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SUMMARY

LOCAL DROUGHT MANAGEMENT PLANNING GUIDE FOR PUBLIC WATER SUPPLIERS

Tennessee Department of Health and Environment
Office of Water Management
150 Ninth Avenue North
Nashville, Tennessee 37219-5404

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Local Drought Management Planning Guide
For Public Water Suppliers

SUMMARY

BACKGROUND

Many water utilities in Tennessee could face significant operational and supply-related problems during droughts or other emergencies. Drought problems are caused by the combined effect of less water available from the source of supply, increased demands for water from system customers, stress on system equipment, and water quality degradation. Other water shortages may be caused by accidents and natural or man-made disasters that disrupt water service or degrade water quality. Many utilities face droughts and emergencies unprepared to mitigate or deal with the health, economic and social disruptions that result. Timely actions based on a clear understanding of potential impacts can reduce drought effects on local water users. To facilitate the identification and implementation of appropriate and acceptable actions to deal with water supply shortages, water utilities should undertake the preparation and adoption of a local drought management plan.

Water suppliers should use Figure 1, "Developing A Local Drought Management Plan" to guide them in developing their plan. A checklist can be found at the end of this "Summary." A drought management plan provides information which is useful in outlining the actions a public water supplier will take during a drought and possibly other shortages. A procedure for developing a local drought management plan is summarized in this document. More detailed information on the development of a particular planning element may be found in the "Local Drought Management Planning Guide For Public Water Suppliers."

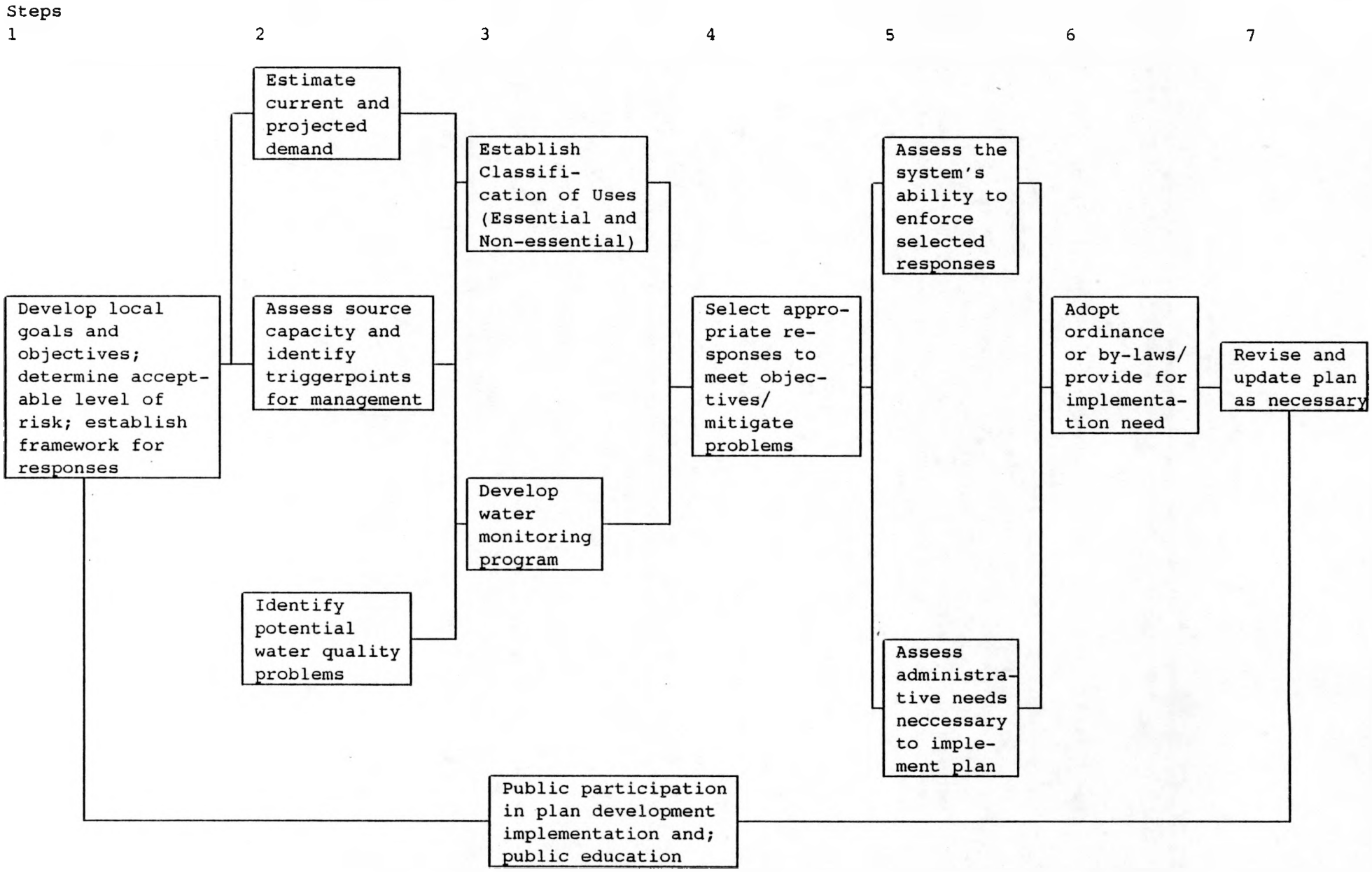
That guide, developed by the Office of Water Management in cooperation with the Tennessee Valley Authority and available from the Office of Water Management, should serve as a basic reference document to this "Summary." Another document, "Guidelines for Emergency Operations Planning for Community Water Systems," provides details on developing emergency operations procedures (EOPs), which are needed to meet the State's minimal emergency planning requirements.

PURPOSE

This Summary and the "Local Drought Management Planning Guide" have been prepared to help public water supply managers (1) assess their situation, (2) develop drought management plans, (3) identify and monitor drought conditions and its stages, and (4) effectively manage system supply and demand during a drought or other emergency. These documents focus on developing drought management plans for public water supplies.

