district. See Worksheet below.
____ 2. Establish a public advisory committee
____ 3. Include public and media in the water shortage planning process
____ 4. Organize water shortage information meetings for the public and the media.
____ 5. Publish and distribute pamphlets on water conservation techniques and water shortage management strategies
____ 6. Organize workshops on water shortage related topics
____ 7. Prepare sample ordinances on water conservation
____ 8. Establish a water shortage information center
____ 9. Write reports for the media early in the course of the water shortage and prepare weekly press releases with current water shortage conditions
____10. Establish a list of authorities on water shortage that can be distributed to the media for further reference.
____11. Organize education activities for the media.
____12. Establish a budget for advertising water shortage programs
____13. Write reports for media early in the event
____14. Prepare reports on the efforts of the water district to conserve water – conjunctive use, system audits, meter retrofits, training for staff, etc.
____15. Establish or use an existing newsletter to provide an overview of water shortage activities, tips for conservation, articles showcasing local conservation efforts on the part of homeowners and businesses.
____16. Conduct press conferences as needed. Use on-location approach if photo opportunities exist (i.e., a local reservoir when reservoir is visibly low)

Worksheet 13 - Use this table to create your media contact list. Be sure to include all media in your community.

Worksheet 13

Media List			
	Name	**email**	**Phone/Fax**
TV Stations - include government access channels			
Print Media - include newspapers from local colleges and news clipping services			
Radio Stations			
Chambers of Commerce			
Political leaders			
Water Dist. Board			
County Sups			
City Council			
Assembly			
Congress			

Source: Santa Barbara County Water Agency, 2001.

Findings Regarding Public Information From 1986-1992 Drought

During the 1986-1992 drought in California, the following findings were made regarding large-scale water shortage-related public awareness campaigns:

1. There was a statistically significant increase in the public's awareness of the water shortage after the campaign, and those who became aware of the water shortage through the campaign were more likely to believe in the seriousness of the water shortage and to conserve water. Television appeared to be the most effective medium for increasing awareness.
2. Even after the campaign, water users greatly underestimated the amount of water they used, but the error was less than before the campaign.
3. The people most willing to reduce water use were also the most likely to report they needed more information on how to do so.

4. The campaign increased trust that the agencies call for conservation was necessary and should be supported.
5. Support for farmers' use of water was greater after the campaign, while support for commercial and industrial use declined. It is generally accepted in social behavior research that conservation campaigns will be more effective if the sacrifices are equitable. This suggests that publicizing the equity of water shortage restrictions may be effective in reducing water use.

VII
ANALYZING REVENUE AND EXPENDITURE IMPACTS
(Staying Solvent)

A complete water shortage plan should include an analysis of the impacts of the water shortage plan activities and the proposed measures to overcome those impacts.

In order to mitigate the financial impacts of a water shortage, a district can establish an emergency fund. The goal is to maintain the fund at 75% of normal annual water department revenue. This fund will be used to stabilize rates during periods of water shortage or disasters affecting the water supply. The district will not have to increase rates as much or as often during a prolonged or severe shortage. However, even with the emergency fund, rate increases will be necessary during a prolonged water shortage. As described earlier in this plan, a Stage 2 shortage requires a 20% reduction in water deliveries, while Stage 3 requires a 35% reduction. The experiences of California water purveyors during the 1986-91 drought shortage demonstrated that actual water use reductions by customers can be considerably larger than requested by the supplier. During the 1986-91 drought shortage it was also politically difficult for many agencies to adopt the rate increases necessitated by a 20 – 50% reduction in sales. When a water shortage emergency is declared, the supply shortage will trigger the appropriate rationing stage and rate increase.

The following Worksheets will provide your district with a step-by-step analysis of how a water shortage will impact the district's revenues and expenditures. In addition, Resources Section 2, Part C outlines how to set up a Rate Stabilization Fund.

Worksheet 14

Projected Ranges of Water Sales by Stage					
	Normal	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
Water Sales - Acre Feet per Year					
Urban					
Agricultural					
Total Acre-Feet per Year					
* Be sure to change percentages to match water shortage stage percentage reductions chosen by the district.					

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 15

Revenues and Expenditures (no additional water purchases and no rate increases)					
	Normal	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
Operating Revenues					
Urban					
Agricultural					
Total Water Sales					
Meter Charges					
Total Revenue					
% reduction					
Operating Expenses					
salaries					
overhead					
cost of supply					
production and purification					
transmission and distribution					
customer accounts					
general and administrative					
depreciation					
capital projects					
rate stabilization fund					
Total Operating Expenses					
Surplus or (Deficiency)					

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 16

Projected Expenditures for Worst Case Water Supply					
	Normal	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Supply and Cost					
Reservoir					
Acre-Feet					
$ per acre foot					
Groundwater					
Acre-Feet					
$ per acre foot					
Recycled Water					
Acre-Feet					
$ per acre foot					
Total Acre-Feet					
Cost of Supply					

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

Worksheet 17

Projected Expenditures for Worst Case Water Supply with Additional Expensive Supplies					
	Normal	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Supply and Cost					
Reservoir					
Acre-Feet					
$ per acre foot					
Groundwater					
Acre-Feet					
$ per acre foot					
Recycled Water					
Acre-Feet					
$ per acre foot					
Water Bank					
Acre-Feet					
$ per acre foot					
Desalinated Water					
Acre-Feet					
$ per acre foot					
Total Acre-Feet					
Cost of Supply					

Adapted from the forms developed for preparation of *Urban Water Management Plans.* State of California, Department of Water Resources. 2000.

VIII.
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