Neither the Summary nor the Guide addresses detailed planning for developing water supplies. Responses requiring a considerable expenditure of money or a long time to implement are not covered. Where a system or source of water fails to meet the most essential demands, that supplier may choose to embark on a long-term program for improving the system's capacity through development of alternative supplies of water, overall demand reduction, leakage control, etc.

Figure 1
Developing a Local Drought Management Plan



Rather than focus on source development, these documents emphasize the development of a plan to manage available supplies and demand during a drought. Sources which are not already owned take time to acquire. Even when water rights are held by the supplier, an auxiliary source takes time to develop. The Guide accepts this as a given situation that cannot be altered without considerable money or time. Where a water system finds that it cannot tolerate the restrictions that would accompany potential water supply shortages, the plan may indicate to the system a need to develop alternative water supplies and/or reduce overall demand. These considerations, however, do not negate the fact that all users face some risk.

Drought management planning can be invaluable in determining what chances are going to be taken and what consequences exist for water users. Acceptable levels of service must be established for various uses and the available water resources managed accordingly. For example, priorities should be established for essential needs such as hospitals, nursing homes, emergency shelters, decontamination of lines, and firefighting over such uses as lawn watering and street cleaning. The planning should establish priorities for water suppliers.

AGENCY ROLES AND RESPONSIBILITIES

The Guide outlines the roles of local, state, regional, and federal agencies. The roles of various water users and managers are defined in broad terms in Tennessee's "Interim State Drought Management Plan," which is the Department of Health and Environment's interim plan for the management of water under drought conditions. The plan was developed based on the Water Quality Control Act of 1977, as amended, and the Tennessee Safe Drinking Water Act.

The Commissioner of the Department of Health and Environment advises public water suppliers and other local users to develop their own response plans. The responsibility to develop and implement a local drought management plan must be that of local systems. Local plans insure that local circumstances are recognized and that critical local needs are met. Specific actions and elements included in the plan should be based on local needs and the acceptability of remedies to the public. Each user or system has a unique set of demands that must be considered in context.

Because all users are potentially subject to decreases in water availability due to source or facility failure, development of an emergency management plan is essential. Source and facilities planning should be practical and cost effective. This planning guide is directed toward drought management. However, many of the principles used to manage water supplies in a drought also apply to other emergency situations where water supplies are short. Storage tank failures, a contamination of supply, treatment plant failures, and pump failures are water supply problems that may require similar emergency operations procedures.

Water supplies will need to distinguish among emergencies the roles and assignments that are appropriate for other agencies and individuals. Problems and needs that are regional or statewide are to be addressed by agencies having a state or regional water management responsibility. Figure 2, "Drought Responses," identifies the scope of the roles of other agencies under various drought scenarios. Because circumstances and needs differ locally, State and Federal roles primarily consist of data collection, information dissemination, technical assistance, and regulatory oversight.

Figure 2

Drought Responses

Condition and Management Phase*	State and Federal Actions	Local Actions		
		Public Water Suppliers	Industrial	Agricultural, Self-Supplied, Environmental
Normal Conditions Water supply is adequate; water quality is acceptable under normal management	.Develop precipitation, streamflow, ground water, and water quality monitoring programs .Conduct state and regional water studies and coordinate recommended actions .Assist public water suppliers and local government in developing Emergency Water Management plans .Establish public education program	.Develop local drought management plan .Develop additional storage and treatment facilities; evaluate distribution system .Adopt standby rates, other necessary ordinances and codes, and establish mutual aid agreements, interconnections, conservation education, etc.	.Develop local drought management plan .Develop additional wastewater storage .Develop alternative water supplies, water storage and conservation measures .Purchase standby equipment and install permanent equipment as necessary for recycling	.Develop local drought management plan .Evaluate need for irrigation .Enlarge pond, purchase tanks, drill wells, install conservation devices and livestock watering tanks .Evaluate agricultural water use and find where conservation could be used, including use of "drip" irrigation .Evaluate domestic water use and install water-saving devices, etc. to reduce stress on supply source
Drought Alert Lower than normal precipitation, declining streamflows, reservoir levels, and groundwater levels; greater than normal demand	.State issues Drought Alert to media and notifies targeted water users (Alerts may be regional or local) .Intensify selected monitoring activities .State initiates an awareness program	.Monitor water sources and daily water use for specific purposes and anticipate user demand .Monitor potential conflicts and problems	.Monitor water sources and daily water use for specific purposes and anticipate demand .Monitor water quality	.Monitor water sources and daily water use for specific purposes and anticipate demand

Figure 2

Drought Responses (continued)

Condition and Management Phase*	State and Federal Actions	Local Actions		
		Public Water Suppliers	Industrial	Agricultural, Self-Supplied, Environmental
Conservation Phase Water supplies/ water quality deteriorating or conflicts among users	.Disseminate water supply and water quality data .Monitor systems and users having past problems and monitor plan implementation .Coordinate state and federal supply and water quality actions .Respond to local and individual appeals for assistance ."Post" streams where water quality standards are not met .Commissioner issues orders to water suppliers and/or dischargers	.Implement "conservation" phase at plan triggering point. Potential conservation measures include curtailment of outside uses, education, and pricing .If conservation goal is not obtained, implement restrictions .Notify OWM of source conflicts	.Institute recycling, cutback production, store wastewater, alter production schedule per industrial water management plan during a drought .If goals are not met, implement additional measures .Notify OWM of source conflicts	.If assessed source is capable, irrigate crops .Provide tanks, maintain streamflows, etc., to meet supply needs of livestock, fish, and aquatic life .Continue conservation of domestic supplies .Notify OWM of source conflicts
Restrictions Phase Continued decline in water supply and/or water quality	.Same responses as in Conservation Phase	.Implement "restrictions" phase at plan triggering point. Restrictions could include banning of some outdoor water uses, per capita quotas, cut-backs to non-residential users .Notify OWM of source conflicts	.Institute additional cut-backs in production, storage of wastewater, or changes in production schedule, etc., per industrial water management plan .Notify OWM of source conflicts	.Same responses as in Conservation Phase

Figure 2

Drought Responses (continued)

Condition and Management Phase*	State and Federal Actions	Local Actions		
		Public Water Suppliers	Industrial	Agricultural, Self-Supplied, Environmental
Emergency Phase Severe water supply or water quality problems due to very limited resource availability	.Governor responds to critical situations by declaring an emergency .TEMA takes action .OWM mediates in conflicts of source utilization under emergency powers	.Notify TEMA and request emergency declaration .Provide bottled water and sanitation supplies to users .Make hospitals, fire-fighting, etc., priority .Initiate hauling of water .Comply with Commissioner's Orders	.Request emergency declaration of Governor .Comply with Commissioner's Orders .Request assistance from local government .Implement hauling water for sanitation, domestic uses	.Local government assistance in obtaintaining water for domestic purposes, and in supporting livestock .Implement hauling water, etc.

*Each phase would be marked by some event or percent of water supply deficit (triggerpoint) as defined locally.

Where conflicts over water rights and water quality problems emerge or local situations become emergency situations, the Tennessee Office of Water Management (OWM), the Tennessee Emergency Management Agency (TEMA), and the Governor can enter the situation on local request. Once a situation is declared an emergency, special actions can be taken under the Governor's emergency powers authority. Conflicts involving water rights will be handled on an emergency, case-by-case basis.

Within this framework, local public water suppliers are afforded considerable flexibility to meet their needs.

DROUGHT MANAGEMENT GOALS AND OBJECTIVES

In order to effectively accommodate the public interest, efforts should be made to identify practical water-related goals and objectives during times of water shortage.

The goals of a local public water supplier's drought management plan may include:

1) equitable distribution of available water supplies;
2) a basis for management decisions; and
3) advance knowledge of actions that will be taken during times of water shortage.

More specific goals relating to levels of service under each management phase may be included in a drought management plan depending on the circumstances of the system.

Good management must know both the dependable capacity of a water source and the capability of equipment to deliver water under heavy demand. The dependable capacity of a supply source is simply the maintained output of a source during a drought. Where a system's capability to treat and deliver water determines the deliverable capacity of a system, monitoring the system's source may not be necessary. If water users have a low tolerance for water use restrictions (for example, mandatory cutbacks to industry), the system may also need to undertake a long-term investment strategy to reduce the risk of short supplies.

A long-term water development plan to meet growing water needs over an extended period should be part of the supplier's normal planning for growth. Such strategies may involve cooperative agreements or the regionalization of systems to develop a source which is otherwise economically unattainable. Another long-term strategy is to reduce overall demand through voluntary water conservation. These long-term plans reduce risk and improve the margin of safety.

Recommended criteria (several exceeding state minimum standards) for evaluating a system's resistance to water shortage include: 1) Pump-tested wells and/or 3Q20 flows sufficient or greater than the capacity of a system; 2) impoundments with 90 days or more storage of raw water; 3) minimum 3-day or longer storage capacity for finished water; and 4) treatment plant capacity that exceeds the previous 12 months average daily use by 30 percent or more.

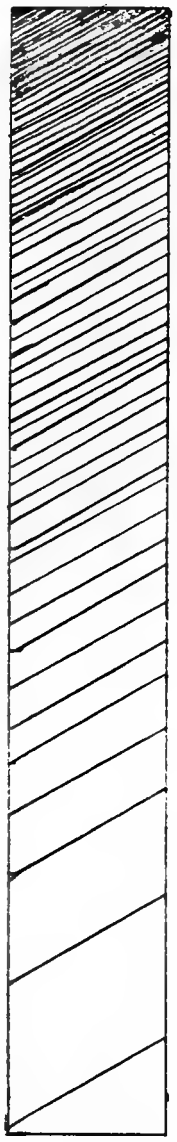
In addition to the system's capacity and source availability of water, other risk factors include 1) the extent of population served; 2) the degree to which the system serves critical, non-deferrable needs; 3) the diversity of sources utilized by the system; 4) capacity and condition of system infrastructure; 5) the diversity of uses (industrial, commercial, institutional, residential, etc.); and 6) the vulnerability of sources to contamination, etc. Figure 3, "Factors in Evaluating Risk," provides a checklist for evaluating a system and identifying possible goals and objectives.

Facilities with large sources and those which are willing to accept extensive restrictions and cutbacks over long periods need a drought management plan to be orderly and equitable in the event of a shortage. A really good management plan will deal with unexpected emergency shortages as well as drought. It will address shortages caused by power outages, linebreaks, hazardous materials spills, earthquakes, floods, fire, tornado, explosion, etc. A good plan reduces the system's vulnerability. It may suggest acquiring auxiliary equipment, as well as temporary conservation actions that reduce water demand during the shortage and actions to increase supplies. Plans for obtaining additional sources of water and activating conservation measures are essential. Emergency operations procedures are essential for all emergencies. Controlling risk with a drought management plan requires knowing what your priorities or service goals are under various degrees of diminished supply. The "Drought Management Planning Inventory for Public Water Supply Systems" in Appendix A of the Guide should help systems identify their goals, those factors increasing risk, and their ability to deliver water.

Figure 4, "Balancing the Water System's Supply and Demand," presents objectives necessary to balance the system's demand for water with its supply of water at different levels of service. As an aid in developing a drought management plan, the Guide recommends that three levels of service be defined in response to increasingly severe drought conditions: "Conservation," "Restrictions," and "Emergency." Responses specified in the "Conservation" phase should reduce water use by 15 to 20 percent. The goal of the "Restrictions" phase should be to reduce use by 30 to 40 percent. The "Emergency" phase should target a reduction of 60 percent or more. Other intermediate phases may be developed.

Figure 3

Factors in Evaluating Risk



High Risk

- Limited or no storage for finished water
- Unknown source capacity of streams and/or wells
- 3Q20 flow less than average daily demand
- No interruptable service contracts
- History of many linebreaks and shortages
- Single source of water, no interconnections with other systems
- Poor infrastructure capacity or condition (leakage exceeds 15 percent)
- Large number of users with critical non-deferrable needs (concerning public health and safety)
- Vulnerable to hazardous materials spills or other contamination
- No drought and emergency management plan
- No emergency power source(s) supporting system components (booster stations, well pumps, etc.)
- Minimum water pressure less than 60 psi in areas of the system
- No facility security
- No emergency personnel

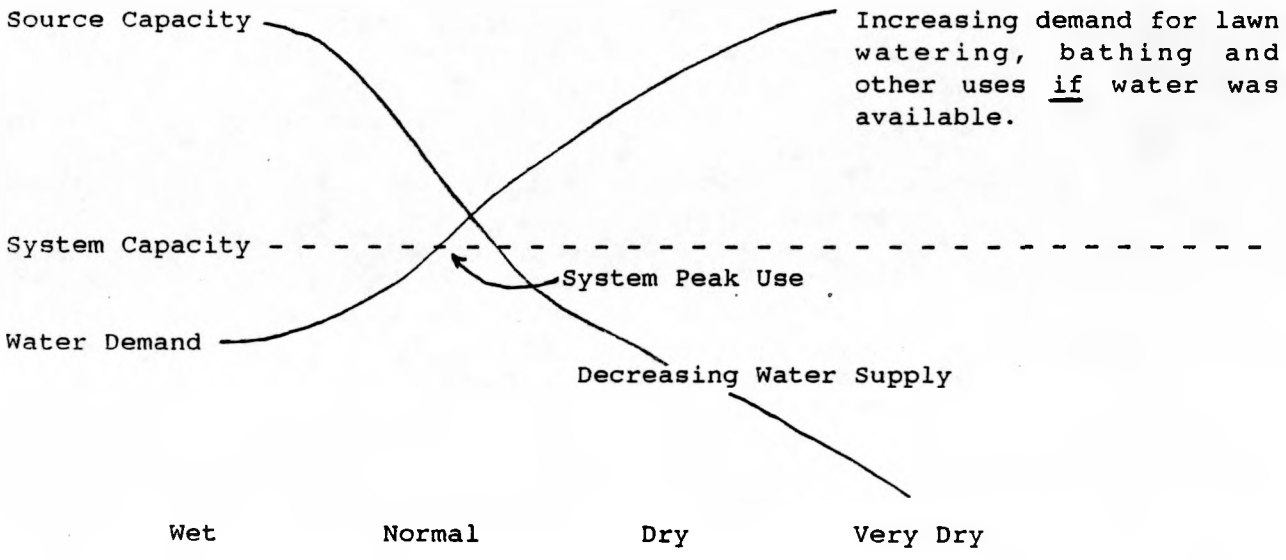
- Adopted drought and emergency management plan and ordinance
- Diversity of water user groups
- 3Q20 which exceeds treatment capacity
- History of linebreaks and shortages
- Diversity of sources and/or source types
- Average daily use 70 percent or less of treatment capacity
- 10 percent or less leakage of treated water
- 3-day or longer storage of finished water
- 90-day or more storage of raw water
- An emergency power source
- Secured facility
- Low vulnerability to hazardous materials spills or other contamination
- Minimum water pressure of 60 psi in all distribution lines
- Trained emergency personnel available

Low Risk

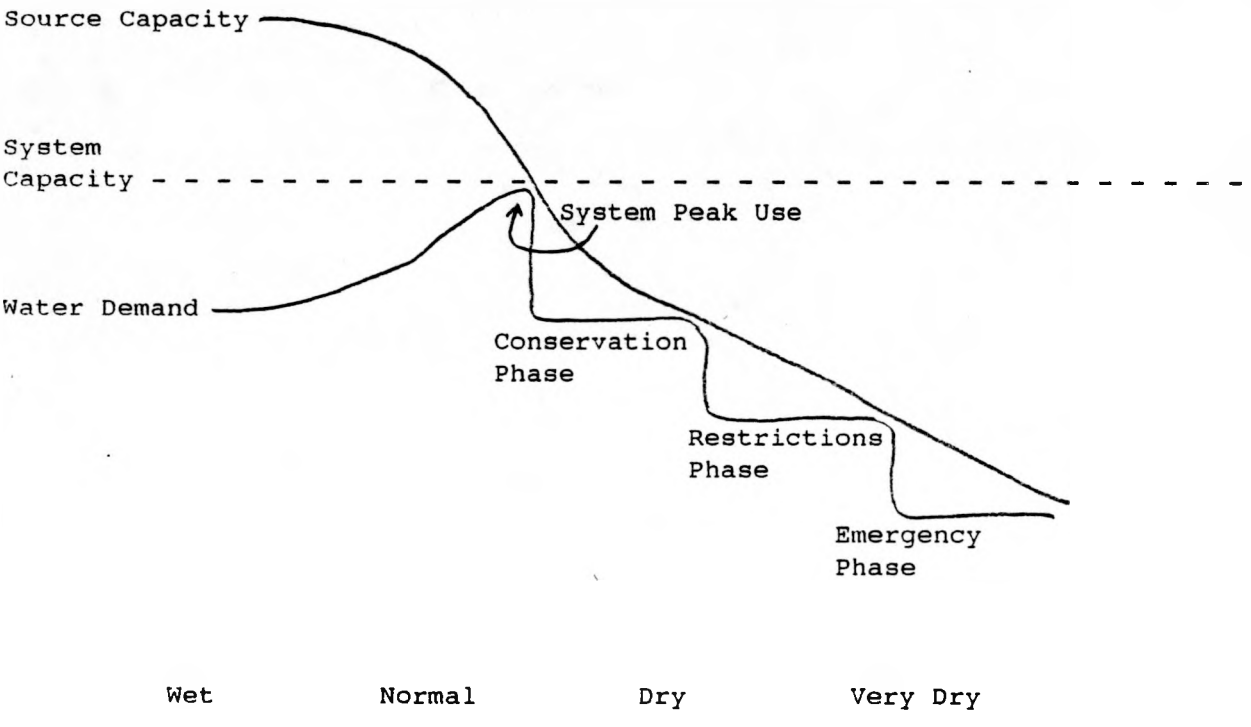
Figure 4

Balancing the Water System's Supply and Demand

A. Unmanaged Water Use



B. Managed Water Use



All suppliers need to plan for at least three drought management phases and assign an appropriate triggerpoint to signal the implementation of each phase. Reductions in supply are possible for all suppliers, even those who consider themselves to be "drought-proof." For example, shortages may occur because of a hazardous materials spill preventing withdrawal of water from a reservoir or river or because of a major fire, linebreak, power outage, treatment plant or finished water storage problem. A supplier's drought management plan should provide an excellent basis for continued emergency management planning. In addition to drought, a comprehensive emergency management plan will consider the effects of all potential emergencies on many services and for each of their components, recognizing that each disaster or emergency has its own characteristics. Identifying the effects produced by particular disasters should help water system managers better anticipate their management responses, although many disasters will have the same result. However, a system with a resultant supply loss must consider the cause in light of its overall extent, specific impacts on other services, and need for coordination with other agencies. The local emergency planning committee (or county emergency management agency) should develop plans and procedures for handling multiple service needs.

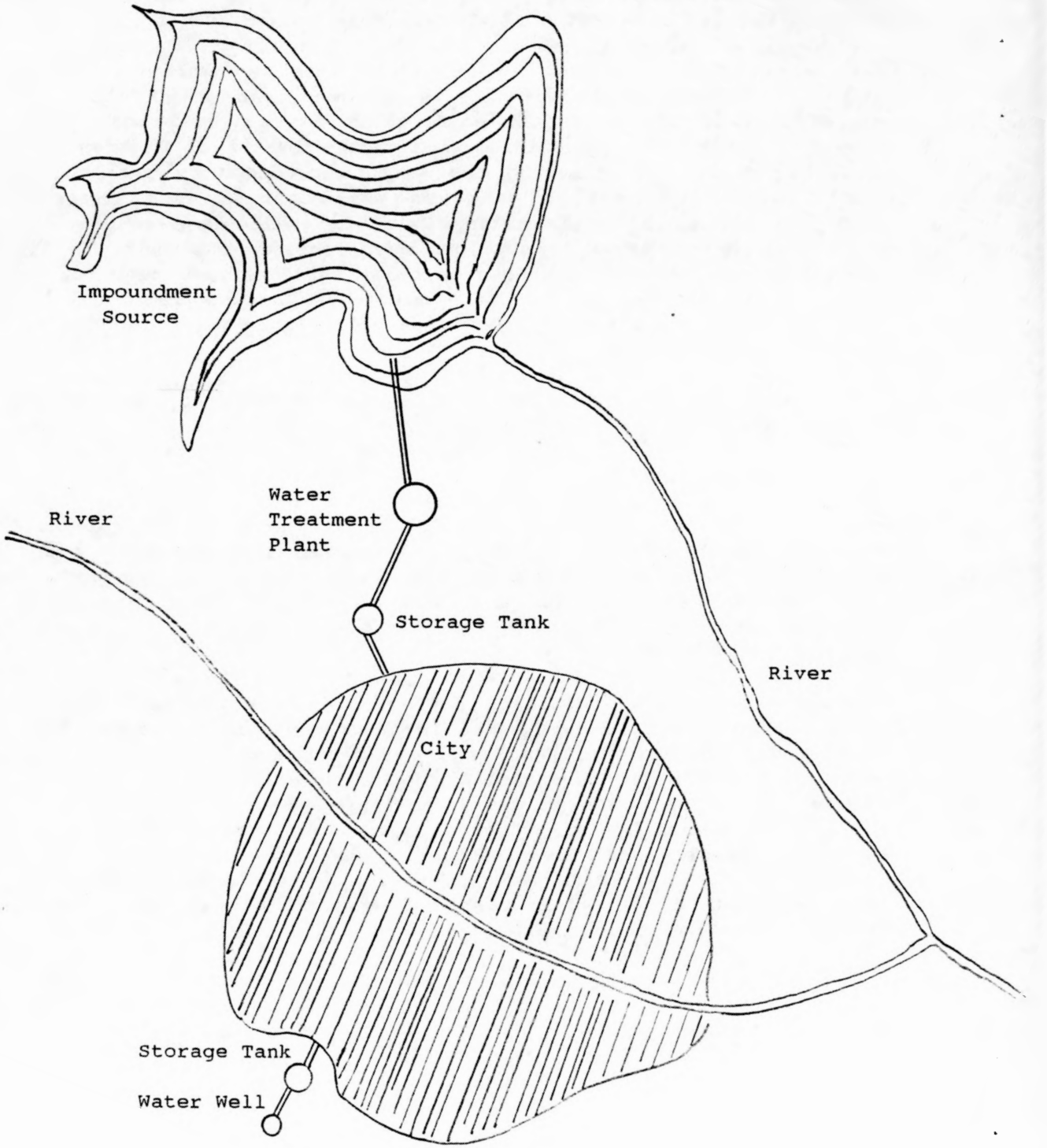
Systems may have subsystems dependent on separate treatment plants, reservoirs, or sources of supply. The service areas for each of these may need to be considered independently when evaluating delivering capacity, identifying priorities, potential reductions in usage, health and safety considerations, and phase implementation. Figure 5, "Municipal Water Systems with Two Sources," shows a system with two components. A supplier, like that shown in the figure, should deal with only one water treatment plant-source at a time. Although planned separately, components can be managed in unison as circumstances dictate. Plans should provide a clear breakdown of each subsystem and the emergency operations procedures that should be used under each phase.

Systems may include additional phases. Because a water supplier serving almost exclusively domestic users is nearly uniform in demand, its objective may be to ease difficulties for its elderly and low-income residents. In addition to banning non-essential uses, this system may decide to use a pricing structure which prices excess use above an established "lifeline" minimum at a significantly higher rate. Another system with a vulnerable source may be more concerned about prolonged industrial layoffs as a result of drought. That community may focus on incorporating water reduction measures that will keep as many of its labor intensive businesses and industrial users operating as long as possible.

Again, the elements included in a supplier's plan should be based on local circumstances and needs and goals of the community. The Guide should serve as a basic reference document of alternatives and procedures which may be helpful in developing that plan.

Figure 5

Municipal Water System with Two Sources



PUBLIC INVOLVEMENT

The development of a local drought management plan should involve the public. To facilitate the public's involvement, the creation of a water management advisory group, task force, committee, or board to be involved in developing an emergency water management plan is critical.

If the system serves a small community, an ad hoc advisory group can provide all the input needed to analyze and shape a plan. If the system serves a large urban area, a formalized board may be needed which presents proposals to the public for its information, revision and ratification. The advisory group should consult interest groups and/or major users with a large stake in water management. When other emergencies are considered, many other groups and other public agencies may have a vital interest in coordinating their actions with the actions of the system. Where alternative responses are identified, public meetings may be planned to allow for public discussion. Establishing an effective mechanism for acquiring public participation in the plan development process insures an appropriate and effective community response.

Consider involving representatives from the following (Wood and others, 1986):

County Emergency Management Agency (Civil Defense)
County Health Department Officials
Hospital Administrators /Nursing Home Operators
Chamber of Commerce
County Executive or Official
Churches
Mayor or City Manager
Fire Chief
Legal Representative
Division of Water Supply, Office of Water Management
Businesses and Industries (which purchase from the system)
Media Representatives (TV, radio and newspapers)
Professional Groups
PTA/School Officials
Water System Personnel
Residential Groups

A major task of an advisory group is to assist in formulating the entire plan. Group members should anticipate impacts, suggest appropriate community responses, and promote the plan among their constituents. After the plan has been activated, they should evaluate the effectiveness of the plan in protecting and insuring adequate water supplies.

The advisory group can provide a strong base for difficult decisionmaking. They should represent community perspectives in evaluating conditions and activating or deactivating specific management phases. They can assist in public education, promote adoption of the plan, and organize and oversee its implementation. The group may also serve in an appeals role for granting variances where circumstances are unique. Most importantly, they should serve as a consensus-building group so that local decisions have general political and community support.

ASSESSING SOURCE CAPACITY

In Tennessee, there are extreme variations in type and character of water sources. The capacity of each source and its contribution to the system is important in understanding the potential for water shortage. Systems with a limited source may expect to impose conservation and restriction measures more frequently than systems with a limitless source capacity. Typical sources

that must be analyzed include: 1) wells (groundwater); 2) free-flowing streams and springs; 3) flow-regulated streams; 4) reservoirs and in-stream impoundments; and 5) connections to other utilities. Each situation must be analyzed to determine the capacity of the source under varying conditions. The extent to which a user relies on a particular source, the contractual conditions applicable, water quality under drought conditions, and the manner of wastewater disposal are important considerations. Because treatment plant capacities, distribution lines, etc., are determined by infrastructure investment and are generally well known, the Guide assumes that these factors will be considered in the system's continuing planning program as it relates to long-term system growth.

ASSESSING DEMAND

During a drought, many utilities experience problems because water demand is significantly greater. A system must estimate its essential, average, and peak water supply needs to assess its management potential. Most systems should be capable of meeting short-term peak demands. Some systems may be capable of meeting longer term peak demands without imposing conservation or restriction measures. Analyzing a system's demand by various user groups and sub-components and knowing each subsystem's capacity to deliver water are important in understanding the potential benefits under a given set of restrictive measures.

IDENTIFYING MANAGEMENT TRIGGERPOINTS

The preceding sections point out that droughts or other emergencies affect systems and users differently. Every water supplier must identify triggerpoints that correspond to some measure of the system's (by subsystem) delivering capacity. It should be based on an assessment of the system's (by subsystem) ability to meet continuing demand given the emergency, its available resources and the potential for serious consequences if demand is not reduced. Figure 4, "Balancing the Water System's Supply and Demand," summarizes those factors which should be considered in establishing a system's triggerpoints.

Source capacity related indices commonly used in establishing triggerpoints include: 1) system hydraulics; 2) rainfall and evaporation; 3) Palmer drought index; 4) crop moisture index; 5) historical comparisons; 6) streamflow and springs; 7) impoundments; 8) water wells; 9) interconnection agreements; and 10) water quality.

The integrity of the supplier's hydraulic system should provide the most obvious of triggerpoints prompting an immediate implementation of an appropriate emergency operations procedure. Other hydraulic triggerpoints, such as dropping water pressure or the relationship between storage and use, should also be considered in the management plan. A drought may involve establishing a triggerpoint based on several indices.

CLASSIFICATION OF WATER USES AND OPTIONS FOR DEALING WITH SHORTAGES AND WATER QUALITY PROBLEMS

Public water suppliers should develop a classification system of water uses to reflect water use priorities. A classification system clarifies issues of fairness, hardship and, ultimately, management effectiveness. Four classes of water use are recommended: First, Second and Third Class Essential Uses and Non-essential Uses. First Class Essential uses might include water for domestic use, health care facilities, other public institutions, emergency shelters, and firefighting. Non-essential uses might include water used for ornamental purposes, outdoor non-commercial watering, etc. Even though a system might choose to use a standby pricing structure or other measures to curb water use demand, classifying and analyzing uses according to their contribution to the system's overall demand may reveal a plan weakness or need for a back-up strategy. In managing water during a drought, plans that primarily rely on non-restrictive options (i.e., pricing, pressure reduction, etc.) could also superimpose a scheme of restrictions where necessary to establish a balance between water use and supply. Figure 6, "Recommended Water Use Classes and Class Restrictions," shows an approach for managing water under deteriorating supply conditions. Under more quickly developing water shortage situations, such as those caused by a chemical spill, power outage, etc., the options listed under "emergency" conditions, as appropriate, should be incorporated into the development of the system's emergency operations procedures (EOPs).

Figure 6

Recommended Water Use Classes and Class Restrictions
(Wood and others, 1986)

General Water Use Class	Program Phase		
	Conservation	Restrictions	Emergency
Essential, First Class	Voluntary Cutbacks	Voluntary Cutbacks	Mandatory or Voluntary Cutbacks
Essential, Second Class	Voluntary Cutbacks	Mandatory or Voluntary Cutbacks	Mandatory Bans
Essential, Third Class	Voluntary Cutbacks	Mandatory Bans	Mandatory Bans
Non-Essential	Mandatory Cutbacks or Bans	Mandatory Bans	Mandatory Bans

Water management options which a supplier should consider are listed below under the management phase thought to be most appropriate:

Options For Dealing With Shortages

I. "Normal" Conditions
   - A. Water Conservation
     1. Water Conservation Education
     2. Water Saving Device
     3. Repair of Household Leaks
     4. Pricing
     5. Universal Metering
   - B. Pressure Adjustment
   - C. Leak Detection
   - D. Reservoir Evaporation Suppression
   - E. Water Saving Plumbing Codes
   - F. Reuse

II. Under "Alert" Conditions (intensify monitoring for potential problems or conflicts)

III. Under "Conservation" Conditions
   - A. Water Conservation (Most of the measures applicable under "normal" conditions are effective in reducing water use under "Conservation" conditions) and Mandatory Cutbacks or Bans of Non-essential uses.
   - B. Media Attention

IV. Under "Restriction" Conditions
   - A. Water Conservation (Voluntary Cutbacks of First and Second Class Essential Water Uses) and Mandatory Cutbacks or Bans of Non-essential and Third Class Essential Water Uses.
   - B. Rationing
   - C. Service Interruptions
   - D. Mutual Aid Agreements (Interconnections With Nearby Systems)
   - E. Temporary Pipelines and Sources
   - F. Additional Wells and Reactivation of Abandoned Wells
   - G. Temporary Impoundments
   - H. Water Recycling
   - I. Modification of Reservoir Management
   - J. Dredging to Improve Intake Capability

V. Under "Emergency" Conditions
   - A. Restrictive Responses (Many of the Responses Appropriate Under the "Restrictions" Phase Also Apply Under "Emergency" Conditions)
   - B. Hauling Water
   - C. Bottled Water
   - D. Sanitation Measures

Anticipated water quality problems should be identified and responses to them formulated. Where a water system experiences a linebreak or a hazardous materials spill occurs, potential water quality problems are obvious. Initial responses include isolation of the problem area, clean-up of the spilled material if appropriate, temporary services implemented and repairs begin. During a drought, water quality problems are also probable, particularly for systems relying on a stream or reservoir. The specific steps to be taken should be outlined in the plan's emergency operations procedures (EOPs).

A SURVEILLANCE SYSTEM

A surveillance system must be established to monitor deliverable supplies and demand on a monthly or more frequent basis, e.g., average daily withdrawal, amount in storage, taste and odor problems, etc. In some instances, subsystems need to be monitored. The frequency of monitoring can be increased as conditions warrant. Records should be maintained and made available to system managers and the advisory task force. Officials should be careful to take note of the additional resources required to monitor the system during various drought phases. System surveillance is important not only for phase activation but enforcement.

PLANNING FOR IMPLEMENTATION

After management plans and emergency operations procedures have been drafted (development of EOPs is discussed in the Division of Water Supply's "Guidelines for Emergency Operations Planning for Community Water Systems"), water system officials must also: 1) specifically evaluate each measure for reduced water use, the impacts of reduced use and their enforceability; 2) determine what management actions and resources are needed to activate, administer and enforce the management measures of the plan; 3) develop and adopt an ordinance or by-law enabling the system to implement its drought and emergency management plan; and 4) develop a program to educate all users on the system about water conservation and the planned responses under the various phases of water management.

To insure that local drought management plans address current circumstances, public suppliers should review and modify adopted plans within three months of deactivating any of its drought management phases or every two years. Local drought and emergency management plans should include a section specifically noting the need to periodically re-evaluate and update their adopted plan.

Checklist for Developing a Drought Management Plan

_____ Appendix A of Guide, "Drought Management Inventory for Public Water Supply Systems," has been completed. This Inventory, once completed, provides the basic information on water sources; water uses; treatment, transmission and storage; personnel, materials and equipment; communication, etc., needed for developing a plan.

_____ An Advisory Group has been established (refer to "Guide," pp. 19-20 or use the list provided in "Summary," p. 13). An advisory group is valuable in identifying publicly acceptable measures.

_____ Local water management goals have been identified and adopted. Possible goals are:

a.) economic uses should have priority except during an "Emergency" phase;
b.) domestic uses should have preferential consideration;
c.) hospital and other health care uses should have priority;
d.) an equitable burden of restrictions should apply to all uses;
e.) a management plan should provide advance knowledge of all actions to be taken; and
f.) regular evaluations of risks (i.e. available source(s), treatment plant capacity, etc.) and long-term development program.

_____ Emergencies which are likely to affect your water system have been identified ("Summary," p. 9 and "Guide," pp. 15-17). Based on those factors, indicate on the risk scale the water system's apparent level of risk. Primary risks include:

a.) vulnerability to toxic spills or other contamination;
b.) 3Q20 (or tested well yield) less than average daily demand;
c.) less than a 3-day finished water and/or 60-day raw water storage;
d.) leakage exceeds 15 percent of treatment capacity;
e.) no emergency power sources supporting components; and
f.) age of system and linebreak-water shortage occurrence.

Note: The greater the assumed risks, the greater the possibility the system will activate emergency phase measures. If risks are unacceptable, the system must consider development of new sources and/or other system improvements.

_____ Three or more system-related service levels have been identified.

___ percent reduction in use, Conservation phase (minimum of 15%)
___ percent reduction in use, Restrictions phase (minimum of 30%)
___ percent of reduction in use, Emergency phase (minimum of 60%)

_____ The current and potential demand of the system and its sub-components has been assessed ("Guide," pp. 37-39).

a.) Population served _____ x _____ minimum gpcd = _____ gallons per day
b.) Average Daily Water Production (last 2 years) _____gpd
c.) Peak Daily Water Use (within last 2 years) _____gpd

d.) Average Daily Commercial/Industrial Water Use (last 2 years) _____gpd
e.) Average Daily Residential Water Use (last 2 years) _____gpd
f.) Average Daily Institutional Water Use (last 2 years) _____gpd
g.) Unaccounted Water (losses) _____gpd
h.) Demand for a-g has been established for subsystem areas, if applicable: Yes No

_____ The capacity of each source (3Q20, tested well yield, etc.) has been determined and the deliverable capacity of the system's sub-components is known ("Guide," pp. 21-35 and 43).
a.) Peak Daily Capacity of the System _____gal
b.) Dependable yield of source _____gpd (i.e., 3Q20 of stream or spring, tested well yield, contractual agreement)
c.) Deliverable capacity has been established for system components: Yes No

_____ Potential water quality problems (as a result of low-flows, etc.) have been identified ("Guide," pp. 50-51).
a.) Taste and odor
b.) Mineral concentrations
c.) Biological contamination
d.) Algae production
e.) Assimilative capacity
f.) Low Dissolved Oxygen

_____ Management triggerpoints ("Guide," pp. 41-51) have been established based on:
a.) System Hydraulics
b.) Rainfall/Evaporation
c.) Palmer Index
d.) Crop Moisture Index
e.) Historical Comparisons
f.) Streamflow/Springflow
g.) Impoundment
h.) Water Well
i.) Interconnection
j.) Other

_____ A system for monitoring available supplies and demand has been established ("Guide," pp. 37-51 and 81). Knowing what to monitor and having a plan for monitoring it when conditions move toward a drought can be valuable in avoiding a last minute crisis.

_____ A classification scheme has been developed ("Guide," pp. 53-56).
a.) Non-essential uses include (list): _____
_____
_____
b.) Third Class Essential Uses include (list): _____
_____
_____
c.) Second Class Essential Uses include (list): _____
_____
_____

d.) First Class Essential Uses include (list): _____

_____

_____

_____ The most appropriate responses for dealing with water shortages under increasingly severe conditions have been identified based on water use/supply relationships in Figure 2 of the "Guide," Balancing the Water System's Supply and Demand," (pp. 5, 57-81).

a.) Options to be considered in improving water supply include:
   1.) Temporary Pipelines and Sources
   2.) Additional wells and reactivation of wells
   3.) Temporary impoundments
   4.) Modification of Reservoir Management
   5.) Mutual Aid Agreements (Interconnections)
   6.) Pressure Adjustment (pump capacity)

b.) Options to be considered in reducing demand include:
   1.) Water conservation education
   2.) Pressure Adjustment (reduction)
   3.) Leak detection and repair
   4.) Reservoir evaporation suppression
   5.) Water saving plumbing codes
   6.) Water reuse
   7.) Metering
   8.) Rationing
   9.) Service Interruptions (contracts)
   10.) Bans (non-essential uses)
   11.) Pricing
   12.) Non-compliance Shut-offs (enforcement action)
   13.) Penalties (enforcement action)

_____ Demand management options selected for each management phase ("conservation", "restrictions," and "emergency") have been evaluated for their water use reduction potential ("Guide," pp. 57-79).

_____ Supply improvement options selected for each management phase have been evaluated for their water supply improvement potential ("Guide," pp. 57-79).

_____ Responses have been planned dealing with likely drought-related water quality problems ("Guide," pp. 79-81).

a.) Posting stream segments/beaches
b.) Treatment with activated carbon, potassium permanganate, ozone, etc.
c.) Providing bottled water
d.) Modify reservoir management
e.) Change level of water intake

_____ Emergency Operations Procedures (EOPs) have been developed (utilizing drought and emergency management planning input) listing the actions that may be necessary in the event of a drought, an imminent or actual contamination of supplies, power outage, linebreak, chemical or equipment problem, or facility loss. Consideration has been given to the following possible causes:

a.) flood, landslide or dam failure;
b.) earthquake;
c.) hazardous materials spill;
d.) fire or explosion;
e.) civil disorder or sabotage;
f.) storm (tornado, snow, ice, wind, etc.);
g.) drought;
h.) chlorine leak;
i.) nuclear war;
j.) contamination from a fixed nuclear facility;
k.) disaster at a nearby system; and
l.) other disasters as appropriate for your system.

(For examples of Emergency Operations Procedures which are used during emergencies, refer to the Division of Water Supply's "Guidelines For Emergency Operations Planning For Community Water Systems," 1988.)

_____ Factors important to the plan's implementation have been considered ("Guide," pp. 81-88).

a.) Plan implementation cost (education materials, revenue decreases, surveillance costs, costs of additional equipment use, notification costs) have been considered and estimated.
b.) Cost recovery options have been considered (pricing structure, taxes, fines) and additional revenues estimated.
c.) A procedure for granting variances has been established.
d.) Procedures for activating and de-activating management phases have been established.
e.) A public education program has been developed, e.g., media, schools, presentations/exhibits, bill inserts, etc.
f.) Plan updates are provided for in the plan.

_____ An ordinance or by-laws have been adopted ("Guide," Appendix D).

_____ Where risks appear to be too great or all the remaining measures are unacceptable for achieving a system's balance, a long-term development plan has been initiated.

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